

A handbook of surgical pathology : for the use of students in the museum of St. Bartholomew's Hospital / [W.J. Walsham].

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A HANDBOOK
OF
SURGICAL PATHOLOGY.



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A HANDBOOK
OF
SURGICAL PATHOLOGY,

FOR THE USE OF STUDENTS

IN THE

Museum of St. Bartholomew's Hospital.

Presented to the Library

SECOND EDITION

by Ernest Hart Esq

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LONDON:
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1890.

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PREFACE TO THE SECOND EDITION.

IN the eleven years which have elapsed since the publication of this work, many and great changes have taken place in the Museum of St. Bartholomew's Hospital. The Museum itself has been moved to its present quarters, and the whole of the preparations have been re-numbered, whilst many new specimens have been added. To such an extent has the Museum been improved during the last few years by a succession of able and energetic curators that it may now be looked upon as containing one of the largest and most complete collections of Surgical Pathology in the world.

In the preparation of this edition, therefore, it was not only necessary to revise and to bring up to date the previous text, but it was requisite to add such new matter as was previously omitted because it could not be illustrated by specimens. In the present edition the lines of the original work have been followed as closely as possible, the only alterations being that greater use has been made of the various Casts, Drawings, and Photographs, and the author ventures to think that for a work of the kind it may now be considered as nearly complete as it is possible to make it.

The author has frequently been asked to publish a new

edition, the former one having long been unobtainable. Want of time alone prevented him acceding to this request, and it was not until Mr. D'Arcy Power kindly undertook the greater share of revision that this second edition was commenced. During the last five years Mr. Power, in his capacity of curator, has had extensive opportunities of acquiring an intimate knowledge of the contents of the Museum, and the author cannot too strongly acknowledge the help which he has rendered to him.

October 1st, 1889.

PREFACE TO THE FIRST EDITION.

THIS work is designed to aid the student in the acquirement of the practical knowledge of pathology now required by the surgical examining boards of this country.

A conversation with Mr. Savory upon the want of a work which would make the Museum more useful to the student suggested the idea of the present undertaking.

My plan is to give a short general account of the several surgical affections, and then to illustrate the morbid appearances, the various stages, the terminations, and, when possible, the causes and the results of treatment of these affections, by specimens selected from the Museum.

The method of conducting the pathological part of the examinations at the Royal College of Surgeons of England is to show the candidate a number of specimens of surgical affections, the morbid appearances of which he is expected to recognise, to account for, and to describe. This book encourages the method of study which the highest surgical authority recommends by the nature of its examinations.

As the work is intended for use in the Museum, only those affections which are there represented by specimens have received attention.

Many of the specimens illustrate more than one pathological condition : hence the same specimen is often referred

to under several heads; but, in such cases, only so much of it is described as bears upon the point under consideration.

The specimens are generally described in the words of the catalogue; but as fresh descriptions have occasionally been written, or those of the catalogue variously altered, I hold myself responsible for the whole.

Many valuable specimens of tumours were placed in the Museum at a time when the microscope was seldom used; and are described in the catalogue without reference to their histological structure. Hence it was necessary to examine many microscopically before they could be of service in the present work. This I have done, by the kind permission of Mr. Morratt Baker, the curator of the Museum, and the results of the examinations, verified in many instances by my friend Dr. Goodhart, are stated at the end of the descriptions of the specimens. Sections of the tumours, with, in many cases, a drawing, have, with the permission of the curator, been placed in the Microscopical Cabinet.

To Mr. Morratt Baker I am indebted for much valuable advice in the preparation of this work. My thanks are also due to my friend Mr. D. A. Gresswell, who has lent me most able assistance in seeing this work through the press, and whose careful reading has been the means of removing many literary inaccuracies which would otherwise have appeared.

27, WEYMOUTH STREET,
PORTLAND PLACE, W.

August, 1878.

CONTENTS.

	PAGE
SECTION I.—DISEASES OF BONE	1
(1) Inflammation and its Results	2
Periostitis—	
Acute Simple Periostitis	3
Diffuse Infective Periostitis	3
Chronic Periostitis	5
Suppurative Periostitis	7
Osteomyelitis—	
Acute Simple Osteomyelitis	8
Acute Diffuse Infective and Septic Osteomyelitis	10
Chronic Osteomyelitis	11
Osteitis—	
Increased Vascularity	13
Rarefaction	13
Sclerosis	15
Osteitis Deformans	16
Caries or Ulceration—	
Caries Simplex or Simple Ulceration	18
Tubercular Caries	21
Syphilitic Caries	48
Necrosis—	
Inflammatory Causes	24
Traumatic Causes	26
Constitutional Causes	28
Characters of Dead Bone	29
Separation of Dead Bone	29
Formation of New Bone	33
Formation of Cloacæ	34
Restoration of Shaft after Removal of Sequestrum	36
Special Forms of Necrosis	36
Suppuration and Abscess—	
Chronic Abscess	42
(2) Affections Dependent upon Simple Defect or Increase in Nutrition.	
Atrophy of Bone—	
Eccentric Atrophy	43
Concentric Atrophy	44

	PAGE
DISEASES OF BONE— <i>continued.</i>	
Hypertrophy of Bone—	
Simple Hypertrophy	46
Eccentric Hypertrophy	46
Concentric Hypertrophy	46
(3) Constitutional Affections of Bone.	
Syphilis—	
Syphilitic Periostitis or Osteitis	47
Syphilitic Caries or Ulceration	48
Congenital Syphilis	49
Syphilitic Necrosis	51
Tubercle—	
Tubercular Caries	52
Senile Tubercle	53
Rickets—	
Deformities of the Bones in Rickets	55
Scurvy Rickets	60
Acromegaly	60
Mollities Ossium	61
(4) New Growths or Tumours in Bone—	
Lipomata or Fatty Tumours	63
Fibromata or Fibrous Tumours	64
Osteomata or Bony Tumours	64
Exostoses	64
Diffused Bony Growths	68
Enchondromata or Cartilaginous Tumours	69
Sarcomata	74
Periosteal	74
Endosteal	77
Myeloid	79
Melanotic	82
Secondary Changes occurring in Sarcomata	83
Carcinomata	84
Secondary Medullary Cancer	84
Secondary Scirrhus Cancer	85
Squamous-celled Epithelial Cancer	86
Hydatids	88
Angioma of Bone	88
SECTION II.—INJURIES OF THE BONES.	
Fractures—	
Varieties of Fracture	89
Causes of Fracture	89
Repair in Simple Fracture	90
Deviations from the Ordinary Process of Repair	97
Fibrous Union	97
Ununited Fracture	97
False Joint (Pseudo-arthritis)	98
Repair in Compound Fracture	99
Special Fractures—	
of the Nasal Bones	100
of the Malar Bone	101
of the Inferior Maxilla	101

	PAGE
INJURIES OF THE BONES— <i>continued.</i>	
Special Fractures of the Ribs and Costal Cartilages	102
of the Sternum	104
of the Clavicle	104
of the Scapula	105
of the Humerus	107
of the Radius	110
of the Ulna	113
of the Radius and Ulna	115
of the Carpus and Metacarpus	116
of the Pelvis	116
of the Femur	117
of the Patella	133
of the Tibia and Fibula	136
of the Tibia	137
of the Fibula	139
of the Os Calcis	140
of the Astragalus	140
Gunshot Injuries	141
SECTION III.—DISEASES OF JOINTS.	
Acute Synovitis	142
Chronic Synovitis	147
Chronic Tubercular Disease—	
Tubercular Synovitis	148
Tubercular Caries	153
Epiphysitis	156
Sacro-iliac Disease	158
Osteo-arthritis—	
Changes in the Cartilages	160
Changes in the Bones	161
Changes in the Synovial Membrane	162
Changes in the Tissues around the Joint	163
in the Hip	163
in the Shoulder	164
in the Knee	165
in the Elbow	166
in the Temporo-maxillary Joint	167
in the Articulations of the Spine	167
in the Joints of the Great Toe	167
in the Hands	167
Suppuration in Osteo-arthritis	167
Charcot's Disease, or Tabetic Arthropathy	168
Gouty Arthritis	171
Syphilitic Disease of Joints	173
Hæmophilia of the Joints	173
Anchylosis, or Stiff Joint—	
Spurious Anchylosis	174
Fibrous or Ligamentous Anchylosis	175
Bony Anchylosis	175
Loose Bodies in Joints	176
Treatment of Joint Disease by Excision	179
Anchylosis after Excision of Joints	182

	PAGE
SECTION IV.—INJURIES OF JOINTS.	
Dislocations—	
Varieties of Dislocations - - - - -	183
Simple Dislocations - - - - -	184
Impediments to Reduction - - - - -	185
State of the Parts after Reduction - - - - -	186
Consequences of Non-reduction - - - - -	187
Anchylosis after Dislocation - - - - -	189
Compound Dislocations - - - - -	189
Special Dislocations—	
of the Sternum - - - - -	190
of the Clavicle - - - - -	190
of the Humerus - - - - -	191
of the Elbow - - - - -	196
of the Radius - - - - -	196
of the Wrist - - - - -	197
of the Thumb - - - - -	197
of the Hip - - - - -	197
of the Patella - - - - -	202
of the Knee - - - - -	203
Subluxation of the Knee - - - - -	204
of the Ankle - - - - -	204
of the Astragalus - - - - -	206
of the Toes - - - - -	207
Congenital Displacement of the Hip - - - - -	208
Congenital Displacement of the Knee - - - - -	209
Wounds of Joints - - - - -	209
SECTION V.—INJURIES AND DISEASES OF MUSCLES, TENDONS, SHEATHS OF TENDONS, BURSE, AND FASCLE.	
Injuries and Diseases of Muscles—	
Rupture of Muscles - - - - -	211
Fatty Degeneration of Muscles - - - - -	211
Ossification of Muscle - - - - -	212
Abscess in Muscle - - - - -	212
Ulceration of Muscle - - - - -	213
Sarcomata in Muscle - - - - -	213
Carcinomata in Muscle - - - - -	213
Cysticercus in Muscle - - - - -	214
Trichina in Muscle - - - - -	214
Injuries and Diseases of Tendons—	
Evulsion of Tendons - - - - -	214
Repair after Subcutaneous Division of Tendons - - - - -	215
Repair in Animals - - - - -	216
Repair in Man - - - - -	216
Deposit of Urate of Soda in Tendons - - - - -	217
Tumours in Tendons - - - - -	217
Displacement of Tendons from their Grooves - - - - -	218
Diseases of the Sheaths of Tendons—	
Inflammation - - - - -	218
Ganglion - - - - -	219
Diseases of Bursæ—	
Simple Serous Enlargement - - - - -	220
Simple Enlargement with Melon-seed Bodies - - - - -	221

	PAGE
Diseases of Bursæ— <i>continued</i> .	
Enlargement with Fibrous Bands in their Interior -	221
Enlargement with Thickening of the Walls -	222
Injuries and Diseases of Fasciæ—	
Dupuytren's Contraction of the Palmar Fascia -	223
SECTION VI.—DISEASES AND INJURIES OF THE SPINE.	
Angular Curvature -	224
(i) Beginning in the Bodies—Tubercular Caries -	225
(ii) Beginning in the Intervertebral Cartilages -	226
Production of Angular Deformity -	226
Spinal Abscess -	227
Progress of Cure -	230
Condition of Spinal Canal and Cord -	231
Disease of the two Upper Vertebrae and of the Articulations between the Atlas and Occipital Bones—Cervical Caries -	232
Tubercular Inflammation of the Interarticular Joints -	233
Caries of the Odontoid Process -	234
Dislocation of the Atlas -	234
Anchylosis of the Interarticular Joints -	235
Lateral Curvature -	235
Posterior Curvature—Kyphosis -	237
Anterior Curvature—Lordosis -	238
Rarer Forms of Diseases of the Spine—	
Osteo-arthritis -	239
Tumours of the Spine -	239
Fracture of the Spine—	
Fracture from Direct Violence -	240
Fracture from Indirect Violence -	241
Condition of the Spinal Cord -	242
Treatment of the Fractured Spine -	244
Dislocation of the Spine—	
Dislocation in the Cervical Region -	245
Dislocation in the Dorso-lumbar Region -	247
Incised Wounds of the Spinal Cord -	247
Malformations of the Spine—	
Spina Bifida -	248
Spinal Meningocele -	249
Meningo-myelocele -	250
Syringo-myelocele -	251
SECTION VII.—INJURIES AND DISEASES OF THE SKULL AND BRAIN.	
Fractures of the Skull—	
Fractures of the Vault -	253
Fractures of the Base -	256
Process of Repair after Fracture -	257
Effusion of Blood—	
Effusion of Blood inside the Skull -	258
(1) Between the Skull and Dura Mater—Subcranial -	259
(2) Between the Dura Mater and Arachnoid—Subdural -	259
(3) Between the Arachnoid and Pia Mater—Subarachnoid -	261
(4) In the Brain Substance—Intracerebral -	261
Contusions and Lacerations of the Brain -	261

	PAGE
Inflammation of the Brain and its Membranes—	
Meningitis - - - - -	262
Encephalitis - - - - -	264
Hernia Cerebri - - - - -	265
Congenital Malformations of the Cranium—	
Meningocele and Encephalocele - - - - -	267
Hydrocephalus - - - - -	268
SECTION VIII.—COMPARISON OF THE VARIOUS DEFORMITIES OF THE SKULL, SPINE, THORAX, AND PELVIS.	
The Skull - - - - -	270
The Spine - - - - -	270
The Thorax - - - - -	271
The Pelvis - - - - -	272
SECTION IX.—INJURIES AND DISEASES OF NERVES.	
Wounds of Nerves - - - - -	274
Process of Repair after complete Division - - - - -	274
Process of Repair after partial Division - - - - -	276
Atrophy of Nerves - - - - -	277
Results of Nerve Section - - - - -	278
Tumours of Nerves - - - - -	279
Perforating Ulcer of the Foot - - - - -	281
SECTION X.—INJURIES AND DISEASES OF THE ORGANS OF CIR- CULATION.	
Injuries of the Heart - - - - -	282
Rupture - - - - -	282
Wounds - - - - -	285
Injuries and Diseases of Arteries - - - - -	286
Wounds of Arteries - - - - -	286
Results following Wounds of Arteries - - - - -	287
(i.) Penetrating Wounds - - - - -	287
(ii.) Non-penetrating Wounds - - - - -	290
Arterio-venous Aneurysm - - - - -	290
Aneurysmal Varix - - - - -	290
Varicose Aneurysm - - - - -	291
Rupture of Arteries - - - - -	292
Effects of the Application of a Ligature - - - - -	294
(i.) To the Cut End of an Artery - - - - -	294
(ii.) To an Artery in its Continuity - - - - -	298
Failure of the Normal Processes that occur after the Application of a Ligature - - - - -	301
Tumours of Arteries - - - - -	304
Arteritis - - - - -	304
Acute - - - - -	305
Chronic - - - - -	306
Secondary Changes in Chronic Arteritis or Atheroma - - - - -	306
Syphilitic Endarteritis - - - - -	308
Results of Chronic Arteritis - - - - -	308
Rupture - - - - -	309
Dilatation - - - - -	309
Thrombosis - - - - -	309
Embolism - - - - -	309
Gangrene - - - - -	311

	PAGE
Primary Calcareous Degeneration	312
Primary Fatty Degeneration	313
Aneurysm	313
Structure of an Aneurysm	313
The Sac	313
The Contents of the Sac	315
The Process of Formation of an Aneurysm	316
Methods of Spontaneous Cure of an Aneurysm	316
(i.) By the Deposit of Laminated Blood-clot	316
(ii.) By the Coagulation of Blood in the Sac	317
(iii.) By Inflammation or Suppuration of the Sac	318
Fatal Terminations	318
From Rupture of the Sac	318
From Pressure upon surrounding Parts	320
Effects of Treatment	322
Varieties of Aneurysms	324
Fusiform Aneurysm	325
Sacculated Aneurysm	326
Dissecting Aneurysm	328
Cirsoid Aneurysm	329
Arterio-venous Aneurysm	290
Arterial Varix	329
Aneurysm by Anastomosis	330
Injuries and Diseases of the Veins—	
Wounds	330
Thrombosis	331
Phlebitis	332
(1) Simple Adhesive or Plastic Phlebitis	332
Causes of Clotting in	333
Extension of the Clot	338
Appearances of the Thrombus	338
Changes in the Thrombus	340
Changes in the Vein-wall and surrounding Tissues	341
Obstruction to the Circulation	342
(2) Suppurative Phlebitis	343
Varix or Varicose Veins	344
Tumours in Veins	345
SECTION XI.—INJURIES AND DISEASES OF THE NOSE AND RESPIRATORY TRACT.	
Diseases of the Nose	347
Lipoma Nasi	347
Deviation of the Septum Nasi	347
Rhinoliths	348
Adenoid Vegetations	348
Chronic Inflammation of the Mucous Membrane	348
Polypi	348
Mucons Polypi	349
Fibrous Polypi	349
Malignant Polypi	350
Glanders	351
Necrosis of Turbinated Bones	351
Rhinoplasty	351

	PAGE
Diseases and Injuries of the Larynx	352
Acute Laryngitis	352
Chronic Laryngitis	352
Follicular Laryngitis	353
Tubercular Laryngitis	353
Œdema of the Glottis	355
Croupous Inflammation	356
Diphtheritic Inflammation	357
Typhoid Ulceration of the Larynx	358
Variolous Ulceration of the Larynx	358
Syphilitic Disease of the Larynx	359
New Growths, or Polypi	360
Ossification of the Cartilages	363
Partial Excision of the Larynx	364
Wounds	364
Impaction of Foreign Bodies	365
SECTION XII.—DISEASES AND INJURIES OF THE THYROID GLAND.	
Simple Bronchocele	367
Fibrous Bronchocele	367
Cystic Bronchocele	368
Malignant Bronchocele	370
Myxœdema	371
SECTION XIII.—INJURIES AND DISEASES OF THE DIGESTIVE TRACT.	
Diseases of the Lips and Cheeks	372
Epithelioma of the Lips	372
Labial Glandular Tumours	373
Nævus of the Cheek	374
Harelip	374
Diseases of the Gums	375
Epulis	375
Diseases of the Jaws	377
Necrosis of the Jaws	377
Tumours of the Jaws	381
Fibromata	381
Enchondromata	384
Osteomata	384
Malignant Growths	385
Cysts	390
Diseases of the Palate	394
Necrosis of the Hard Palate	394
Tumours of the Hard Palate	394
Tumours of the Soft Palate	396
Ulceration of the Soft Palate	397
Cleft Palate	398
Diseases of the Parotid Gland	399
Tumours of the Parotid Gland	399
Salivary Calculi	401
Diseases and Injuries of the Tongue	402
Macroglossia	402
Glossitis	402
Syphilitic Diseases of the Tongue	405
Fatty Degeneration of the Tongue	406

	PAGE
Diseases and Injuries of the Tongue— <i>continued</i> .	
Malignant Disease of the Tongue - - - -	406
Injuries to the Tongue - - - -	408
Diseases of the Floor of the Mouth - - - -	408
Diseases of the Tonsils, Fauces, and Pharynx - - - -	409
Chronic Enlargement of the Tonsils - - - -	409
Fibrous Tumours of the Tonsils - - - -	410
Ulceration of the Fauces, Tonsils, and Pharynx - - - -	410
Diseases and Injuries of the Œsophagus - - - -	412
Inflammation - - - -	412
Stricture - - - -	413
Gastrostomy for the Relief of Cancerous Stricture of the	
Œsophagus - - - -	417
Dilatation of the Œsophagus - - - -	418
Post-mortem Digestion of the Œsophagus - - - -	419
Rupture of the Œsophagus - - - -	419
Impaction of Foreign Bodies in the Œsophagus - - - -	420
Injuries and Diseases of the Thoracic and Abdominal Viscera - - - -	421
Injuries sustained in the Operation of Paracentesis - - - -	421
Rupture of the Abdominal Viscera - - - -	422
Diseases of the Vermiform Appendix - - - -	424
Intestinal Obstruction - - - -	424
Impaction of Foreign Bodies in the Intestines - - - -	426
Internal Strangulation - - - -	426
Volvulus - - - -	428
Intussusception - - - -	429
External Hernia - - - -	437
Congenital Malformations - - - -	433
Chronic Intestinal Obstruction - - - -	434
Impaction of Fæces - - - -	434
Alterations in the Walls of the Intestines - - - -	435
Pressure upon the Intestinal Wall - - - -	436
Chronic Peritonitis - - - -	436
Contraction of Cicatrices - - - -	436
SECTION XIV.—HERNIA.	
Anatomy of Hernia - - - -	437
The Sac - - - -	437
The Contents of the Sac - - - -	440
The Condition of a Hernia - - - -	443
Reducible Hernia - - - -	443
Irreducible Hernia - - - -	444
Strangulated Hernia - - - -	446
Inflamed Hernia - - - -	451
Incarcerated Hernia - - - -	452
Special Forms of Hernia - - - -	453
Inguinal Hernia - - - -	453
Femoral Hernia - - - -	459
Umbilical Hernia - - - -	462
Obturator Hernia - - - -	463
Diaphragmatic Hernia - - - -	465
Ventral Hernia - - - -	466

	PAGE
SECTION XV.—INJURIES AND DISEASES OF THE RECTUM.	
Fissure of the Anus - - - -	469
Ulceration of the Rectum - - - -	469
Fistula in Ano - - - -	473
Hæmorrhoids or Piles - - - -	476
Prolapse of the Rectum - - - -	479
Polypi of the Rectum - - - -	480
Villous Tumours of the Rectum - - - -	483
Stricture of the Rectum - - - -	483
Congenital Malformations of the Rectum - - - -	488
SECTION XVI.—INJURIES AND DISEASES OF THE GENITO-URINARY ORGANS.	
Injuries and Diseases of the Penis and Urethra - - - -	491
Warts on the Penis - - - -	491
Primary Syphilitic Sores on the Penis - - - -	491
Tubercle of the Penis - - - -	492
Carcinoma of the Penis - - - -	492
Stricture of the Urethra - - - -	493
Organic Stricture - - - -	494
The Consequences of Stricture - - - -	496
Congenital Malformations of the Penis - - - -	501
Diseases of the Labium, Clitoris, and Female Urethra - - - -	502
Labial Cysts - - - -	502
Hypertrophy of the Labium - - - -	502
Tumours of the Labium - - - -	502
Hypertrophy of the Clitoris - - - -	504
Urethral Caruncle - - - -	504
Diseases of the Scrotum - - - -	504
Hypertrophy of the Scrotum - - - -	504
Elephantiasis Scroti - - - -	505
Tumours of the Scrotum - - - -	505
Carcinoma of the Scrotum - - - -	506
Diseases of the Tunica Vaginalis - - - -	508
Hydrocele - - - -	508
Vaginal Hydrocele - - - -	508
Congenital Hydrocele - - - -	510
Encysted Hydrocele - - - -	510
Hæmatocoele - - - -	512
Diseases of the Testicle - - - -	513
Acute Inflammation - - - -	513
Chronic Inflammation - - - -	515
Tubercle of the Testicle - - - -	517
Syphilitic Testicle - - - -	519
Malignant Disease of the Testicle - - - -	521
Cartilaginous Tumours - - - -	525
Fibrous Tumours - - - -	526
Cystic Disease - - - -	526
Atrophy - - - -	528
Undescended Testicle - - - -	528
Undeveloped Testicle - - - -	529
Congenital Tumours - - - -	529

	PAGE
Diseases of the Spermatic Cord - - - - -	530
Hydrocele of Cord - - - - -	530
Hæmatocele of Cord - - - - -	532
Fatty Tumours - - - - -	532
Varicocele - - - - -	532
Diseases and Injuries of the Prostate - - - - -	533
Inflammation - - - - -	533
Chronic Enlargement - - - - -	534
Malignant Disease - - - - -	540
Tubercle - - - - -	541
Fatty Degeneration - - - - -	542
Concretions and Calculi - - - - -	543
Diseases of the Vas Deferens and Vesiculæ Seminales - - - - -	543
Hydatids - - - - -	543
Tubercle - - - - -	544
Injuries and Diseases of the Bladder - - - - -	545
Rupture - - - - -	545
Cystitis - - - - -	549
Hypertrophy and Sacculation - - - - -	551
Dilatation - - - - -	555
Tubercle - - - - -	556
Tumours - - - - -	557
Malignant Disease - - - - -	559
Hæmaturia - - - - -	564
Calculus in the Bladder - - - - -	565
Varieties of Calculi - - - - -	565
Structure of Calculi - - - - -	568
Shape of Calculi - - - - -	571
Colour of Calculi - - - - -	572
Spontaneous Fracture - - - - -	573
Situation of Calculi - - - - -	574
Effects of Calculi - - - - -	575
Congenital Malformations of the Bladder - - - - -	576
Extroversion of the Bladder - - - - -	576
SECTION XVII.—DISEASES AND INJURIES OF THE GENITO-URINARY	
ORGANS— <i>continued</i> - - - - -	579
Injuries and Surgical Diseases of the Kidneys - - - - -	579
Rupture of the Kidney - - - - -	579
Calculus in the Kidney - - - - -	579
Hydronephrosis - - - - -	582
Nephritis - - - - -	584
Tubercle of the Kidney - - - - -	587
Malignant Disease of the Kidney - - - - -	588
Operations on the Kidney - - - - -	590
Diseases of the Ureters - - - - -	593
SECTION XVIII.—DISEASES OF THE BREAST - - - - -	596
Hypertrophy - - - - -	596
Cysts - - - - -	596
Tumours - - - - -	597
Serocystic Disease - - - - -	604
Malignant Disease - - - - -	608
Sarcomata - - - - -	608

	PAGE
Diseases of the Breast— <i>continued.</i>	
Carcinomata -	609
Scirrhus	609
Medullary	617
Colloid -	618
Duct Cancer	613

SECTION I.

DISEASES OF BONE.

IN studying diseases of bone it should be borne in mind that bone, as we are accustomed to see it in the dry state, differs widely from bone as it exists during life. A living bone is composed of connective tissue impregnated with earthy salts; it is covered with a membrane, the periosteum; whilst its interior is lined with a similar membrane, the endosteum, and filled with a richly vascular adipose tissue, the medulla. Numerous bloodvessels proceeding from the periosteum and medulla traverse the Haversian canals, forming a complete vascular anastomosis through the bone; whilst a living cell (osteoblast) occupies each lacunar space, and is connected with adjacent cells by radiating processes, which lie in the canaliculi. It should also be remembered that many bones do not acquire their full proportions till adult life; and, further, that nutritive changes are actively proceeding even in the fully-formed bone. The long bones attain their length by growth and ossification of the cartilage between their diaphysis and epiphyses, and their thickness by subperiosteal ossification; while simultaneously the central part of the originally solid bone becomes absorbed, and its place occupied by vascular connective tissue containing fat (the medulla).

Diseases of bone may be divided into the following classes:

1. Inflammation and its results.

2. Simple defect or increase in nutrition (atrophy and hypertrophy).
3. Changes dependent upon constitutional causes.
4. New growths.

1.—INFLAMMATION AND ITS RESULTS.

Inflammation of bone, occurring as it does in the soft parts of bone, differs in no way from inflammation of soft structures, save that the presence of the hard earthy framework exercises some modifying influence upon the process, and leads to some peculiarities of appearance. Thus the same vascular and exudative changes ensue, and are accompanied by the like phenomena of redness, pain, heat, and swelling. The inflammation also may be simple and local, or diffuse and septic or infective; and it may be influenced by certain constitutional states of the system, as gout, rheumatism, syphilis, or by local causes, as the presence of miliary tubercle. Moreover, the results of inflammation of bone are the same as those of inflammation of soft structures. Caries and ulceration, and, again, necrosis and gangrene, may, in fact, be considered as synonymous terms, which are conventionally applied to different structures—caries and necrosis to bone, ulceration and gangrene to soft parts.

Inflammation of bone is spoken of as Periostitis, Osteomyelitis, or Osteitis, according as it affects the periosteum, the medulla, or the bone respectively; but although it may be limited primarily to one of these structures, it sooner or later affects all three, so that in many specimens, as in **No. 33**, it is impossible to say which was the first to be affected, or whether the inflammation should be considered periostitis, osteo-myelitis, or osteitis.

The varieties of inflammation of bone may now be considered in succession:

PERIOSTITIS.

Periostitis may be acute or chronic.

ACUTE PERIOSTITIS.

Acute periostitis may occur (1) as a simple local or (2) as a diffuse and infective inflammation.

(1) ACUTE SIMPLE PERIOSTITIS.

Acute simple periostitis is generally the result of a local injury, and occurs most frequently in the tibia, as that bone is the most exposed to injuries. The inflammation is limited and usually terminates in resolution. Suppuration, however, may occur, or the inflammation may become chronic.

There is no specimen of acute simple periostitis in the museum.

(2) DIFFUSE INFECTIVE PERIOSTITIS.

Diffuse infective periostitis, or acute necrosis, is an affection nearly always confined to early life. The exciting cause is usually a slight injury, such as a blow or fall, in a strumous or otherwise debilitated subject. It appears, however, to be of infective origin, for micrococci are always found in the pus. It generally attacks the shafts of the long bones, more especially the tibia and femur. In the early stages of the disease the periosteum appears red and injected and somewhat gelatinous, in consequence of commencing cell-infiltration; occasionally it is white and gangrenous. As the disease advances, the inflammation spreads to the bone and to the medulla; suppuration rapidly ensues, and pus, often in considerable quantities, is formed beneath the periosteum. If the pus be not let out by a timely incision it quickly spreads far and wide, stripping the periosteum from the bone, and leaving the latter, thus cut off from its nutritive supply, bare and dead. The death of the bone is, however, chiefly due to the acute inflammation which frequently attacks it and the medulla

simultaneously with the periosteum. In this manner large portions, or even the whole of the shaft, may perish, though the epiphyses usually escape (see No. 31).

When the disease is very rapid in its course the periosteum is occasionally separated even before pus has had time to form, in which case a small quantity of turbid, blood-stained fluid is commonly found between it and the bone.

Diffuse infective periostitis is generally limited to the diaphysis of long bones. The epiphyses are seldom attacked, since they have a separate set of vessels, which, so long as the epiphysial cartilages remain unossified, do not communicate with those of the diaphysis. Exceptions to this rule do, however, occur (see Nos. 34a and 34b). The neighbouring joints are sometimes involved in the disease, as their capsules are genetically continuous with the periosteum. Acute periostitis frequently terminates in septicæmia and pyæmia, abscesses in the heart and pericardium being exceedingly common in pyæmia from this cause.

The manner in which the dead bone is separated, and the shaft restored by the formation of new bone, will be found described under necrosis (see page 29).

Acute infective periostitis, with death of the whole diaphysis; the epiphyses not affected.

30.—Acute infective periostitis of the clavicle following a fall upon the shoulder. The whole length of the bone, with the exception of the acromial and sternal ends, died, and was found, as it is now seen, in a cavity formed by the separated periosteum and surrounding soft parts. The cavity in the recent state was filled with bloody pus. The patient was a delicate boy, aged five years. Several days after the fall the parts were swollen, and he complained of severe pain in and about the clavicle. It was treated as a fracture, but in a few days severe inflammation of the pericardium, heart, and pleuræ followed, and the boy died of pyæmia eleven days after receiving the injury.

31.—A femur from which the periosteum of the shaft had been completely separated by a large collection of pus, from a child two

and a half years old. The child had received a slight injury four days before admission. Death occurred from pyæmia. The heart is contained in No. 1234. It is covered with a thick layer of recent lymph, and when fresh the pericardium contained pus. See also 31a, 32, and 37.

159a.—The entire diaphysis of the ulna of a child which separated as the result of acute infective periostitis.

Acute infective periostitis, with death of a portion of the diaphysis.

35.—Section of a boy's tibia in which there is necrosis of the middle of the shaft, with detachment of the periosteum and adjacent soft parts from the whole circumference of the dead portion. The necrosis was consequent upon acute infective inflammation of the periosteum.

169.—The tibia of a boy, aged eight years. The greater portion of the shaft is dead, whilst new bone extends for some distance from the lower epiphysis upon the dead portion. The patient received an injury to the leg a few weeks before death. He died of pyæmia with acute pericarditis.

Acute infective periostitis, with death of the epiphyses and the greater part of the diaphysis.

34a and 34b are specimens of acute periostitis spreading to the epiphyses. Such a condition is very rare. The diaphyses of the tibia and fibula with the upper epiphyses are contained in 34a; the lower epiphyses, to which the inflammation has spread, have been sawn off, and are contained in 34b.

CHRONIC PERIOSTITIS.

Chronic periostitis is almost always associated with inflammation of the adjacent bone, but, unlike the acute, is seldom accompanied by severe constitutional symptoms and death of large portions of bones. It is generally the result of an injury to the bone or periosteum, or of syphilis, struma, typhoid fever, or rheumatism, and is generally limited in extent, constituting what is commonly called a node.

The periosteum, after presenting some increase of vascularity, which is, however, much less than in acute periostitis,

gradually becomes thickened, gelatinous, and fatty-looking, in consequence of cell-infiltration, and can be more readily stripped off the adjacent bone than in health.

The superficial layers of the bone beneath the thickened periosteum are also usually infiltrated with inflammatory products. When the inflammation has reached this stage it may terminate in resolution, or the inflammatory material both in the periosteum and in the substance of the bone may undergo ossification, leading to the permanent thickening of the bone, or, as is less commonly the case, break down into pus, leading to ulceration or necrosis of the bone beneath. The ossifying variety, or the *hard node* as it is called when limited in extent, is more common on the bones of the lower extremities; the suppurating, or the *soft node*, on the cranium.

OSSIFYING VARIETY OF PERIOSTITIS.

41.—Section of a tibia exhibiting the effects of chronic periostitis. The periosteum is greatly thickened, and has been peeled off on one side in order to show beneath it the irregular deposit of bone derived partly from subperiosteal ossification and partly from ossification of inflammatory matter in the circumferential Haversian canals. **Case E. 42.**—The other half of the above specimen dried.

The new bone formed under the periosteum presents various appearances. It may be produced in—

Smooth uniform layers.

Case E. 74a and Case F. 300.

Thin spongy layers.

Case F. 301 to 303.

Stalactitic plates and masses.

Case E. 50 and 51. See also 140 and 144.

Node-like masses.

Case F. 307.—Sections of a tibia with nodes on its anterior surface. The sections of the nodes show that the new bone was produced in great part on the surface of the old shaft, indicating

that the inflammation was limited in great extent to the periosteum, a condition but rarely met with except in syphilis.

Case F. 306, 308, and 309 are typical specimens of *syphilitic* nodes situated on the subcutaneous surface of the tibia.

Case E. 47.—Sections of a tibia exhibiting a circumscribed thickening and induration of its anterior wall, the result of periostitis following the irritation of a chronic ulcer of the soft parts covering it.

These nodes produced by *chronic ulcers* must be distinguished from those resulting from syphilis, which at first sight they somewhat resemble. In both there is a circumscribed formation of new bone, but in the former the new bone is sharply defined, with elevated edges; in the latter it is imperceptibly bevelled off into the old shaft: in the former the surface is flattened; in the latter it is rounded: in the former it is irregular, rough, and coral-like; in the latter smooth, compact, and reticulated. See also **Case E. 47a, 48, 49, and 52.**

It frequently happens that a cutaneous ulcer, though primarily leading to periostitis and the formation of new bone, may by extension cause the ulceration of the same.

Case F. 329 and 329a.—Portions of tibiæ. Ulcers of the integuments produced periostitis which gave rise to new bone in consequence of irritation; the ulceration afterwards extended to the new bone.

SUPPURATIVE VARIETY OF PERIOSTITIS.

In the bones of the cranium.

Periostitis of the cranial bones is nearly always of syphilitic origin. It generally leads to ulceration and necrosis of the bone beneath.

Case F. 334, 335, 336, and 342, and many other specimens in this series, exhibit necrosis of the skull following suppurative periostitis (*soft nodes*). In these specimens the necrosed bone is seen in various stages of separation. The process of separation is described under necrosis.

In the bones of the extremities.

Suppurative periostitis in the bones of the extremities is rare. When it occurs it is accompanied by ulceration

rather than by necrosis of the adjacent bone. Around the ulcerated portion the periostitis generally assumes the ossifying form; hence new bone is usually deposited upon the surface of the shaft above and below the ulcerated spot. This condition is analogous to the ulcer of soft parts with callous edges.

142.—Portion of a tibia in which a large piece of the middle of the shaft has been destroyed by ulceration extending through it. The remaining bone exhibits the effects of inflammation, being light, brittle, and porous, and there is a sub-periosteal deposit of new bone upon its surface above and below the diseased part.

The ulceration was the result of periostitis consequent upon external injury from a rope coiled round the leg.

OSTEO-MYELITIS.

The term "osteomyelitis" is applied to inflammation and suppuration in the medulla and cancellous tissue of bone. It may be acute or chronic.

ACUTE OSTEO-MYELITIS.

Acute osteomyelitis may occur (1) as a simple local, or (2) as a diffuse septic or infective inflammation.

(1) ACUTE SIMPLE OSTEO-MYELITIS.

Acute simple osteomyelitis is almost invariably caused by some injury to the interior of a bone. Thus it most commonly occurs in the medulla of long bones after compound fracture and after surgical operations, such as amputations or resections, or in the diploë of the skull-cap after scalp wounds or blows upon the head. When it occurs after amputations it is usually quite local, though at times it may spread some distance up the medullary canal and cause central necrosis. The sequestrum in this case is usually of a conical shape—a condition well shown in specimens 170, 171, and 172.

In the following specimen (3208, in the top gallery) of sections from the extremity of a stump after amputation

above the knee, the effect of acute localized osteo-myelitis is well seen. Here, as is frequently the case when osteo-myelitis attacks a stump, the inflammation has been in great part limited to the bone which immediately surrounds the medullary membrane. At the extremity of the stump the inflammation has involved the whole circumference of the sawn end of the bone, from which the periosteum has receded, leaving nearly an inch of bone protruding beyond the soft parts. The protruded portion, and that immediately adjacent to it, is dead and in process of separation. As the osteo-myelitis spread up the medullary cavity it became less diffuse, and involved less and less of the surrounding bone, so that more of the interior than of the exterior of the shaft perished, giving to the sequestrum a *conical* appearance. This is well illustrated on the surface of the sections where the line of separation between the dead and the living bone is marked by an arched layer of granulations. A mass of soft, spongy new bone surrounding the old shaft above the necrosed portion is formed, as seen in the specimen, between the receded periosteum and the surface of the living bone. In an earlier stage a fungating reddish mass of granulations is generally seen projecting through the ring of necrosed bone from the inflamed medullary cavity. This, with the recession of the periosteum, is pathognomonic of osteo-myelitis. See also 3207.

3201.—Portion of a femur from a stump. Both this and the preceding specimen exhibit, in a dry condition, the appearances described in 3208.

3203.—Section of a femur from a stump, exhibiting an irregular osseous deposit on its surface, immediately above its extremity. A thin ring of the outer lamella has perished. Similar rings of bone which have separated in other cases are seen in Nos. 3204, 3205 and 3205a. See also 241 and 242.

3200.—A sequestrum from a stump. Its conical shape is well seen, and was produced as described in 3208. See also 3202, in which the same process has occurred.

(2) ACUTE DIFFUSE INFECTIVE AND SEPTIC OSTEO-MYELITIS.

This variety may be idiopathic or traumatic in origin.

A. *The idiopathic variety* (infective) occurs in young and debilitated subjects, and appears to depend upon the presence of micro-organisms in the system. The disease is very acute and widely diffused. The inflammation rapidly involves the whole medulla, and thence spreads through the cancellous and compact tissue to the periosteum; the large patulous veins of the medulla become filled with purulent thrombi, and the patient usually dies of septicæmia or pyæmia in a few days. Abscesses in the heart and pericardium are more frequent in pyæmia from this than in pyæmia from any other cause. At first the bone-substance itself is unaffected, but after the inflammation has reached the periosteum and suppuration has taken place the whole or greater portion undergoes necrosis. On section (see 61) in the early stage the medulla, and to a less extent the cancellous tissue, appear intensely red and injected, and sprinkled here and there with numerous small ecchymoses. Later on collections of pus are seen scattered over the section, the yellow colour of which strongly contrasts with the vivid redness of intervening portions. Still later the periosteum is found separated, the medullary membrane thickened, and a large portion of bone white and dead. In less acute cases the bone lamellæ immediately surrounding the medulla alone die (*central necrosis*).

In long bones.

33.—Section of a tibia from a boy aged eighteen. The medulla is intensely inflamed, and inflammatory exudation and pus are abundantly deposited in the cancellous tissue throughout the whole bone. Suppuration has also occurred between the epiphyses and shaft, and irregular ulceration extends through the articular cartilages into the knee and ankle joints. (See No. 573.) The periosteum is separated from the shaft in nearly its whole extent, and is

very vascular, thick, puffy, and velvet-like on its inner surface ; the whole shaft of the bone is in a state of necrosis.

In short bones.

223.—Portions of the tarsus. Diffuse osteo-myelitis has occurred in the cancellous structure of the os calcis, and the whole of the internal cancellous texture of the bone has perished, and was in process of separation from the thin osseous layer constituting its walls.

B. *The traumatic variety* (septic) occurs as the result of injury to the interior of a bone, whose cancellous tissue has been exposed under septic conditions. It is met with after compound fracture, excisions, amputations, and the operation of trephining the skull.

60.—Sections of the head, neck, and shaft of a femur exhibiting the earlier stages of osteo-myelitis. The bone-substance itself is unaffected, but the medulla is intensely injected, and pus has been formed in places. The osteo-myelitis followed amputation of the thigh.

See also 58. In this specimen the medulla has sloughed. The osteo-myelitis was the result of boring holes and driving ivory pegs into the bone. The experiment was performed on a dog.

175 and 176 are specimens of necrosis of portions of the cranial bones, the result of osteo-myelitis in the diploë set up by trephining. The inflammation was probably due to the trephine wounds not being kept aseptic.

CHRONIC OSTEO-MYELITIS.

This affection can hardly be distinguished from chronic osteitis. Indeed, in the latter affection, the soft tissues lining the medulla, cancellous spaces, and Haversian canals are as a rule equally involved in the inflammatory process, as is frequently the periosteum. In rare instances, however, the inflammation is chiefly confined to the medullary membrane and to the layers of bone which immediately surround it, as in specimen 59, in which the endosteum measures one-twelfth of an inch in thickness. It has been partially re-

flected from the wall of the medullary cavity to show its thickness. The inflammation may then terminate in central necrosis (216 and 221), or in ossification of the inflammatory products—osteo-sclerosis (Case F. 259a)—with consequent obliteration of the medullary canal, as is also well shown in the same specimen, and even better in Case F. 259.

59.—Portions of the humerus, radius, and ulna. The sections of the humerus exhibit thickening of the medullary membrane, the result of osteo-myelitis. The membrane is in some places nearly a twelfth of an inch in thickness, and presents an uneven, velvet-like surface. A portion of the lamellæ surrounding the medullary canal has necrosed and lies loose in this cavity. A piece of glass is passed through a long fistulous passage leading from the medullary cavity through the lower end of the humerus into the elbow-joint. The greater part of the articular cartilage is removed from the ends of the bones forming the elbow-joint, and the remaining synovial membrane is thickened. See also 64 and 66.

OSTEITIS.

Osteitis, or inflammation of the bone itself, is always associated with some amount of inflammation of the periosteum and medullary membrane; it is therefore difficult in many cases to determine whether a given specimen should be considered as one of osteitis, periostitis, or osteo-myelitis—a point of some pathological interest, but fortunately of no practical importance. Osteitis may occur in any bone; it is most frequently met with, however, in the ends of the long bones, in the bones of the tarsus and carpus, in the bodies of the vertebræ, in the skull, and in the shafts of the bones of the lower extremities, especially the femur and tibia. It is generally the result of tubercle, syphilis, or rheumatism; but it may occur without any very evident predisposing cause. Osteitis in the ends of the long bones and in the bodies of the vertebræ will be more particularly referred to under "Diseases of the Joints" and "Diseases of the Spine." The term "osteitis," as here used,

refers to chronic or sub-acute inflammation of bone. Acute inflammation is practically indistinguishable from acute periostitis or osteo-myelitis, under which it is included (pages 3 and 8). Osteitis may conveniently be divided into three stages: 1st, Increased vascularity; 2nd, rarefaction; 3rd, sclerosis—each corresponding to a similar stage in the inflammation of soft parts.

1st Stage.—Increased vascularity.

The bloodvessels in the Haversian canals and cancellous spaces become dilated and distended with blood, as in the initial stage of inflammation of soft parts, and the vascular derangement rapidly extends to the vessels of the periosteum and medulla. The periosteum appears red and injected, and more readily separable from the bone than in health. On removing the periosteum, the surface of the bone appears suffused with a pinkish blush (see **No. 18**), markedly contrasting with the whiteness of the surrounding healthy bone. Scattered over the pink surface are numerous bloody points, due to the rupture of the enlarged bloodvessels that run from the periosteum into the Haversian canals.

On section (see **Nos. 21 and 22**) the bone appears full of blood, and of a bright red colour, with here and there a patch of yellow from commencing inflammatory infiltration. The medulla, like the periosteum, is slightly red and injected. The appearances of the surface of the bone after removal of the periosteum are seen in **61**, where the periosteum, which is very vascular, has been reflected. The surface of the bone is of a pink colour and dotted with points of red, showing the injection of the enlarged bloodvessels in the Haversian canals. The appearances on section are seen in **21 and 22**, where the bone above and below the necrosed part is inflamed. It appears highly vascular, and of a bright red colour.

2nd Stage.—Rarefaction.

In the second stage, comparable with that of exudation in soft parts, the connective tissue, enveloping the blood-vessels

in the Haversian canals and cancellous spaces, becomes infiltrated with inflammatory material, derived from the escape of white blood-corpuscles and from the exudation of liquor sanguinis from the dilated vessels. The earthy salts are loosened from their connection with the animal matter, and the bone lamellæ and trabeculæ are softened, eaten into as it were, and in part absorbed by the pressure of the inflammatory material which here, as in other inflammations, takes the form of red masses of granulations. The Haversian canals and cancellous spaces therefore appear preternaturally dilated and expanded, the compact bone being thus converted into cancellous and the cancellous bone being widened out. The bone appears, microscopically (see specimen 3a in the microscopical cabinet), eaten out into crescentic spaces known as *Howship's lacunæ*, in each of which is seen a number of multi-nucleated large cells (osteoclasts, or giant cells) in contact with the bone. These osteoclasts, which are derived from the small-cell-exudation, are believed to have an important but unknown share in the absorption of the bone. Some authors, however, maintain that the bone-corpuscles themselves take part in this rarefying process; whilst others believe that they remain entirely passive and are simply destroyed, together with the lacunæ in which they are contained, by the pressure of the inflammatory material.

The periosteum and adjacent soft parts are generally thickened and infiltrated with inflammatory products. The bone itself is lighter and softer than natural, and usually increased in size, and in the dry specimen is rough, porous, and "worm-eaten" on the surface.

On section (No. 138b) it presents a mottled reddish-yellow appearance, from the presence of the inflammatory material in the cancellous spaces; the walls of the shaft in the case of the long bones are increased in thickness, and instead of presenting their ordinary compact structure, appear cancellous, apparently from the separation and widening out of the bone lamellæ. The medullary membrane, like the periosteum, is usually thickened and infiltrated. In

macerated specimens (No. 116) the whole bone appears light, spongy, and cancellous in texture.

When a whole bone, as the tibia, is inflamed, it may become increased in length as well as in thickness. (Case E. 74b and Case E. 102). In the latter specimen the left tibia is nearly an inch longer than the right, of which a section is alone preserved. During its increase in length it has become curved, its ends, confined by their attachments to the fibula, having been hindered from separating more widely.

116.—Portion of an os innominatum. The bone is increased in thickness from the expansion of its Haversian canals and cancellous spaces. Its texture is very light and brittle.

138.—Section of a femur. There has been an abscess in its cancellous tissue just above the condyles. The bone is expanded from pressure of inflammatory material for some distance beyond the seat of the abscess. See also 138a and 138b.

Case E. 102.—A tibia and fibula. The tibia exhibits the rarefying stage of osteitis. The increase in the length of the tibia, which has resulted from the inflammation is well seen.

3rd Stage.—Sclerosis.

This stage is comparable with that of induration and fibroid thickening or scarring of the soft parts. The inflammatory material filling the dilated cancelli and Haversian canals, together with that infiltrating the periosteum and medulla, becomes organized and undergoes ossification, so that the cancellous bone is converted into compact. Mr. Marrant Baker thinks that too much stress is laid upon the expansion of the compact bone and subsequent ossification of the inflammatory material in the expanded cancelli. He believes that the increased thickness of the wall of the shaft is due rather to formation of new bone, both by the periosteum and endosteum, than to expansion of the original shaft.

The whole bone is exceedingly hard and heavy. On removing the periosteum (see No. 100), which is always thickened, the surface of the bone is found covered with

an irregular deposit of new osseous material. On section (see No. 101) the walls of the shaft appear uniformly dense, compact, and greatly increased in thickness, the cancelli obliterated, and the medullary canal encroached upon or completely filled up by the new osseous material. The latter condition is very common in the ends of stumps after amputation. The Haversian canals are smaller and fewer in number than natural. Although sclerosis, in conformity with the general usage, has been here described as a *stage* of osteitis, it would be more scientifically correct to regard it as a *termination*. For it must be remembered that after inflammatory exudation has taken place, although ossification is the most common result, other changes than this may occur, such as caries, necrosis, or suppuration and abscess, all of which might be as correctly designated stages of osteitis as sclerosis, but which with more propriety are always described as what they, accurately speaking, are—so many different terminations of the inflammatory process.

100.—Section of a tibia exhibiting various changes of structure consequent upon osteitis. Ossification of the inflammatory new formation in the cancelli has taken place in some situations, while in others the osteitis has only reached the second stage. In other parts, again, suppuration has occurred.

Case E. 99.—A femur, tibia, and fibula, exhibiting the rarefying stage of osteitis and the commencement of that of sclerosis.

Good specimens of sclerosis in the shafts of long bones are also seen in **Case E. 47, 47a, and 49**, also in **Case F. 103, 112, 259a, 302**, and many other specimens in **Case F.** In most of these it is difficult to say how much of the increase in thickness of the walls of the shaft is due to osteitis, and how much to periosteal and endosteal formations of new bone.

Case E. 76.—Portions of a skull-cap, exhibiting obliteration of many parts of the diploë, with irregular thickening and porosity of its tables, and deepening of the arterial grooves upon the internal table.

Case E. 77, 79, and Case F. 348 and 349.—Similar specimens.

Under the name of *osteitis deformans* Sir James Paget

has called attention to a peculiar form of chronic inflammation of the bones. "The disease," he says, "affects most frequently the long bones of the lower extremities and the skull, and is usually symmetrical; the bones enlarge and soften, and those bearing weight yield and become unnaturally curved and misshapen. . . . The bones show the consequences of an inflammation, affecting in the skull the whole thickness, in the long bones chiefly the compact structure of their walls, and not only the walls of their shafts, but in a very characteristic manner those of their articular surfaces."

Case E. 73.—Sections of the tibia and of the bones of the cranium, from the case upon which Sir James Paget's description of this form of osteitis is based. See also 74, 74d, and **Case E. 74a, 74b, and 74c.**

It is probable that many of the large porous skulls referred to above are specimens of a similar disease.

CRIES OR ULCERATION.

The term "caries" is here used as synonymous with ulceration of bone. It is the molecular death and disintegration of bone, a continuation, in fact, of the rarefying stage of osteitis, the thinned and eroded trabeculæ becoming in caries still further eroded, and finally broken down into small particles which escape with the inflammatory discharges or become absorbed. Its favourite seat is in the cancellous tissue; it may occur, however, though much less frequently, in the compact tissue.

Many points of resemblance exist between caries and ulceration of soft parts. "Each affection," says Bransby Cooper, "is preceded by inflammation; each is attended by the formation of matter; each may be followed by the production of granulations; each may arise from local or constitutional causes; and each may be combined with the total extinction of vitality in certain points of the textures affected. Thus, precisely in the same way as we often see

ulceration and sloughing exhibited together in the soft parts, we also frequently find caries and necrosis prevailing together in the bones" (*caries necrotica*). Moreover, in caries of bone, as in ulceration of soft tissues, the parts around may be healthy, thickened, or in a state of softening. On contrasting caries with necrosis, it will be seen that caries is molecular death of bone, necrosis death *en masse*; that caries generally affects the cancellous tissue, necrosis the compact; that caries is accompanied with but little, necrosis with extensive, formation of new bone.

Caries may be divided into *Simple*, *Tubercular* and *Syphilitic*.

CARIES SIMPLEX, OR SIMPLE ULCERATION.

Simple ulceration may occur in any bone that has been the subject of inflammation. It is commonly met with, however, attacking the articular surface of the cancellous ends of bones after destructive inflammation of the joints; less frequently it occurs in the compact tissue of the shafts of the long bones after some forms of periostitis, and still more rarely in the lamellæ immediately surrounding the medullary canal after chronic osteo-myelitis.

Simple ulceration is characterized by its limited extent, by the indurated condition of the bone around, and by the tendency of the ulcerated surface to form granulations. Its appearances may be studied in detail as it occurs in the articular surfaces of bones after destructive joint-disease (see Nos. 591 and 757), and in the compact tissue of the shafts of long bones after periostitis.

In the articular surfaces of cancellous bones.

Simple ulceration, when it attacks the articular surfaces, commonly sets in as soon as the cartilages are destroyed and the bared bone presents in the cavity of the joint. The process is as follows. Whilst the cartilages are undergoing destruction the bone beneath becomes inflamed. The rarefying process, however, in the layers of bone next the

cartilage does not pass into that of sclerosis, as described under osteitis, but is continued; the thinned and eroded bone trabeculæ becoming still further thinned and eroded until they are completely disintegrated and broken down, or so thinned that they are worn away by the friction of the contiguous articular surfaces upon each other. Whilst this destruction is taking place, the inflammatory material, which has been formed in less quantities in the bone below, where the inflammation was less intense, becomes organized and ultimately undergoes ossification, thus limiting the extent of the ulceration. The manner in which granulations may afterwards form, and, by uniting with those of the contiguous articular surface, produce bony ankylosis, will be described under diseases of the joints.

The ulcerated surface (**No. 757**) appears sharply circumscribed, of a bright red colour, superficially excavated, and covered with small quantities of pus and minute particles of disintegrating bone. On section (**No. 588**) the bone immediately below the excavated surface appears simply rarefied, infiltrated with inflammatory material, and slightly softened, but not oily and fatty-looking as in tubercular caries. Still further from the surface the bone retains its natural hardness, or may be harder than natural from ossification of inflammatory material in the cancelli. New bone is also formed beneath the periosteum around the ulcerated articular end.

In the dry specimen the ulcerated surface appears superficially excavated and "worm-eaten," whilst the bone immediately below presents the ordinary characters of rarefying osteitis, and still lower those of sclerosis. The periosteal new bone generally assumes the form of stalactitic spicula, markedly differing from the flat nodular masses surrounding joints which have been the subjects of osteo-arthritis.

590.—The bones of the ankle-joint. The cartilage has been removed in great part from the articular surfaces of the tibia, fibula, and astragalus, and the bone beneath is superficially ulcerated. See also 589.

597.—Bones of the wrist, exhibiting the effects of inflammation in the whole of the carpal and metacarpal joints. The *articular surfaces* of the several bones are extensively ulcerated, some superficially, others deeply; there is a very abundant formation of new bone around the ulcerated parts. The ulceration was the result of inflammation of the wrist-joint. Compare this specimen with 136, in which the ulceration was of the tubercular variety, and began in the interior of the bones themselves.

596.—Bones of an elbow-joint, exhibiting the effects of inflammation which probably commenced in the joint. The texture of the bones has become porous and spongy, their articular surfaces are ulcerated, and upon the external surface of each bone there is an irregular deposit of new bone in ridges and sharp processes.

Compare the stalactitic arrangement of the new bone in this specimen with the low nodular osteophytic growths in 692a, 693a, and Case G. 696, which are specimens of osteo-arthritis.

726.—The excised articular portions of the bones of the elbow-joint. Their articular surfaces are all ulcerated, and in the humerus the ulceration has extended deeply. The ulcerated surfaces are *hard*, and in parts *smooth*, as if the ulceration had not been progressive at the time of the excision. The surfaces of the bones not included in the joint are thinly covered by periosteal new bone.

In the compact tissue of the shafts of long bones.

Ulceration of the shafts of long bones is rare; when it occurs it is generally the result of chronic periostitis. The inflammation spreads from the periosteum to the adjacent bone, and the compact is converted into cancellous tissue, as in ordinary rarefying osteitis. In the superficial layers, where the inflammation is most intense, the rarefying process is continued, and the bone trabeculae are finally worn away, as in the articular ends, by the pressure of the inflammatory material, which, together with the internal layers of the periosteum, either assumes the form of granulation tissue or suppurates and breaks down into pus. In the latter instance the ulceration is frequently combined with necrosis of small portions of the superficial layers of the bone.

On removing the periosteum, the internal surface of which appears covered with granulations, the bone is found superficially excavated, softened, and broken down, while the bone below is rarefied, and, still deeper, sclerosed. Sub-periosteal ossification is likewise generally present on the surface of the shaft around the ulcerated part.

After the inflammation has ceased, the granulations covering the excavated surface undergo ossification, and so in great part restore the loss of substance of the shaft.

65 and Case E. 65a.—Sections of a tibia, in which several irregular, thin pieces of the outer wall of the shaft have perished. The surface of the wall around the dead portions of bone is extensively ulcerated, and around this ulcerated part new bone has been abundantly formed.

142.—Portion of a tibia in which a large piece of the middle of the shaft has been destroyed by ulceration and necrosis. The remaining bone is inflamed, and new bone has been formed around the ulcerated part.

137.—The upper part of a femur, the surface of which is irregularly, and for the most part superficially, ulcerated. Small portions only of the external lamellæ remain, and these are in many parts covered by a thin layer of new bone. The epiphyses of the great trochanter and the head of the bone have separated.

These changes were consequent on sloughing over the great trochanter.

Case F. 111.—Portion of a tibia exhibiting deep ulceration of its walls, with thickening and induration of the surrounding bone.

Case C. 1068.—Five dorsal vertebræ exhibiting superficial ulceration on the anterior surface of the bodies; the ulceration was connected with a psoas abscess. Contrast this with **No. 15** and **Case E. 17**, in which interstitial absorption of the vertebræ has been produced by the pressure of an aneurysm. In the latter specimen it will be observed that the fibro-cartilages and contiguous edges of the vertebral bodies are entire.

TUBERCULAR CARIES.

Tubercular, like simple caries, is here regarded merely as a continuation of the rarefying stage of osteitis, as a continuation, however, not of ordinary simple osteitis, but of an

osteitis depending on the presence of tubercle in the affected bone. To this variety some pathologists entirely confine the term "caries." It is characterized by the tendency of the inflammatory products to undergo caseous degeneration, by the extensive destruction of the affected part, by the softened, fatty, and oily condition of the bone around, by the little tendency to the formation of new bone, and by the feeble efforts towards repair.

The favourite seats of tubercular caries are the cancellous ends of the long bones, the short cancellated bones of the tarsus and carpus, and the cancellated vertebral centra.

The ulcerative process is preceded by a low or so-called "strumous" form of inflammation in the interior of the bone, due to the presence of miliary tubercles. The inflammation, the products of which manifest a marked tendency to undergo caseous changes, gradually makes its way to the surface, where it sets up inflammation of the periosteum and destruction of the articular cartilage and neighbouring joint.

In this condition the bone, which still retains its outward form, is light, soft and porous, so that it can be cut with a knife; on section its cancelli appear dilated, and filled with a reddish jelly-like material, in which the tubercle nodule, with its characteristic bacilli, can be demonstrated by appropriate methods. The thinned and eroded trabeculae next appear to undergo fatty changes and to break down and disintegrate, whilst the inflammatory material softens into pus. The disintegration (*ulceration*) may begin either at the surface or in the interior of the bone. In the former case the surface appears irregularly and deeply excavated, and covered with a thin ichorous and bloody pus mingled with small portions of broken-down bone; whilst immediately below, the trabeculae are so soft and rotten that they can be readily broken down by the pressure of a probe. On section (see 123) the bone is softened and its cancelli filled with a yellow caseous mass, the products of the disintegration of the inflammatory material and osseous trabeculae

When the disintegration begins in its interior, the bone often becomes reduced to little more than a thin shell (123), from the breaking down and disintegration of the cancellous tissues. In some instances the ulceration may be accompanied by necrosis of small portions of the bone (*caries necrotica*) (see 124 and 212), or by limited formations of pus (*abscesses*) (see 129).

The periosteum becomes vascular, thickened, and loosened from the carious spot, but, as a rule, no new bone is formed around, as in simple ulceration. The adjacent soft parts likewise become thickened and infiltrated, and are frequently found riddled with fistulous passages, lined by characteristic granulations (see the skin surface of No. 577, where glass rods have been passed into the carious ankle-joint), leading down to the bone. Abscesses, having no necessary connection with the bone beneath, may also be produced by the breaking down of inflammatory material infiltrating the soft tissues (see 577, where there is a small abscess on the left-hand side of the specimen).

123.—Sections of the articular ends of the femur and tibia of a young subject. The compact layer of the bones is thin and soft; the cancellous tissue is delicate, and filled with caseous material.

121 and 126.—Similar specimens.

In the preceding specimens the cartilages have as yet become only slightly affected.

136.—The bones of two wrists, together with the lower ends of the radii and ulnæ and the metacarpal bones, exhibiting the effects of tubercular ulceration. On the left side the carpal bones are nearly destroyed, and there are large deep cavities, bounded by soft, greasy, crumbling bone, in the adjacent parts of the bones of the forearm and metacarpus.

Compare this with simple ulceration in bones of the wrist (597.)

222.—An os calcis. In its posterior third is a considerable cavity, which communicated by a sinus with the sole and with the inner side of the foot. It contained fœtid pus, and the mass of dead bone seen in one side of the specimen. The bone thus situated was necrosed and separated, but being impacted at the point where the sinus communicated with the cavity, there was no evidence

during life of the completion of its separation. The bone around the cavity in which the sequestrum is contained is infiltrated with inflammatory material, and is in places carious. The man from whom this preparation was taken died of tubercle of the lungs.

601, 729, and several other specimens in the Joint series, afford excellent illustrations of the carious changes which take place in the articular surfaces of bone.

SYPHILITIC CARIES.

This is described under the heading of "Syphilis in Bone" (see p. 48).

NECROSIS.

Necrosis is the death of the whole or part of a bone, and is analogous to gangrene of the soft parts. It usually affects the compact tissue of the shafts of the long bones; less frequently the cancellous tissue in the ends of the long and interior of the short bones.

When the whole of a bone dies the necrosis is said to be complete or total; when only a part, incomplete or partial. If only the outermost laminae perish, it is spoken of as peripheral; if only the innermost (those immediately surrounding the medulla) as central.

Although necrosis is here classed as one of the results of inflammation, it may be produced by other means. The immediate cause, however, can in all cases be traced to the cessation of the circulation through the bone, and the consequent cutting off of the nutritive supply. The conditions that may give rise to this stoppage of the circulation are very numerous, and will be considered under the heads of inflammatory, traumatic, and constitutional causes.

INFLAMMATORY CAUSES.

Inflammation of the periosteum (*periostitis*), of the medulla (*osteo-myelitis*), or of the bone itself (*osteitis*), is a frequent cause of necrosis. In periostitis and osteomyelitis the death of the bone, as we have already seen, is

due to the cutting off of its blood-supply in consequence of the destruction of the vessels which run from the periosteum and medulla to the bone, and in part to the effects of the osteitis which always accompanies these inflammatory conditions. This process is analogous to that which occurs in acute cellulitis, where death of the skin results from the destruction of the vessels which ramify in the cellular tissue.

The necrosis of the jaw so common in lucifer-match-makers appears to be the result of a local periostitis induced by the contact of the phosphorous fumes with the periosteum lining the tooth-socket. Mercurial necrosis of the jaw seems also to depend upon inflammation of the periosteum. Both will be more particularly referred to under diseases of the jaws.

In osteitis the cessation of circulation is brought about by the pressure of the inflammatory material upon the blood-vessels contained in the Haversian canals and cancellous spaces—a process which may be compared to that which happens in acute inflammatory gangrene. Necrosis, however, under such conditions is more common than gangrene, since bone from its hard and resisting nature is less capable of rapid distension than soft parts; hence its vessels are more likely to become compressed. It is only, however, when the inflammation is very acute that the inflamed portion of the bone dies; when it is less acute the walls of the Haversian canals and cancellous spaces, as we have seen, gradually yield and disintegrate before the more slowly produced inflammatory material; the vessels therefore escape compression, and rarefaction or the molecular death of the bone (*ulceration or caries*), rather than necrosis, results. Portions of bone, however, in the neighbourhood of the inflamed part may die from the impairment of their circulation by the inflammation or ulceration around. Hence the frequent occurrence of necrosis and caries in the same bone (*caries necrotica*). Necrosis following osteitis is most commonly met with in the cancellous tissue of the short and in the heads of the long bones.

Necrosis following periostitis and osteo-myelitis.

32.—The whole shaft of a femur in a state of necrosis consequent upon acute periostitis. The death of the bone was due to the destruction of the vessels of the periosteum by the acute suppuration of this membrane, and to the propagation of the inflammation through the Haversian canals to the medulla.

31a.—A humerus from a girl aged 14 years, who died of pyæmia. The whole shaft is completely necrosed. The upper epiphysis is separated from the shaft, but the periosteum is attached in shreds to the greater part of the circumference of the bone, being separated to only a very slight extent at the upper and posterior surface of the shaft. In the recent state the medullary canal was filled with a soft semi-purulent mass.

232.—Nearly the whole of the lower jaw in a state of necrosis, removed from a man who had been engaged some time in a lucifer-match manufactory. See also 230, in which the necrosis was also due to phosphorus poisoning.

160.—The last phalanx of a thumb which exfoliated, almost entire, in a case of whitlow. Necrosis following a whitlow is due to the destruction of the periosteum by the acute suppuration in the sheath of the flexor tendons. See also 161 and 162.

TRAUMATIC CAUSES.

Necrosis may occur after almost any injury to a bone. Its immediate cause is referable, in the majority of cases, to the destruction of the periosteum or of the medullary membrane, and to the formation of extensive clots in the vessels contained in the Haversian canals; more rarely, as in the case of an injury to a bone without wound of the soft parts, it appears to be the result of compression of the blood-vessels by extensive extravasations in the bone, in the medulla, or beneath the periosteum. The inflammation, however, which commonly follows injury has a share in its production.

Among the common injuries that produce necrosis in the ways above mentioned are—compound fractures, sawing of trephining, wounds of soft parts exposing the bone, burns, applications of strong acids, or even simple blows or falls upon a bone.

From compound fracture.

240.—Portion of a tibia from a compound fracture. Part of the extremity of the upper fragment has acquired the peculiar white appearance of necrosed bone. Here necrosis was probably caused, not only by the denudation or death of the periosteum, but also by the plugging of some of the vessels of the bone by clots, and compression of others by the products of the inflammation following the injury. See also 236.

198a.—A sequestrum removed from the thigh of a man aged 20, four years after a compound fracture. It had given no trouble until about a week before its removal.

From sawing and trephining.

3201.—Portion of a femur from a stump, the sawn end of which has undergone necrosis. This was probably due either to local osteo-myelitis following the injury, or to the formation of extensive clots in the divided bloodvessels, cutting off the nutritive supply from the end of the bone.

176.—Portion of a skull which exfoliated after trephining. As in the former specimen of necrosis from sawing, the death of the bone was due either to the formation of extensive clots in the divided bloodvessels, or to osteitis following the injury inflicted by the trephine.

From burns and cauterization of the periosteum.

Case F. 178.—A skull-cap in which there has been necrosis of a large portion of both tables of the frontal and right parietal bones, as the result of a burn. See also No. 19, in which the necrosis was due to an experimental cauterization of the periosteum in a dog.

243.—Sections of a tibia, of which nearly the whole length and thickness of the walls of the shaft perished after inflammation of the periosteum, produced by the application of nitric acid to a sloughing ulcer in the front of the leg.

From the destruction of the medulla.

24.—Section of the tibia of a dog, in which a large portion of the cancellous tissue and of the walls of the shaft perished from destruction of the medulla. In such a case the necrosis is in part due to the destruction of the vessels of the medulla, and in part to the intense inflammation set up in the surrounding bone as the result of the injury.

From blows or falls.

164.—The lower part of an os coccygis, which necrosed and exfoliated after a fall on the buttocks.

180.—Portion of an upper jaw, with two molar teeth, which separated by exfoliation, from a boy aged six years. The necrosis was consequent on a severe blow upon the face.

194a.—A section of the upper end of a tibia. A portion of the extremity of the diaphysis, about three inches in length, is necrosed, and lies in a cavity formed by a thin layer of new sub-periosteal bone, which is perforated by cloacæ. The surface of the sequestrum is very irregular, as if from absorption, and it is surrounded by granulation tissue, which connects it with the surrounding new bone. The limitation of the disease at the intermediary cartilage between the epiphysis and diaphysis is very distinct. The patient, a healthy lad, had received a slight blow on the shin from a fir-cone. Five days afterwards the leg was acutely painful, the skin over the tibia being swollen and very tender. A month later, the limb was amputated. See also 164a, in which a large fragment of rib underwent necrosis as the result of a slight injury.

CONSTITUTIONAL CAUSES.

Amongst the constitutional causes may be mentioned syphilis, tubercle, rheumatism, and the continued and eruptive fevers. In all these the necrosis is probably due to local inflammations of the periosteum and bone. Acute necrosis appears to be due to a peculiar infective condition analogous to that of pyæmia. In this disease large portions of bone, without any evident exciting cause, die.

Case F. 335.—The skull-cap of a young woman, in which in the course of *syphilis* the greater part of the outer table of the frontal bone suffered necrosis.

154.—A lower jaw, nearly the whole body of which suffered necrosis after the administration of a few grains of calomel in a case of *fever*.

158.—An ulna necrosed in its entire extent, saving its epiphyses, separated and removed during life from a child who had suffered from an attack of the *chicken-pox*. It appeared to result from acute periostitis.

156.—A clavicle in a state of necrosis, following an attack of *glanders* contracted from a glandered horse.

188.—Part of the upper third of the shaft of the humerus which had necrosed, and was removed by operation from a youth of strumous habit, who had suffered from *rheumatism*.

CHARACTERS OF DEAD BONE.

Dead bone can be readily recognised. It is (No. 244) bloodless, white, hard, dry, and sonorous when struck, often becoming brown or black (No. 260) on exposure to the air and discharges. When separated, its free surface is smooth and even, or, if previously inflamed, rough and irregular, its margins serrated and ragged, and its previously attached surface rough and uneven. These appearances, however, vary somewhat, according to the situation, previous condition, etc., of the dead bone.

When previously healthy.

194.—A tibia from a young subject, in which there has been necrosis of nearly the whole shaft. The dead bone, which was previously healthy, is white, bloodless, and smooth.

When previously diseased.

229.—A tibia, exhibiting necrosis of its anterior wall. The dead bone, distinguishable by its black colour, instead of presenting the ordinary smooth appearance, is rough and uneven. This condition is due to the removal of part of its surface by ulceration previous to its death; the black colour has been produced by the action of the air and discharges. See also **Case F. 340b**.

223.—Portion of a tarsus, exhibiting necrosis of the os calcis. The whole internal cancellous structure of the bone has perished, and was in process of separation from the thin osseous layer constituting its walls.

SEPARATION OF THE DEAD BONE.

When from one or more of the causes previously illustrated necrosis has taken place, certain changes are set up in the parts around, whereby the dead bone is separated from the living and the parts are restored to their healthy

condition. The following brief outline of the process, as it occurs in the superficial layers of the shaft of a previously healthy bone, may be taken as a type of what commonly happens. The numerous modifications depending on the previous condition of the bone, situation of the necrosis, etc., will be referred to under the specimens illustrating these peculiarities.

As the result, say, of an injury, a portion of bone dies; the periosteum covering the dead portion, if not already detached, rapidly becomes so (see **No. 33**); the bone around, from the irritation of the necrosed part, becomes inflamed, and a groove, due to ulceration (see **No. 22**), forms between the living and the dead, at the expense of the adjacent living bone. The groove deepens (see **No. 19**), until the dead portion is finally cut off from the surrounding living bone, and lies bathed in pus in a cavity lined with granulations (see **No. 27**). It is now called a *sequestrum* (see **No. 254**). The separated periosteum, simultaneously with these changes, ossifies, except at certain spots where it has been perforated by pus and discharges making their way from the dead bone to the surface. These apertures are called *cloacæ* (see **No. 253**). If the sequestrum is now removed, the cavity that contained it fills with granulations, which subsequently ossify, and finally lead to the restoration of the shaft of the bone. The successive changes which occur in the separation of the necrosed bone will be illustrated under the following heads:

- I. Separation of the periosteum.
- II. Increased vascularity and inflammation of the adjacent living bone.
- III. Formation of a groove around the dead at the expense of the adjacent living bone.
- IV. Complete separation of the dead bone by the deepening and completion of the groove.

I. *Separation of the periosteum.*

The periosteum (when not destroyed, as it sometimes is in cases of injury) separates and is pushed to some distance from the necrosed portion by the accumulation beneath it of blood or pus, according as the necrosis is due to injury or inflammation.

After the periosteum has separated it becomes inflamed, thickened, and lined with a layer of granulations. It finally undergoes ossification, as will be illustrated under the heading of "Formation of New Bone."

33.—Section of a tibia. The periosteum is separated from the shaft of the bone in nearly its whole length, and is very vascular, thick, pulpy, and velvet-like on its inner surface. This velvet-like appearance is due to the presence of a layer of granulations. Similar changes are seen in 35, and in 21 to 30, as well as in 31a.

II. *Increased vascularity and inflammation of the adjacent living bone.*

In necrosis of inflammatory origin these changes necessarily exist prior to the death of the bone. But in necrosis from other causes the dead bone acts as a foreign body, and sets up increased vascularity and inflammation in the bone around, which ultimately lead to further changes, to be presently described. The inflamed bone is recognised in the fresh or wet condition by its pinkish colour, which strongly contrasts with the white appearance of the dead portion and the surrounding healthy bone. Its surface is dotted with red points, the openings of dilated bloodvessels contained in the Haversian canals. These points appear as small apertures in the dry specimen, giving it a worm-eaten appearance, such as is seen in cases of osteo-arthritis (Case G. 682).

21.—Section of a tibia, in which necrosis has been produced in the outer layers of a small portion of its walls. The dead bone is distinguished by its yellow colour. The living bone around is inflamed, and can be recognised by its pinkish colour and the red points on its surface.

Case F. 179.—A skull-cap, exhibiting extensive necrosis and ulceration of the whole thickness of the parietal bones. A groove has been formed around the dead portion ; the increased vascularity of the adjoining living bone is indicated by the presence of numerous minute apertures in it. These apertures are the dilated Haversian canals, and in the recent state contained enlarged blood-vessels. The dilatation of the Haversian canals was caused by the pressure of the inflammatory new material formed between the walls of the canals and the vessels contained in them, causing absorption and destruction of the bone.

III. *Formation of a groove around the dead at the expense of the adjacent living bone.*

This, the next change in the process of separation, may be compared with the formation of the line of demarcation in gangrene. The inflammation immediately surrounding the necrosed spot terminates in ulceration, the animal matter is destroyed, the earthy particles are set free, and a groove of separation is commenced, which becomes lined with granulations formed by the differentiation of the inflammatory material external to the line of ulceration. The necrosed part thus separating is analogous to the slough in gangrene.

238.—Section of a tibia. In this specimen the bone surrounding the dead portion was previously healthy, but has become inflamed, and has begun to ulcerate beneath the lower part of the dead piece of bone, where a distinct groove without granulations may be seen. The upper half of the dead piece of bone is already separated from the living, the ulceration having proceeded further in this situation ; the groove is here lined with granulations, known in the specimen by their soft, reddish, vascular appearance. See also 19 and 23, and, in the dry state, **Case F. 334.**

IV. *Complete separation of the dead bone by the deepening and completion of the groove.*

As the ulceration advances, the groove gradually deepens until the dead bone is completely cut off from the living, and lies free, bathed in pus, in a cavity lined with granulations.

In the more common forms of necrosis the dead is not completely surrounded by living bone, but is in certain situations in contact with the periosteum. Under these circumstances the periosteum may either share in the death of the bone, or separate from it and undergo ossification. In the former case the necrosed bone is readily cast off from the living, and is said to *exfoliate*, the dead portion being called an *exfoliation*; whilst in the latter it becomes enclosed on all sides in a case of new bone (formed in part by the surrounding living bone, and in part by the ossified periosteum), from which it cannot easily escape; it is then said to be *invaginated* (**Case F. 190b**), and is called a *sequestrum* (**198a, Case F. 204**).

243.—Section of a tibia, of which nearly the whole length and thickness of the walls of the shaft perished, and were in process of separation from the cancellous and medullary texture, which has preserved its vitality and a nearly healthy condition. The groove formed between the dead and living bone is filled with soft vascular granulations.

244.—Parts of a femur, a portion of the whole thickness of the shaft of which died and was separated. The dead bone is contained in a cavity formed by the deepening and completion of the groove. The cavity is lined with granulations. See also **20** and **162**.

FORMATION OF NEW BONE.

While the dead is separating new bone is being produced in the parts around. As already stated, the periosteum, if it does not share in the death of the bone, separates from it, becomes inflamed, and lined with a layer of vascular granulations which finally undergo ossification. The new bone is at first porous and rough (**No. 253**) on the surface, somewhat resembling callus, but if the sequestrum be removed, it soon becomes smooth and compact, and ultimately differs but little, if at all, from ordinary bone. Its external surface is covered by the superficial layers of the old periosteum, or, perhaps, in some cases, by the condensed connective tissue derived from the surrounding soft parts. The internal sur-

face of the new bone, that next the sequestrum, is lined with granulations.

Ossification, however, is not confined to that portion of the periosteum which was in contact with the necrosed part, but extends for some distance beyond it, between the periosteum and the original wall of the shaft, thus completing the osseous cavity for the sequestrum. The new bone in this situation is produced both from the periosteum and the old bone. Ossification of the inflammatory material in the inflamed bone around the diseased spot also occurs.

21.—Section of the tibia of a dog in which the shaft of the bone in its whole length and nearly its whole thickness died. The periosteum separated from it and is thickened. Upon the internal surface of the separated periosteum the formation of new bone has taken place in small irregular deposits. It will be observed that these are all opposite to the parts on which the surface of the dead shaft is rough, making it probable that the new bone is formed on portions of the surface of the old shaft, which separated with the periosteum and served as a nucleus for the growth of new bone. The old bone at its extremity is still connected with the periosteum; hence it has received some of the fluid injected into the bloodvessels.

22.—Section of the tibia of a dog, in which, as in the preceding specimen, nearly the whole shaft of the bone died. The dead bone is in process of separation. New bone is formed around it in much larger quantities than in the preceding specimen, and apparently in the deeper layers of the periosteum, the superficial laminae of which appear to cover the outer surface of the new bone, and are, to all appearances, continuous with the periosteum covering the old shaft.

FORMATION OF CLOACÆ.

At certain situations the separated periosteum and contiguous soft parts become perforated by the pus and discharges from the dead bone making their way to the surface. Where the periosteum is thus destroyed no new bone is produced, and the holes thus left in the osseous capsule are called *cloacæ*. The passages leading through the

soft parts from these openings to the adjacent skin become lined with granulations, and remain permanently open so long as the sequestrum is not removed or cast out. A characteristic fungous granulation generally projects from the cutaneous ends of these sinuses.

248.—Section of a tibia from a boy, in which there has been necrosis of a large portion of the whole thickness of the wall. The largest piece of the dead bone has been removed, and is preserved in the next specimen, **No. 249**. On the inner surface of the separated periosteum a layer of new bone, half an inch thick, and forming almost a new wall to the tibia, has been produced. An aperture (*cloaca*) is seen in the covering of new bone leading from the pus cavity, in which the sequestrum was contained, to the surface of the skin, a portion of which is left and formed part of the boundaries of an external ulcer, exposing the dead bone on the front of the leg.

Case F. 261.—Part of a tibia, in which there has been necrosis of a portion of the shaft. The dead bone is completely separated, and lies loose in a cavity surrounded by new bone, but it is too large to be removed through any of the cloacæ in the new bone. See also **Case F. 255, 256, 257**, and many other beautiful specimens in **Case F.**

In rare instances no cloacæ are formed, a fact believed to depend upon delayed separation of the sequestrum and the consequent absence or delay of suppuration.

Case F. 258.—Sections of a femur, in which a portion of the whole circumference of the inner layers of its walls has perished and has been separated from the surrounding bone. New bone has been abundantly formed in and upon the outer layers of the wall which separated it from the sequestrum. There is not in this new bone any aperture or cloaca leading into the narrow space around the sequestrum.

Case F. 259.—Sections of a tibia. A sequestrum of a large portion of the inner layers of its wall is completely enclosed within the thick and hard layer of new bone formed in and united with the remaining portions of the walls. There is no aperture leading through the new bone to the cavity containing the sequestrum.

RESTORATION OF THE SHAFT AFTER REMOVAL OF THE SEQUESTRUM.

When the sequestrum is removed the cavity in which it was contained becomes filled with granulations that have grown inwards from the contiguous walls. These undergo ossification and the shaft is finally restored. Whether the medullary cavity is reproduced is not determined.

SPECIAL FORMS OF NECROSIS.

The general nature of necrosis having been described, it remains to point out the modifications depending upon the seat of the disease.

Necrosis chiefly affecting the outer layers of the wall of a bone (peripheral necrosis).

When necrosis attacks the outer layers only, the dead portion, as we have already seen, may become invaginated by the ossification of the periosteal sheath; if the latter is wanting, it is cast off or *exfoliated*.

The periosteal sheath is absent when the soft parts covering the dead bone have been extensively destroyed, and when the necrosis affects the bones of the skull, the bones of the tarsus, and the lower part of the posterior surface of the shaft of the femur.

19.—A tibia of a dog, exhibiting a portion of its wall, dead, and in process of *exfoliation*, the result of the extensive destruction of the periosteum produced by the application of the actual cautery to the bone.

Case F. 335.—The skull-cap of a young woman, in which the greater part of the *outer table* of the frontal bone has suffered necrosis, and was in process of exfoliation.

Case F. 204.—Portion of a femur, in which there had been necrosis of the posterior wall of the lower part of the shaft. The dead bone was separated, and was held only by a bridge of new bone formed across it.

It should be noted that when necrosis attacks the posterior part of the lower end of the shaft of the femur (*popliteal necrosis*, as it is commonly called—**Case F. 190, 190a and 204**), the necrosis is nearly always limited to the triangular surface bounded by the condyloid ridges on either side, and the lines of the condyles below. This is due to the firm attachments of the periosteum to these ridges, where it blends with the external intermuscular septum on the outer side and the tendon of the abductor magnus on the inner side. The reason why necrosis is so common in this situation is probably the loose attachment and thinness of the periosteum, and the absence of any muscular insertion on this surface of the femur. It should be further remembered, in operating for necrosis in this region, that the dead bone, through the absence of the periosteal sheath, lies in contact with the popliteal artery. This vessel ere now has been wounded by a sharp fragment of the sequestrum in attempts at extraction.

Necrosis chiefly affecting the inner layers (central necrosis).

Central necrosis is generally the result of a circumscribed osteo-myelitis. The dead bone, from its inability to escape, often remains a source of irritation for years, and causes great thickening of the bone around. Fistulous passages, the result of the pus and discharges making their way through the healthy bone, commonly extend from the cavity containing the sequestrum to the surface.

867.—Section of the shaft of a femur, exhibiting a fistulous cavity in its interior, with necrosis of a small portion of the inner layer of its walls. Two bristles are placed in a groove, extending to some depth between the dead and the contiguous living bone. A vascular membrane, having a soft velvet-like surface, lines the fistulous cavity in the bone. 868.—The other half of the bone, 867, macerated.

167a.—The lower two-thirds of the left femur, which has undergone central necrosis. The bone is much thickened, especially at its upper and posterior portion, by a deposit of new osseous material

derived from the periosteum ; whilst the lower portion of the bone is sclerosed so that the medullary canal is filled up with dense bone. In the upper part of the specimen the shaft has undergone lamellar necrosis. The dead bone has not exfoliated, but is in many places ensheathed by new bone derived from the endosteum and periosteum. See also 24, and **Case F.** 257, 258, 259 and 262.

Necrosis chiefly affecting the intermediate layers of the wall of a bone.

251.—Sections of a tibia, in which large portions of the wall are separated after necrosis. The separated portions include only the middle laminæ of the wall. The sequestra thus lie in cavities between the separated internal and external laminæ of the wall.

Necrosis affecting the cancellous tissue.

Where necrosis affects the cancellous tissue, which it occasionally does, though much less frequently than the compact, it is the result of chronic osteitis, and is commonly accompanied by ulceration. It frequently leads to inflammation and destruction of the neighbouring joint, either from the escape of pus into the joint or from extension of the inflammation to the synovial membrane.

210.—A clavicle, in which a piece of the cancellous texture near its sternal end has suffered necrosis. The dead bone lies loose within a cavity, in which it is partially exposed by apertures formed in the surrounding walls of the bones.

213.—Lower end of the left femur from a man, aged twenty-nine, who was admitted into the hospital on account of disease of the bone of nearly ten years' duration. The thigh was amputated at the patient's urgent request. A small, loose, ragged sequestrum was found on section deeply seated in the internal condyle. The bone around the sequestrum was in a state of inflammatory thickening. The knee-joint was not affected. See also 216, 217, 218, 221, 576.

Case F. 226a.—Portion of the temporal and occipital bones, showing the results of necrosis of the mastoid process. The temporal was trephined shortly before death.

226b.—Part of the temporal bone of a child. The mastoid portion is brown and rough ; it has undergone necrosis. The periosteum is retracted over the internal surface of the petrous

portion, leaving the bone bare. The child died with a cerebral abscess consequent upon the necrosis of the mastoid process. The brain is preserved in **Series xxx., No. 2486a.**

Necrosis affecting the whole thickness of the shaft of a bone.

Necrosis of the whole thickness of the shaft is usually the result of acute periostitis, osteo-myelitis, or in rare instances of chronic osteitis.

264.—A tibia, from which a portion of the shaft, nearly four inches in length and including both the walls and the medullary canal, separated after necrosis. The remaining portions of the shaft are connected by a thick band of tough ligamentous tissue, attached to their gradually attenuated ends. They are also soft, light, and smooth on their surface, as if extremely atrophied. Ligamentous union of the tibia and astragalus appeared to have existed. The fibula is healthy.

From a girl, in whom the disease had long existed. The leg could not be used in walking. See also 172.

Mr. Marrant Baker* has drawn attention to a form of necrosis affecting the whole thickness of the shaft, which he calls *intra-osseous*, from the fact that the sequestrum, instead of lying loose in its bony case, as in ordinary necrosis, is held immovably fixed by the formation of new bone on its endosteal as well as on its periosteal aspect. "A transverse section best brings to mind the condition present. Outside is the shell of periosteal new bone; next within is a more or less complete tube of dead bone; while innermost is the section of the solid endosteal rod of new bone, on which the dead bone is placed like a ferrule."

This form of necrosis is believed by Mr. Baker to depend upon chronic osteitis, for, as will be seen in the accompanying specimens, the "conditions characteristic of complete necrosis, so well marked in one part of the bone, are replaced in other parts by conditions equally characteristic of chronic osteitis with hypertrophy and sclerosis; while connecting the two, there is an intermediate or neutral territory, in which it is difficult to say whether the term necrosis or chronic osteitis is the more appropriate."

* See "Med.-Chir. Trans.," vol. lx., p. 187.

Another peculiarity in this form of necrosis is the long delay which occurs in the separation of the sequestrum from the living bone and the consequent absence or delay of suppuration. It is therefore often termed *quiet necrosis*.

167.—Section of a femur, removed by amputation at the hip-joint. Nearly the whole of the shaft has perished, and before the operation the bone had undergone so-called spontaneous fracture; but at no time, either before or after the operation, could any trace of suppuration be discovered. The dead bone is not at all points loosened from its connections. Near the trochanters it is still continuous with the cancellous tissue of the interior, and at the lower end of the bone, near the condyles, the same connection is observable. Between these two points, moreover, the medullary canal is encroached upon, more at the lower than the upper part, by new bone, which has been formed within the sequestrum, and which is continuous with the cancellous bone of the articular extremities and of the immediately adjacent portion of the shaft. On the outer aspect of the sequestrum dense and hard new bone has been everywhere laid down by the periosteum, so as to form a moderately thick sheath, which closely envelops the dead bone, so closely, indeed, that at some points it is difficult to make out any line of separation. Where the shaft has not perished in its whole thickness the new bone and the old are continuous, so that, one might say, at these points there is *hypertrophy* instead of *necrosis*. The periosteal sheath of new bone extends from just above the cartilage of the condyles to the trochanters and around the whole circumference of the bone, excepting one or two small openings at which the dead bone lies exposed. But these openings look rather as if they were made accidentally after the removal of the limb than like cloacæ formed during life.

Case F. 256.—Sections of a femur, in which there has been necrosis of nearly the whole length and thickness of the walls of the shaft. There are several round and oval apertures leading through the bone into the narrow space by which it is separated from the surface of the sequestrum. The sequestrum is in most parts immovable, and for various reasons; in the first place it is still in direct continuity with that portion of the shaft which has not perished, and there is no indication of even the commencement of a line of demarcation. Indeed, the only distinguishing mark is the appearance of the dead bone, which is whiter and smoother

than the apparently living. The sequestrum is also riveted by new cancellous bone, which extends into its medullary canal for some little distance from the cancellous bone of the articular extremities. Here and there, moreover, through a 'break' in the sequestrum—*i.e.*, where the original shaft has not perished, the new bone without and within has become continuous, so as still further to lock the dead bone. See also **Case F. 258, and 259.**

258a.—Section of a femur, in which a small portion of the compact tissue, about the junction of the middle and upper third, has become necrosed. Immediately around this, and for some distance along the shaft, an excessive amount of new bone has been formed. The surrounding soft tissues have shared in the morbid action, and the inflammatory process has resulted in the formation of a tumour-like mass of condensed tissue around the sclerosed bone. In the upper part of the preparation, the bone has become thickened at the expense of the medullary canal, which is occluded. A very small channel leads from the cavity containing the necrosed bone into the mass of tissue surrounding the shaft, and along this a glass rod is passed into a small abscess cavity which contained a few drops of pus. From a man, aged twenty-nine, who had noticed a swelling on the thigh for three months. It was painful and tender. On an incision being made into the tumour, it was thought to be a periosteal sarcoma, and amputation was performed at the hip-joint.

Necrosis affecting the whole diaphysis of the shaft of a long bone.

Death of the whole diaphysis is commonly the result of acute periostitis or osteo-myelitis.

170.—A tibia, the whole diaphysis of which had suffered necrosis.

Necrosis affecting the epiphysis only.

211.—Portion of a radius, in which necrosis has taken place in a piece of its lower epiphysis and articular surface. There is abundant deposit of new bone on the sound bone immediately around the diseased part.

Necrosis affecting the whole of a bone—diaphysis and epiphyses.

33.—A tibia, of which the whole shaft and both epiphyses have suffered necrosis; the result of osteo-myelitis.

SUPPURATION AND ABSCESS.

Acute suppuration in bone has already been described under osteo-myelitis (see **Nos. 33, 59, and 60**). It remains to discuss the chronic form.

CHRONIC ABSCESS.

Chronic abscess generally occurs in the cancellous tissue in the ends of the long bones, especially those entering into the knee and elbow joints. In rare instances it is met with in other bones—*e.g.*, the sternum, ribs, and clavicle. It is usually the result of chronic osteitis. The central portion of the inflamed tissue softens into pus, as has already been described under rarefying osteitis (p. 14), while the inflammatory material in the surrounding bone undergoes ossification and becomes the abscess wall. In some cases necrosis of portions of the bone may occur, as may be seen in **Nos. 217 and 218**, which are examples of *caries necrotica*.

The abscess cavity is lined by a soft, vascular, pus-secreting (*pyogenic*) membrane (**No. 132**), and the bone around is generally sclerosed. Upon the outer surface of the part of the bone corresponding to the cavity in its interior there is often a considerable deposit of new bone, the result of irritation of the periosteum. Chronic abscesses are generally single; they vary from the size of a pea to that of a hen's egg, and are generally, but not always, productive of some amount of enlargement of the end of the bone. Intermittent attacks of inflammation of the synovial membrane of the neighbouring joint are very common in the course of the disease. Perforation into the joint sometimes occurs.

132.—Sections of the lower part of the tibia, in the articular end of which is a chronic abscess. The cavity is lined by a vascular membrane a line in thickness, and it contained a puriform fluid. There is a small aperture in one side of the cavity which penetrated the wall of the bone, but with this exception the bone around the cavity appears healthy, and the joint is not implicated.

132a.—Section through the lower part of the left tibia and

ankle, showing an abscess in the bone, with some inflammation of the tibio-astragaloid joint. From a man aged forty-seven, who had injured his ankle thirty years previously, and who for ten or twelve years subsequently had sinuses about the part, from which pieces of dead bone came away at different times. Seven years before the amputation the patient suffered from a "gathered ankle," and was laid up for five weeks; the "gathering burst," but no dead bone was discharged. In March, 1884, he had rheumatic pains in his ankle, which swelled. On admission to the Bristol Infirmary the joint was stiff, but not uniformly enlarged. The skin was adherent, glazed, and pigmented. There was a good deal of hard swelling over the tendo Achillis. No tenderness anywhere above the joint. The abscess may have been secondary to the joint-disease, or else it may have supervened on the long-standing osteitis of the tibia. See also Nos. 128, 129, 130.

2.—AFFECTIONS DEPENDENT UPON SIMPLE DEFECT OR INCREASE IN NUTRITION.

ATROPHY OF BONE.

Atrophy of bone is the result of defective nutrition. It may occur as a senile change, or from disuse consequent upon disease or injury of the bone itself, or of some part in relation with it. It may also be induced by long-continued pressure, as by the plug used to stop the perforation in the palate in the following specimen (**Case E. 14**), in which case it is sometimes spoken of as interstitial absorption of bone, or even as caries.

Atrophy is manifested by wasting and rarefaction of the compact tissue. It is always attended by loss in weight, frequently by decrease in size and by fatty degeneration of the bone trabeculæ. It may proceed to such an extent that in extreme cases but little more of the bone remains than a thin shell enclosing a few scattered trabeculæ. Atrophy may be divided into *eccentric* and *concentric*.

ECCENTRIC ATROPHY.

The eccentric is that variety of atrophy in which the compact is simply converted into cancellous tissue, the

change taking place from within outwards, so that the bone, although lighter, still retains its outward form and appearance. It is always accompanied by fatty degeneration, and generally occurs in old people.

From old age.

7.—Section of the upper part of a femur from a very aged woman. Its texture is remarkably soft and light, and contained an abundance of fatty matter, which as a result of maceration has assumed the appearance of adipocere. The walls of the femur are at their thickest part not more than a line in thickness; the neck is shortened, and is rather less oblique than natural; the head is reduced in size and irregularly flattened.

From disuse.

Case E. 10.—Sections of a femur, in which there is an enlargement of the medullary cavity, with thinning of the walls and general lightness and dryness of texture.

CONCENTRIC ATROPHY.

The concentric is that variety of atrophy in which the wasting takes place from without inwards, so that the bone decreases in size. It may occur in the young as well as in the old, and is generally the result of disuse. Hence it is common in stumps after amputation, and in bones that have been subjected to prolonged rest from joint-disease or ununited fractures.

From disuse after amputation.

3.—Sections of the stump of a humerus, exhibiting the results of atrophy from long disuse after amputation. The sawn end tapers to a small cone; the walls of the shaft are less than a line in thickness, light and dry, and nearly all the osseous part of its cancellous tissue being removed, the medullary canal appears upon maceration like a smooth-walled cavity.

Case E. 2.—A scapula and part of a humerus. The arm had been amputated long before death, and through disuse the bones are atrophied, but the humerus in a much greater degree than the scapula. The shaft of the humerus has less than half its natural diameter and tapers to a slender cone, at the end of which there is

some rough new bone. The marks of the attachments of muscles on it are nearly obliterated, and the texture is light and dry. The head of the humerus is flattened and nearly all absorbed, and there is a corresponding diminution and change of form in the glenoid cavity.

Case E. 5.—An os innominatum and part of a femur. After amputation through the middle of its shaft, the stump of the femur has atrophied, just as the humerus in the specimen last described ; but its head and the acetabulum are unchanged.

From disuse consequent upon joint disease.

11.—Sections of the upper part of a tibia, exhibiting the effects of extreme atrophy. The walls are so thin that they are in nearly every part transparent. The interior of the bone is filled with soft fat, intersected by few and very slender trabeculæ. The articular surface is ulcerated and partly covered with the fibrous tissue of adhesions.

12—A section of the shaft and lower end of the same tibia partially macerated. It presents the same character of atrophy as the preceding specimens, and shows in a more marked manner the diminution of size which is associated with the thinning of the walls and the proportionate increase of fat.

The patient was a lad, fifteen years old, who had suffered for more than a year with disease of the knee joint. The limb had been kept constantly at rest. See also 8 and 12a.

From pressure.

15.—A section of four dorsal and lumbar vertebræ, the bodies of which have been deeply hollowed out by absorption consequent on the pressure of an aneurysm of the aorta. See also 16 and **Case E. 17**, and 17b.

HYPERTROPHY OF BONE.

Simple hypertrophy of bone is due to an increase in the length or breadth of a bone when such increase is not due to inflammation. The term must, therefore, be confined to those cases in which the extra growth has been the result of increased blood-supply. The increased nutrition may be due to increased functional activity in the bone itself, or to

some change in the surrounding parts leading secondarily to such a change in the bone. The latter cause is illustrated by the two forms of hypertrophy of the cranium of Sir James Paget, which he designates eccentric and concentric—the one in which the growth takes place outwardly, as in hydrocephalus, to form a covering for an expanding brain, the other in which growth takes place inwardly to fill up the space left by a retreating brain.

SIMPLE HYPERTROPHY.

1c.—The tibio-tarsal bones of a pigeon. The right tibio-tarsus has been fractured and repaired. The fibula is hypertrophied both in length and breadth, and is firmly united to the distal fragment. It appears to have acted as a splint during the union of the fracture.

ECCENTRIC HYPERTROPHY.

Case E. 1.—An enlarged skull from a dwarf aged twenty-eight years, consequent upon hydrocephalus. See also **Case D. 2519**, and **2520**.

CONCENTRIC HYPERTROPHY.

Case F. 348.—A skull-cap, in which there is an irregular increase in the thickness of the diploë, producing large convex elevations of the outer surface about the prominences marking the original centres of ossification of the parietal bones. The diploë is consolidated as well as thickened; the outer table is smooth and healthy; the inner table is deeply impressed by the vascular grooves. The cavity of the skull appears to have been small, especially in the parts beneath the external elevations. See also **Case E. 82, 83, 85**, and **Case F. 349**.

3.—CONSTITUTIONAL AFFECTIONS OF BONE.

SYPHILIS.

Syphilitic affections of the bones commonly, though not invariably, occur late in the progress of constitutional syphilis, during the so-called tertiary stage, after the periods at which the skin and mucous membranes are

usually affected. The bones are also sometimes affected in the congenital form of the disease.

Syphilis in bone is essentially of an inflammatory nature, and may manifest itself under any of the forms of inflammation already described. Hence we have syphilitic periostitis, osteitis, caries, necrosis, etc. In whichever of these forms it may occur the disease is characterized, like all the later syphilitic affections, by its limited extent, by its asymmetry, by its tendency to the production of large quantities of new material (gummata), and by the fibroid thickenings left should the inflammatory material be absorbed.

SYPHILITIC PERIOSTITIS AND OSTEITIS.

Periostitis, when of syphilitic origin, is nearly always chronic and of limited extent. It is productive of those low, smooth, circumscribed elevations, so characteristic of syphilis, called nodes.

Under appropriate treatment these nodes seem entirely to be absorbed, although when an opportunity occurs of examining the bone after death, depressed stellate, fibroid-looking cicatrices of the periosteum are invariably found where the swellings formerly existed.

If the disease is allowed to run its course, the inflammatory material invades the adjacent bone (syphilitic osteitis). One of two changes next occurs: the inflammatory material forming the node, together with that infiltrating the bone, either undergoes ossification, producing those permanent swellings and densely thickened bones so common in syphilis, or disintegrates, when caries or necrosis is the result. The former is more common in the lower extremities, the latter in the bones of the cranium. See **Case F. 305, 306, 307; and 347a**, and many others, for specimens of syphilitic nodes. The differences between ossified syphilitic nodes and the node-like swellings on the bones, consequent upon the irritation of chronic ulcers of the integuments, have already been pointed out (see page 7).

SYPHILITIC CARIES OR ULCERATION.

Syphilitic ulceration, as above stated, is the result of syphilitic inflammation of the periosteum and bone. The following varieties of ulceration have been described as characteristic of syphilis: (1) The annular; (2) the tuberculated; (3) the penetrating; (4) the reticulated.

The annular variety.

These annular ulcers have been compared to the rupial ulcers of the skin. They present an annular form, an ulcerated groove extending round a central portion of diseased bone, which portion is gradually removed as the groove widens towards the centre.

Case F. 320.—A skull-cap, exhibiting extensive syphilitic ulceration of its outer table. The ulcers are distinct, large, and round. Some of them, especially one on the frontal bone, show that they commenced in an annular form, an ulcerated groove forming round a portion of diseased bone, which portion was subsequently removed by the widening of the groove. The inner table is very vascular, and less extensively ulcerated. See also **Cases F. 315, and 316.**

The tuberculated variety.

This variety, so called because the ulceration is preceded by a tubercular condition of the bone, is the result of syphilitic periostitis. The small-cell-infiltration in the substance of the bone raises the surface into irregular tubercular elevations, and subsequently, by destroying circumscribed portions of the bone, produces ulcers. The ulcers are small, circular, or oval; they often penetrate somewhat deeply into the bone. From the fact of both being preceded by a tubercular condition, this ulceration has been compared to tubercular syphilitic ulceration of the skin.

Case F. 315a.—A skull-cap in which a large portion of the outer table of the frontal bone and of the whole thickness of the parietal bones has ulcerated. The bone is rough and tubercular,

presenting the features which are characteristic of advanced syphilitic disease. The sutures between the bones have disappeared. From a man aged twenty-five, who was probably congenitally affected with syphilis. He died of Bright's disease with œdema of the glottis. He does not appear to have been treated with mercury. See also **Case F. 313, 323, and 343.**

The reticulated variety.

This variety is so called because the ulceration is preceded or accompanied by a trellis-work-like or reticulated formation of new bone around the ulcers, the result of ossifying periostitis.

Case F. 308 and 329 are good specimens of this variety.

The penetrating variety.

This is merely a modification of any of the former varieties of ulceration in which the bone is deeply penetrated. It is common in the bones of the cranium, rare in the long bones. In the latter, however, it has sometimes been a cause of spontaneous fracture.

Case F. 312.—Parts of a tibia, clavicle, humerus, and skull, from a man who died of syphilis. In one part of the shaft of the tibia the walls and the new bone covering them are *penetrated* by small irregular ulcers. The same disease has affected the middle of the clavicle; and in it the ulceration has extended so far that a slight force broke the remaining portion of its shaft. In the humerus the lower half of the shaft is thickly covered by light and porous new bone, through which many ulcers of various sizes have *penetrated*; some of these extend deeply into the original wall of the humerus, portions of which also appear to have suffered necrosis. In the skull the outer tables of the frontal and right parietal bone present an uneven tuberculated surface; through this numerous distinct and coalescing ulcers *penetrate*, and, reaching the diploë, spread therein in wider spaces, and in a few instances pass also through the inner table (**Case F. 340a**).

CONGENITAL SYPHILIS.

Congenital syphilis in the skull affects the bones by causing atrophic lesions leading to a condition of craniotabes

(see p. 55), which is usually found during the first year of life. In this affection the bones of the vault become thinned in circumscribed patches to such an extent as to leave only a thin membrane (**Case F. 342**). These spots are most frequent in the occipital region, though they sometimes occur in the parietal bones. In other cases the earthy salts are removed from the bone by a process which results, as in craniotabes, in the formation of a membrane. In these, however, the constituent parts of the membrane are unravelled, so that there appears to be a meshwork of blood-vessels and delicate fibrillæ distended with fluid. This is the *gelatiniform atrophic variety of Parrot*. There are no specimens of the latter form of atrophic change in the Museum.

Congenital syphilis may also lead to osteophytic lesions in the skull, of which the best known are Parrot's nodes, found in the so-called "natiform" skull. In this form of skull (**Case F. 350**), which is somewhat larger than normal, there is usually an exaggerated prominence of the frontal eminences, whilst between them and the eyebrow is a shallow furrow or depression. Posteriorly on the parietal bones similar eminences exist, but they are more widely spread and are lower. These changes appear to be due to chronic infantile periostitis, with softening, though Mr. Hutchinson thinks that a tendency to hydrocephalus probably takes some share. The bridge of the nose is often flattened in cases of congenital syphilis, due, it is supposed, to the internal and external periostitis of the nasal bones.

The changes in the teeth which are characteristic of inherited syphilis are best seen in the permanent upper central incisors. The modifications which these teeth undergo are shown in drawings **Nos. 190b and 190c**. The changes may be summed up as a dwarfing of the upper central incisors, which are too short and too narrow, and which display a single central notch in the free convex edge. These conditions are usually symmetrical, but may in some cases be notably one-sided.

Case F. 350a.—A natiform skull showing four large osteophytes round the anterior fontanelle, and several smaller ones on the supra-occipital region. These, when fresh, were all of a bright red colour. See also 350.

SYPHILITIC NECROSIS.

Necrosis from syphilis is most often met with in the bones of the cranium. It is generally the result of suppurative periostitis (*the soft node*), and then only attacks the outer table, as the inner has a separate blood-supply. It also occurs after syphilitic inflammation of the dura mater, and then affects the inner table only for the same reason, or the process may affect both the inner and outer table at the same time. A syphilitic sequestrum, which is separated in the usual way by a groove of ulceration, is generally round, porous, and indented at the edges, the porosity being due to ulceration of the bone previous to its death. The hole left on the separation of the sequestrum is usually round, with jagged and shelving edges, and seldom extends through more than one table. New bone is not usually formed on the outer table around the sequestrum.

The changes occurring in syphilitic necrosis are well seen in the following specimens: **Case F. 321** shows the superficial ulceration of the bone in which as yet no line of demarcation is visible. In **Case F. 335** the necrosed portion is becoming separated, and a shallow groove has formed. In **Case F. 336** the groove is deepened; and in **Case F. 337** the necrosed portion has entirely disappeared, leaving a hole which extends through the whole thickness of the skull.

Case F. 334.—A skull-cap, exhibiting necrosis of a portion of the outer table of the frontal bone, with thickening of the inner table to a corresponding extent. The dead bone is black; previous to its necrosis it appears to have been superficially ulcerated. There is a very shallow groove of separation around it.

Case F. 335.—The skull-cap of a young woman, in which, in the course of syphilis, the greater part of the outer table of the frontal bone suffered necrosis, and was nearly separated from the adjacent

bone. A deep groove has formed round the dead portion, and a large part of its under surface is separated. The inner table has not perished, but beneath the centre of the necrosed portion there are several irregular ulcerated openings in it.

Case F. 342.—A skull-cap, exhibiting some of the effects of syphilis. In some situations there has been a complete destruction of the bone through both tables of the skull; at the borders of the apertures thus made the disease seems to have stopped, and the parts appear to have cicatrized, for their edges are thin, smooth, and hard. In other situations ulcerations appear to have been in progress, the bone in these parts exhibiting a rough surface, a porous texture, and many small deeply penetrating holes. The spaces left by the removal of the bone are filled by membrane, in which there are several small deposits of new bone; and the outer surfaces of all the portions of the skull which remain between the ulcers are tuberculated, seamed, and starred. See also **Case F. 317, 336, 340.**

TUBERCLE.

Tubercle occurs in bone either in the form of gray miliary tubercles, or in the more advanced condition known as yellow caseating tubercle. The favourite seat of tubercle in bone is the cancellous tissue of the long bones, especially in their articular ends, or in the carpus, tarsus, and bodies of the vertebræ. The changes which it produces in the bones lead either to caries (see **No. 1097**) or to necrosis. In the vast majority of cases it appears that the so-called "strumous" inflammation in bone is really tubercular in origin, although there appear to be a certain number of cases in which an osteitis is chronic, owing to the constitutional weakness of the patient, and in which no signs of tubercle ever present themselves.

Miliary tubercles in bone appear as small, roundish, semi-translucent bodies, resembling tubercles in other parts, and after they have undergone caseous changes, as yellowish deposits of cheesy-looking material infiltrating the trabecular spaces, in which condition it is often impossible to distinguish them from caseous masses of inflammatory

origin. Like the latter, they may undergo further changes leading to caries and necrosis.

Tubercles in bone, answering to this description, are undoubtedly but seldom seen, although this is probably in great part due to their presence being rarely sought for where they are most likely to be found, namely, in the sternum and ribs of subjects who have died with the constitutional disease known as "acute tuberculosis."

120.—Portions of a sternum and ribs. There is a large cavity in the sternum filled by tuberculous-looking matter. This cavity was closed in, both behind and in front, by a membrane, apparently the thickened periosteum, a part of which is now reflected. The tubercular material was probably produced either by the degeneration of miliary tubercles or by the caseation of inflammatory products.

SENILE TUBERCLE.

This affection of the bones occurs, as its name implies, in old people, and it is often called "senile struma." The patients have usually shown some symptoms of the tubercular diathesis during early life, but have apparently been cured. They frequently die of tubercular disease, implicating some of the organs. The disease presents the characteristics of tubercular disease of bone as it occurs in younger patients. When it attacks the carpal bones, it appears to give rise to necrosis more often than to caries, as is seen in the following preparation.

569a.—A portion of the forearm and hand from a man aged 58, prepared to show the great destruction of synovial membrane which has taken place as a result of tubercle of the carpus. The synovial membrane of the carpal articulations has everywhere undergone pulpy degeneration. The bones of both the proximal and distal rows of the carpus are as bare and denuded of cartilage as if they had undergone maceration—a condition which is very characteristic of this form of disease. Tubercle was found in the synovial membrane upon microscopical examination.

RICKETS.

Although rickets is generally described as a disease of the bones, it is in reality a constitutional affection of which the bone lesions, although an important, are by no means the only feature. Here, however, we are merely concerned with the affection as it manifests itself in the bones, and must refer the student for a full account of the disease to some of the various treatises on the subject.

The characteristic appearances of a bone affected with rickets are as follows: The periosteum is thickened, vascular, and adherent; the whole bone is softened, so that it can be readily bent (288a) or cut with a knife (No. 282); the lacunæ appear enlarged, the lamellæ separated, and the medulla and cancellous spaces filled with a red, gelatinous, pulpy material. The long bones are swollen where their shafts join the epiphyses (282); the cranial and other flat bones are generally thickened. The swelling at the epiphyses which is so marked a feature in rickets is in part due to the fact that the imperfectly formed new bone is softer than natural, and being compressed between the epiphysis on the one hand, and the diaphysis on the other, bulges at the circumference.

The above condition is the result of a defect in ossification. If the epiphysial line of a rickety bone be examined microscopically, it will be found that the layer of modified cartilage capsules is greatly increased in thickness, and no longer forms the straight transverse line seen in healthy epiphyses. Islets of cartilage surrounded by imperfectly ossified bone are found at considerable distances from the line of ossification, whilst the Haversian systems are badly developed, and in many places the fibrous tissue framework of the bone has failed to receive any deposit of calcium phosphate. As a result of these changes, a layer of spongy, ill-formed bone is produced (osteoid tissue of Virchow: microscopical cabinet, Nos. 4 and 5) under the periosteum, and at the junction of the shafts with the epiphyses. At the same time the re-

absorption of the normally-formed bone is taking place around the medullary cavity as in healthy growth, so that thus it comes to pass that the whole is replaced by the new ill-formed bone. While in their softened state the bones become variously bent and distorted, as will be presently described, the various curves and distortions which they assume doubtlessly depending in great part upon mechanical causes. When the disease ceases healthy osseous tissue is again formed, and the bones are consolidated in their bent and deformed condition. The adult bones are harder and stronger than normal, and their concavities are strengthened by buttresses of new bone, as is well seen in **Case F. 284** and **285**.

282.—A section (cut with a knife) of the femur of a rickety child, curved in consequence of the want of its natural hardness.

281.—Section of the femur and tibia of a child. The bones, which have become curved, have recovered their osseous texture and their inflexibility, but their curvature remains. See also **Case F. 287** and **288**.

DEFORMITIES OF THE BONES IN RICKETS.

The head.

The cranium is slightly enlarged, but appears larger than it really is in consequence of the arrested development of the bones of the face. The forehead is high, square, and prominent. The fontanelles remain open long after they should have closed. The bones of the cranium are generally thickened, soft and spongy, the thickening being especially apparent where ossification is still progressing; that is, along the line of the sutures. In some instances, however, the bones are not thickened, but are excessively thinned in circumscribed patches (see **268**), so that the brain may be simply covered by a thin membrane. This is the condition known as *craniotabes*. It is also met with in congenital syphilis and in chronic hydrocephalus (**Case D. 2521a**).

The teeth are developed late, or if they have been already formed, have a tendency to decay or fall out.

72.—Fragments of the upper part of a skull increased in thickness, said to have been obtained from a rickety patient.

The spine.

The spine commonly presents an increase of its normal curves. If the disease occurs whilst the child is still in arms, the curve assumes the posterior form (*kyphosis*: **Case A. 1111**), in consequence of the tendency of the head and upper part of the body to fall forward as the child is being nursed, and it is usually combined with a slight lateral deviation to the right from the child leaning against the mother's left breast, children being usually held with the left arm. When the disease occurs after the child can run alone, the normal lumbar curve is generally increased (*lordosis*). In advanced rickets more or less lateral curvature is always present, as is seen in the rickety dwarf (**Case B. 272**).

Case B. 272.—Skeleton of a woman, exhibiting lateral curvature in consequence of rickets.

Case B. 273.—The spine, pelvis, and lower extremities of a woman. The spine presents three lateral curvatures, the result of rickets.

Case C. 1117.—The spine and pelvis of a young person, exhibiting lateral curvature of the spine, probably from rickets.

Case C. 1126.—A spine, thorax, and pelvis. The spine in the dorsal region is curved with its convexity backwards and a little to the right.

The thorax.

The rickety thorax is characteristic; its transverse diameter is greatly diminished, and its antero-posterior greatly increased. This deformity, which generally goes by the name of pigeon-breast, is produced by the lateral yielding of the softened ribs to atmospheric pressure during inspiration, and the consequent thrusting forward of the sternum.

On either side, where the cartilages join the ribs, two

vertical depressions or grooves are generally observed, in consequence of the greater recession of the chest walls in these situations. The left groove is generally shallower than the right, in consequence of the support which the ribs receive from the heart; whilst the right, though deeper, does not extend so far downwards, on account of the support afforded by the liver. A slight transverse groove—Harrison's sulcus—is also frequently seen passing from the xiphoid cartilage over the attachment of the diaphragm. It is caused by the dragging of the diaphragm during inspiration upon the rickety and unnaturally softened ribs. The ribs, where they join the cartilages, are swollen, like the ends of the other long bones, giving rise to a characteristic knobbed appearance in this situation (see **No. 270**).

When much lateral curvature of the spine (the result of the rickets) coexists with deformity of the thorax, the characteristic appearances of the latter are partially obscured.

271a.—Portions of two ribs, with their costal cartilages, showing the "beading" or "rosary" characteristic of rickets.

Case B. 272.—The skeleton of an adult woman, exhibiting the effects of rickets. The typical shape of the thorax is here obscured by the coexisting lateral deviation of the spine.

Case C. 1126.—A spine, thorax, and pelvis. As there is but slight lateral deviation of the spine in this specimen, the thorax exhibits the deformity characteristic of rickets uncomplicated by that which always accompanies lateral curvature.

The pelvis.

The pelvis is generally flattened from before backwards, the symphysis pubis being approximated towards the sacrum, whilst the latter is pressed forwards and downwards, giving the pelvic inlet a characteristic hour-glass shape. In rarer instances the pelvis becomes more or less triangular from the approximation of the acetabula. The sacrum is flattened, and placed more horizontally than natural, whilst its apex, together with the coccyx, is curved sharply forwards; the iliac crests are everted, the tuber-

osities widely separated, and the pubic arch increased in width. In some instances the pelvis is asymmetrically distorted, probably the result of coexisting lateral curvature.

Case B. 275.—The pelvis and lower extremities of a middle-aged woman who had suffered from rickets. The cavity of the pelvis is contracted, especially on the left side, by the pressing in of the acetabulum; but the lower aperture of the pelvis is wide, the rami of the ischia being bent outwards and their tuberosities divergent.

Case C. 1126.—A spine, thorax, and pelvis. The pelvis is of nearly natural form and size, but its obliquity is lessened in consequence of the flattening of the sacrum; its antero-posterior diameter is rather diminished, while its transverse diameter is greatly increased. See also **Case E. 276 and 279.**

The long bones.

The long bones are usually found bent in the direction of their normal curves, their ends are somewhat swollen and nodular, and in length they are shorter than natural in consequence of the early coalescence of the epiphyses. The compact tissue of the shaft is thicker and more condensed than in health, especially along the concavity of the curves. The order in which the long bones are generally affected is : 1, bones of lower extremity; 2, the clavicle; 3, bones of upper extremity.

The bones of the lower extremity.—*The femora*, when the disease occurs before the child can run alone, are curved forwards from the weight of the legs bending down the softened bones across the nurse's arms. When the child can walk the weight of the body tends to increase the natural curves and the femora bend forwards and outwards. The neck of the femur becomes more horizontal than natural, but not shortened, and the shaft is flattened from side to side. The walls of the bone in the middle and along the concavity of the curve have a greater thickness than elsewhere; the linea aspera is very prominent, and often forms a straight line, representing, as it were, the chord of the arc

formed by the curved part of the shaft. The lower end is broad and flat.

The tibia and fibula are generally curved forwards and outwards in their lower thirds, and their shafts are flattened from side to side. In many of the following specimens, however, the tibia and fibula are curved forwards and inwards, and so form exceptions to the general rule.

The bones of the feet are turned inwards, so that the great toes sometimes almost touch each other, whilst the arch of the foot is lost.

Case F. 283.—A femur, tibia, and fibula from a child. They are all considerably curved from rickets, but have regained their natural firmness.

Case F. 287.—Section of the rickety femur of an adult. The shaft is greatly curved and laterally flattened, and the section shows that, as usual, the walls of the bone are much thicker on the concave than on the convex side of the curve.

Case F. 288.—The fibula of an adult. Its shaft is curved and flattened. The principal curve is directed with its convexity inwards; but there is also a slight curvature forwards in the upper part of the shaft.

See also **Case F. 284, 285, 286, 287a**; **Case B. 272, 273, 274.**

Rickety knock-knee is either the result of deficient growth of the external condyle, of excessive growth of the internal condyle, or of premature synostosis on the outer side of the epiphysial line. This condition, together with the characteristic forward and outward bend of the tibia in its lower part, is well seen in cast **No. 19a**. The same cast exhibits a certain amount of flat foot upon the right side, a deformity which is exceedingly common both in rickety knock-knee and in rickety tibiæ. See also casts **Nos. 2c** and **2d**.

The bones of the upper extremity.—*The clavicle* usually presents two curves, one beginning just externally to the insertion of the sterno-mastoid, the other a little internally to the acromial end. The first has its concavity looking downwards, and is caused by the weight of the arm; the

second has its concavity backward, and is produced by the backward pressure of the arms as the child crawls on its hands and knees (**Case B. 272**).

The humerus is generally curved with its convexity forwards; the curve is produced by the weight of the arm, which is unsupported below the insertion of the deltoid.

288a.—Sections of the humerus of a rickety child. The whole bone is extremely soft, and can readily be bent in any direction. The compact bone is thinner than natural, and is surrounded by thickened periosteum. At the centre of the shaft is a fracture, three weeks old, surrounded by a considerable deposit of callus.

This specimen illustrates the well known fact that rickety bones readily unite after fracture.

The radius and ulna are curved outwards.

Case B. 272.—See the clavicle, humerus, radius, and ulna in this specimen.

288b.—Part of a radius, to show the enlargement of the lower end, characteristic of rickets.

Having studied separately and in detail the characteristic deformities of the several bones, the student may now take a general survey of the whole rickety skeleton in the following specimen (**Case B. 272**).

SCURVY RICKETS.

Scurvy rickets is an acute affection of young children characterized by a sudden swelling in connection with the bones, and most usually with the femur. There is œdema and acute tenderness, with spongy gums in a certain proportion of cases. When the bones are examined after death, the swelling is found to be due to extravasations of blood beneath the periosteum. The disease is also known as “infantile scurvy” or “acute rickets.”

There is no specimen at present in the Museum.

ACROMEGALY.

This disease is characterized by a symmetrical enlargement of the bones of the hands and feet, as well as of those

of the head and face, where the nasal and inferior maxilla are chiefly affected. The disease is supposed to be associated with changes in the thyroid body.

There is no specimen at present in the Museum.

MOLLITIES OSSIUM.

Mollities ossium, or osteo-malacia, is a rare disease, characterized by softening of the bones through the re-absorption of their earthy salts and destruction of their osseous lamellæ. It is an affection of adult life, and generally occurs in females, especially during pregnancy. The bones of the trunk, and more particularly those of the pelvis, are first affected, but all the bones sooner or later participate in the disease.

In the early stages the bones retain their outward form, but are so soft that they can be cut with a knife. On section the medullary spaces, or, in the case of the long bones, the medullary canal also, are seen to be slightly enlarged, and filled with a soft gelatinous material, somewhat resembling spleen pulp. The veins of the medulla are said to be engorged and dilated. Later on the bones become still further softened and variously bent, broken, and deformed, while the osseous lamellæ in great part disappear, reducing the bone to little more than a thin shell enclosing a similar substance to that seen in the first stage, but mixed with a fatty-looking material.

On microscopic examination of small portions of the trabeculæ the decalcification is seen to begin around the Haversian canals and medullary spaces, the bone corpuscles in these parts having entirely disappeared, while in the centre of the trabeculæ they are still present. The material infiltrating the medulla is seen to consist of variously shaped cells and fatty material.

Another form of disease characterized by softening of the bones has been described as mollities ossium, and is what is commonly recognised by that name in this country. It

appears to consist of little more than fatty degeneration of the bones. The specimens of *mollities ossium* in the Museum appear to be examples of this latter form of disease.

289.—Section of a humerus which has been macerated from the same subject as the femur No. 293. The walls of the bone are thin, but of their natural hardness. The adipose substance filling the medullary cavity and cancellous texture is converted by maceration into a white firm substance resembling adipocere.

From a woman seventy-two years old who had been bed-ridden with paralysis of the lower extremities for nearly two years. Her hip and knee joints were fixed in permanent flexion. At short intervals before her death her right femur and right arm were fractured whilst she was being turned in bed.

289a.—Sections of the upper extremity of a right humerus. There is a large cavity in the head, which was filled with thin blood-stained fluid. The enlarged medullary canal contains a soft fatty material, which was yellow and red in the recent state. The wall of the bone is thinned, especially near the head.

293.—Section of a femur in which that change of structure has taken place which is usually denominated *mollities ossium*. The walls of the bone are very thin, and their substance so soft as to be readily divided by a knife. The osseous lamellæ and filaments are removed from the cancellous texture, and the medullary cavity and all the cells of the cancellous texture are filled with a *fatty* substance, which is now, after maceration and the action of alcohol, of the consistence of lard.

294.—Section of a femur affected with *mollities ossium*. The walls of the bone are thin, soft and flexible, and their lamellæ are partially separated. The place of its medullary and cancellous tissue is occupied by soft, jelly-like, transparent fat. A similar kind of fat appeared to be diffused through the proper texture of the walls. Scarcely any of the osseous part of the medullary texture remains, except a thin layer beneath the articular surface of the bone. The periosteum and articular cartilage are healthy.

295.—Sections of the upper part of the same femur, and of the patella of the same patient, macerated. The fat diffused through their whole tissue is converted into adipocere.

From a lady thirty years old. The disease had been some years in progress, and had affected in various degrees all the bones of the

extremities. This femur had been fractured by a slight force shortly before death.

Case E. 293a.—A portion of the thorax of an old person, showing the changes which result from osteomalacia.

From an old female subject brought for dissection.

Case E. 290.—A pelvis from a woman who was the subject of osteomalacia.

Compare this specimen and **Case E. 291** and **292**, in which the disease is less advanced, with the rickety pelvis in **Case E. 276** and **278**, and in **Case C. No. 1126**.

4.—NEW GROWTHS OR TUMOURS.

New growths in bone bear a general resemblance to those of soft parts. They have, however, a remarkable tendency to undergo ossification and to assume more or less the characters of true bone.

Bone, as we have seen, is built up of several distinct elements—fibrous tissue, cartilage, earthy particles, and medulla. Tumours of bone are composed of the same tissues as those which constitute the bone itself; hence, they may be fibrous, cartilaginous, osseous, marrow-like, etc. But it is only tumours of slow growth which resemble in structure the mature tissues of normal bone; those of rapid growth do not acquire the characters of the mature tissues, but permanently retain a cellular structure; the former are commonly innocent, the latter malignant.

LIPOMATA, OR FATTY TUMOURS.

These tumours are occasionally found as congenital malformations springing from the deeper layers of the periosteum of long bones. They may attain a very large size, and consist of ordinary adipose tissue, intermixed with a considerable proportion of fibrous tissue. An example of such a growth is seen in:

436a.—A large irregular fatty tumour, weighing fifteen ounces, and measuring six inches by five. The growth is divided into several lobes, which are held together by a little areolar tissue, but

it is only partially encapsuled. It is extremely firm, and consists of fat held together by trabeculæ of dense fibrous tissue. Microscopical examination confirms the naked-eye appearances, for the sections show collections of fat-cells separated by thick bundles of connective tissue. There is no muscular fibre in the growth, nor does it appear to be undergoing any degenerative change. The tumour grew from the periosteum of the femur of a boy aged nine years. It was attached by a firm broad base, which commenced just below the lesser trochanter, and extended downwards along the upper third of the left thigh on its outer aspect. Before removal the tumour was supposed to contain pus. It was probably congenital.

FIBROMATA OR FIBROUS TUMOURS.

Fibrous tumours of bone, except in the jaws, are rare. They have all the physical and microscopical characters of fibrous tumours of soft parts. They are described under tumours of the jaws, as there are no specimens of fibrous tumours of other bones in the Museum. (Nos. 434, 435, and 436.)

OSTEOMATA OR OSSEOUS TUMOURS.

The osteomata are tumour-like growths having the structure of true bone. They must be distinguished from those osseous formations which are the result of the ossification or calcification of other tumours, and from the node-like deposits of bone consequent upon inflammation. They are always innocent, generally of slow growth and of small size; occasionally, however, they may attain considerable dimensions.

The osseous tumours may be divided into the exostoses and diffused bony growths.

EXOSTOSES.

Exostoses are circumscribed outgrowths from the surface of a bone. They are usually divided into the cancellous or soft, and the compact or ivory. The former are more

common on the bones of the extremities, the latter on the bones of the skull. Osseous growths of a similar character, in rare instances, are met with projecting into the medullary canal. They are then called enostoses.

The cancellous or soft.

These are composed of cancellous surrounded by a thin layer of compact bone. They are commonly continuous with the cancellous and compact tissue of the bone from which they spring, and in most cases contain medulla. They are surrounded either by fibrous tissue continuous with the periosteum, or by a layer of cartilage, in which latter case they are by some regarded merely as ossifying enchondromata. When they spring from the ends of the long bones, they are probably outgrowths of the epiphysial cartilages. They are generally single, and are most often found upon the shafts of the long bones at spots where muscles are inserted. They are occasionally multiple.

Exostoses springing from the insertion of muscles.

Case G. 372.—The upper part of a femur, exhibiting a bony process of a pyramidal form continued from the trochanter minor. To the extremity of this bony process the tendon of the psoas and iliacus muscles is attached.

Case G. 373.—The upper part of a femur, exhibiting a bony process like the last described, which was connected with the trochanter minor by ligamentous substance.

380.—An exostosis growing from the inner and back part of the femur—the adductor tubercle. It is covered with a smooth layer of cartilage, which is itself invested by a thin layer of fibrous tissue. The cancellous tissue is filled with medulla. The exostosis was attached by a narrow base.

This is a very common situation for exostoses, and it should be remembered that they are here in close proximity to the synovial membrane of the knee-joint, which may be injured in removing them. Such an accident may best be prevented by flexing the leg on the thigh, whereby the

synovial membrane is drawn downwards and away from the tumour.

Case G. 384.—Portion of a femur with an exostosis attached by a long pedicle to the inner and front part of its shaft just above the internal condyle (adductor tubercle).

Case G. 369.—Exostosis of the humerus, which grew from the insertion of the pectoralis major.

Exostoses of the last phalanx of the great toe.

Exostoses of the last phalanx of the great toe are very common. They generally grow from the distal end of the phalanx and, in most cases, from the inner edge of its dorsal surface. As they increase in size they raise up the nail before them, as is well seen in 392, and in section in 393, but do not cause much pain except when pressed upon by the boot. They vary from the size of a pea to that of a Spanish nut. They are commonly surrounded by cartilage, occasionally by fibrous tissue. Although exceedingly hard, they are much less compact than those occurring on the cranium.

Nos. 389, 390 and 391 are good macerated specimens of exostoses of the last phalanx of the great toe, showing the situation and the structure of the growth. In 392 and 393 the soft parts with the nail are preserved to show the clinical features of the exostosis. From the specimens it may be gathered that it is rarely, if ever, necessary to amputate the last phalanx of the great toe, for the exostosis may always be removed by avulsion of the nail and the subsequent use of the bone-scissors and gouge.

Exostoses on other parts of the last phalanx of the big toe and on the phalanges of other toes are extremely rare. A specimen of exostosis on the last phalanx of the little toe follows.

394.—Section of the last phalanx of a little toe and of an exostosis which has grown from the middle and extremity of its dorsal surface, lifting up the nail. See also 395, the other section macerated and dried. The patient, from whom this specimen was taken, was a woman twenty-five years old. The tumour had been growing regularly, but with scarcely any pain, for two years.

Exostoses springing from parts of the bones other than those above mentioned.

376.—Section of femur, from the surface of which an osseous growth has arisen. The growth is flattened and elongated, and has pointed processes directed downwards. It consists of cancellous tissue surrounded by a thin shell of compact bone, and is attached by a broad base.

Case G. 374, 375 376, are similar instances of flattened exostoses springing from the diaphyses of long bones. They are attached by a broad base, and have a smooth convex surface. From the manner in which they overhang the bone, they are often called mushroom exostoses. When they are felt through the soft tissues during life they cause the bone to appear so much thickened that they are difficult to diagnose from osteitis and periostitis, on the one hand, and from endosteal sarcomata expanding the bone on the other. Their greater hardness and their slow growth, together with the absence of pain, are the chief points to be relied upon in the differential diagnosis.

Exostoses in other and rare situations are seen in 360a, 369, 377, and 386.

Multiple exostoses.

370 and 401.—Specimens of exostosis from a boy who had a number of symmetrical tumours. His father had likewise this disease. See also **Case G. 383** for multiple exostoses on the femur.

404, 405, 406.—Specimens of multiple exostoses in dogs.

The compact or ivory.

These are composed of compact bone, commonly intermixed with a small proportion of cancellous tissue, which is, however, more closely set than ordinarily. The compact bone is much harder than natural, and the Haversian canals, lacunæ, and canaliculi are smaller, fewer in number, and more irregularly placed. These exostoses are rare, except in connection with the bones of the skull; they are exceedingly hard, ivory-like and compact, and of slow growth. They occur in two forms, one as small, lens-shaped outgrowths from the outer table, with broad or pedunculated

bases; the other as nodular masses springing from the diploë. The latter often attain a large size and project into the frontal sinuses, causing great displacement of the soft parts. Ivory exostoses are extremely difficult to remove by the ordinary operative measures, and it is, therefore, better to let them alone.

358.—An ivory exostosis growing from the lower and back part of the parietal bone. It is attached by the central portion of its base only. See also No. 396.

359.—Sections of an occipital bone to the lower part of which an ivory exostosis is attached by a narrow base. The outer part of the growth is smooth and very dense; within, it is in part cancellous and in part nearly as dense as ivory. Its textures have coalesced with those of the outer table and diploë of the skull.

Excellent specimens of ivory exostoses *in situ* are seen in No. 362 and Case G. 361.

Case G. 360.—Section of a skull, exhibiting a small ivory-like exostosis with a narrow base growing from the outer table of the frontal bone just above the external angular process.

DIFFUSED OSSEOUS GROWTHS.

These are defined by Sir James Paget as “tumour-like in the most prominent parts, and yet unlike tumours in that their bases of connection with the bones are very ill defined, and that from their bases the morbid changes in which they originated extend outwards on the same or even to other bones, gradually subsiding.”

They are composed of finely cancellated bone, more compact than the cancellous exostoses, but less compact than the ivory. They generally begin in the walls of the antrum, and grow inwards until that cavity is completely filled. They also frequently occur at the same time upon the outer surface of the superior maxillary bone, and upon the septum and side walls of the nose; they are sometimes symmetrical, as in Mr. Langstaff's case (No. 397), and occasionally perish and separate, presenting the ordinary phenomena of necrosis.

397.—Section of the bones of the face, exhibiting an osseous growth which nearly fills up the antra. The sections through the antra open to view a small cavity in each. This cavity indicates, as does also the disease of the adjacent bone, that obliteration is the consequence, not of the growth of new distinct tumours into them, but of the thickening of their walls. The new bone by which they are increased in thickness is hard, nearly solid, and heavy; it is almost all formed on their inner surfaces, and only a few small but similar growths are elevated on their outer surfaces and project on the face and into one of the orbits. The septum nasi and spongy bones are similarly thickened, enlarged, and very dense in their texture.

398.—A superior maxillary bone in which the cavity of the antrum is completely filled by a growth similar to that in the foregoing specimen. As in the former case, the new growth has taken place principally from the inner surface of the walls of the antrum, but in this specimen the disease has advanced a stage further, and the whole cavity is obliterated. All the external surface of the maxillary bone is superficially tuberculated and porous, its walls being changed into bone of the same texture as that which occupies the place of the antrum. The disease is attended with general but irregular enlargement of the maxillary bone; its alveolar portion alone retains a nearly natural form. See also 399 and 400a.

ENCHONDROMATA OR CARTILAGINOUS TUMOURS.

Cartilaginous tumours of bone are most frequently met with in the bones of the hand, somewhat less frequently in the contiguous ends of the femur and tibia, and still less frequently in other bones.

They commonly occur as one or more circumscribed spherical masses of cartilage in the interior of the bone, or as irregular, lobulated growths beneath the periosteum; in rare instances they grow both within and without the bone at the same time. They are composed either of a single mass of cartilage without visible partitions, or of numerous small clustered masses bound together by connective tissue and blood-vessels. They are usually exceedingly hard and firm, occasionally soft and compressible, generally of slow

growth, and of small or moderate dimensions, but they may grow with great rapidity and attain a large size. They are nearly always innocent, simply displacing surrounding structures, not infiltrating them; in rare instances, however, secondary growths have been found in distant organs.

On section they appear translucent, bluish-gray or pinkish-white, homogeneous or coarsely granular, and frequently mapped out into irregular lobules. The cartilage is usually of the hyaline variety, but all gradations between hyaline cartilage and mucoid tissue occur. In the rapidly growing tumours sarcomatous elements have also been found, the presence of which probably accounts for their occasional malignancy. They are liable to undergo ossification, calcification, mucoid and fatty degeneration; cysts are likewise frequently found in them. Exostoses surrounded by a layer of cartilage, although described as osteomata, are by many regarded as ossifying cartilaginous tumours.

The peculiarities presented by cartilaginous tumours occurring in different bones and in different situations in these bones may be studied under the following heads:

In the bones of the hand.

Cartilaginous tumours in the hand are always confined to the metacarpal bones and phalanges. They generally affect several fingers at the same time, and two tumours frequently occur in the same bone. They usually begin in the medulla near the articular ends. As they grow they expand the bone around them, and at length, perforating the bony shell, project as nodulated tumours upon its surface. The integument, at first tightly stretched over them, may subsequently ulcerate from their pressure. By the coalescence of several of these tumours large masses are sometimes formed in which two or more fingers become completely buried and indistinguishable from each other. When a single tumour occurs upon the bones of the hand, it begins outside the

bone, thus resembling those that grow about the articular ends of the long bones.

Cartilaginous tumours in the bones of the hand rarely undergo ossification; they more often undergo calcification. They nearly always occur in the young, are often congenital, generally of slow growth, and always innocent.

416.—Sections of a little finger and of the metacarpal bone of the forefinger of a lad seventeen years old. The greater part of the cancellous tissue of the shaft of the metacarpal bone is filled with a minutely lobed, pale grayish mass of cartilage like that of the foetal skeleton, which also, projecting through an absorbed portion of the wall, forms an hemispherical tumour rising from the shaft. A similar growth of cartilage exists within, and projects as a tumour beyond the first phalanx of the little finger; but in this instance the wall of the bone is not penetrated by the cartilage, but has grown in a thin layer around it. A portion of the medullary canal of the second phalanx of this finger contains a similar growth of cartilage, but scarcely any external tumour or enlargement of the bone is observable.

The patient had on his left hand four, and on his right hand six, similar tumours, but these alone were troublesome and increasing. The tumours had begun to grow when he was five years old, and their growth had been irregular, some increasing, while others remained stationary.

414.—The right hand of a lad fourteen years old, in the bones of which are numerous cartilaginous tumours like those in the preceding specimen. In many of them are small scattered formations of cancellous bone with medulla; all of them appear to have grown within the several bones, expanding parts of their walls and periosteum into their osseous and fibrous investments. See also 415.

The tumours had been growing without any known cause from early childhood till the finger and hand were amputated.

412 is a hand which has been completely destroyed by the growth of multiple cartilaginous tumours. The enchondromata have fused in their growth to form a huge mass in which the individual digits are completely lost, and by which the tendons, vessels and nerves have been wholly destroyed. The method in which this huge mass of new growth has been formed is seen in 413 and 414, which represent an earlier stage in the same disease.

In the articular ends of long bones.

Cartilaginous tumours of the articular ends of the long bones nearly always begin between the periosteum and the bone, and although they border upon the articular cartilage, do not arise from or encroach upon it. Their general shape is spherical, and their composition is like that of ordinary hyaline cartilage. They frequently contain sarcomatous elements. The layer of compact bone in contact with the tumour becomes eroded and cancellous, and ossification of the tumour then takes place in the form of osseous spicula growing out from the surface of the bone; ossification also begins in distinct centres in the mass of the tumour. Cystic degeneration is common. These tumours often grow rapidly and attain a large size; the integuments over them are apt to slough. They generally occur in the young.

425.—Section of a tibia and of a large cartilaginous tumour surrounding its upper two-thirds. The tumour is seated entirely between the bone and the extended periosteum; the continuity of the periosteum with the investment of the tumour is distinct at the lower part. At its upper part portions of cancellous bone are embedded in it, and portions of similar bone have grown into most of those parts of the tumour which are in contact with the surface of the tibia. A large cavity within the tumour is irregularly bounded by nodules of its cartilage and by a coarse network of fibrous bands, the remains of partitions between portions of the tumour, whose softening probably led to the formation of the cavity. All the tissues bounding the cavity appeared, in the recent state, to be soft, flocculent and sloughing, and it was filled with brownish-yellow, putrid, and decomposing fluid. The general shape of the tumour is spheroidal; its weight is twenty-four pounds.

The patient was a girl fourteen years old. The tumour had been growing for eighteen months.

244.—Section of a tibia and of a large cartilaginous tumour which has formed around its upper third. One half the tumour, the vessels of which have freely received the injection, is of a soft, fleshy, vascular texture (probably sarcomatous). The internal part of the tibia is sound. See also 422 and 423.

In the middle of the shaft of long bones.

Cartilaginous tumours in this situation are rare. They begin as distinct masses simultaneously within the medullary canal, and outside the shaft between the periosteum and the bone. As they enlarge, the bone between them becomes absorbed, and they finally coalesce into one large tumour. In structure they partake more of the character of the fibrous than of the ordinary hyaline cartilage.

418.—Section of a femur with a large spheroidal tumour which has formed within and around it. In the upper part of the bone a fracture occurred several years before death. The two portions of bone overlapping have firmly united. The tumour, which nearly surrounds the middle of the shaft, is composed of a firm substance like fibro-cartilage. A portion of the same substance occupies the corresponding part of the medullary cavity, in which the disease apparently commenced.

The microscopical characters are those of fibro-cartilage. A section of the tumour with drawing is contained in the Microscopical Cabinet, No. 9.

419.—The other half of the above specimen, dry.

In the cranial, facial, and pelvic bones, ribs, and vertebræ.

Cartilaginous tumours of these bones generally spring from the deeper layers of the periosteum. They have a remarkable tendency to spread in all directions, causing great destruction of adjacent parts.

In the facial bones.

1773.—Section of a large tumour formed on the face of a lad fourteen years old. The greater part of it occupies the situation of the superior maxillary bones, which are completely absorbed. Above, the tumour has extended through the left side of the base of the skull into its cavity, where it forms a large projection in the situation of the anterior lobes of the cerebrum; below, it is united to the soft palate; in front, it protrudes and distends the left nostril, and has caused the ulceration of a part of the integuments of the face. The outer surface of the tumour is nodulated; its interior, shown by the section, is formed of close-set nodules and

masses of cartilage, partially and irregularly ossified, and in some parts intersected by layers of a softer, probably fibrous, tissue. A portion of its external surface, projecting below the left nostril, has sloughed. See also No. 1774.

In the pelvic bones.

429.—Section of a cartilaginous tumour which was connected with an os innominatum. The remaining part of it, consisting principally of bone, is mounted on a stand in Case G. 428.

In the ribs.

409.—A cartilaginous tumour springing from a rib and making its way into the chest and vertebral canal through the intervertebral foramen.

SARCOMA.

Sarcomata of bone are divisible into periosteal and endosteal. They have the same structure as those of soft parts, viz., embryonic tissue in various stages of development. The three varieties of sarcomata, the round-celled, the spindle-celled, and the myeloid, occur in bone, the two former generally in connection with the periosteum, the latter with the medulla. These varieties, however, may be modified, as in soft parts, by the admixture of fibrous tissue, cartilage, mucous tissue, pigment or bone; and, according as these several tissues predominate, the tumour is designated fibro-, chondro-, myxo-, melanotic- or osteo-sarcoma; when cysts are developed, cystic-sarcoma. Some of these will be more particularly referred to below.

PERIOSTEAL SARCOMATA.

The periosteal sarcomata are either round, mixed, or spindle-celled. They spring from the deeper layers of the periosteum, and as they increase in size carry the superficial layers before them, and at length, perforating them, make their way into the connective-tissue between the muscles and other adjacent soft parts. At the same time they generally invade the bone, infiltrating and dilating the

Haversian canals, and so converting the compact tissue into cancellous. Occasionally, however, they merely indent, but do not infiltrate the bone. In appearance they are whitish or cream-coloured, often blotched with red from rupture of their vessels and extravasation of blood; yellow patches are also seen here and there, due either to fatty degeneration of the sarcomatous elements or to the breaking down of blood-clots. If these changes proceed further, cysts may be formed; these cysts are at times lined with epithelium.

In consistency the tumours are either tough, hard, and fibrous, or soft, gelatinous, and brain-like, but they may present all gradations between these conditions. The round-celled sarcomata are more rapid in their growth than either the spindle or the mixed-celled form, and are generally softer and more malignant. A microscopical examination, however, is necessary to distinguish the round from the spindle or mixed-celled forms. In sarcomata the neighbouring glands are not usually affected. When these tumours undergo calcification or ossification, the earthy particles may proceed both from the periosteum and the surface of the bone. Ossification more generally occurs in those of slow, calcification in those of rapid growth; the ossific deposit resembles imperfectly formed bone. Periosteal sarcomata, except in the humerus, usually spring from the articular ends of the long bones; they often recur after amputation in the bone next above, and not in the stump.

Periosteal round-celled sarcomata.

438a.—A portion of the spinal column, showing a mass of sarcoma tissue. The growth arises from the laminæ of the sixth, seventh, and eighth dorsal vertebræ, and extended outwards amongst the muscles of the back for about an inch and a half on the right side. Microscopically, the tumour was found to be a round-celled sarcoma.

From a lighterman, aged eighteen, who was admitted to the Victoria Park Hospital for aortic valvular disease. Whilst he was in the hospital he suddenly became paraplegic. He suffered some pain, which was at first localized to the chest, and the paralysis did not

extend upwards. The paraplegia was diagnosed as being the effect of pressure upon the cord. An acute bed sore developed forty-eight hours after the attack of paraplegia. The total duration of the growth of the tumour appears to have been about six months. At the autopsy the spinal cord, where it was invaded by the growth, was found to be very much softened. The membranes were unduly adherent to the bone, and were a little thickened. On removing the thoracic organs, the growth was seen to have extended from the spine into the thorax. See also 517a.

Periosteal mixed-celled sarcoma.

454a.—A section of the right foot, showing a sarcomatous growth springing from beneath the periosteum of the bones of the tarsus. The growth is large, and, as usual, not circumscribed; it extends through the deeper tissues of the foot, and has involved the skin of the sole, where it presents as a fungating mass. Microscopically it is a spindle and oval celled sarcoma, with a hyaline matrix and many hæmorrhages.

From a woman, aged forty-two. The swelling was first noticed seven months before the amputation was performed.

446a.—A section of the left humerus, showing a sub-periosteal sarcoma springing from the lower third of the shaft. The growth is well circumscribed, and is very firm. It has caused considerable absorption of the posterior wall of the shaft, but as compensatory thickening of the bone has occurred, there is no weakening of the shaft. Microscopically the growth is a mixed-celled sarcoma, in the substance of which much blood has been extravasated.

From a man aged thirty-one, who had noticed the swelling for two years. A rapid increase in the size of the growth took place after a fall upon it, which occurred a year before the amputation was performed.

A microscopical section is preserved in Series lv., No. 14a. The scapula from the same case is preserved in the next specimen.

Periosteal spindle-celled sarcomata.

446b.—Section through a scapula from which a large sarcoma is growing. The tumour springs from the periosteum covering the infra-spinous fossa; it has infiltrated and destroyed almost the whole of the infra-spinatus muscle, and it surrounds the outer portion of the clavicle.

From a man aged thirty-three, whose left humerus (preserved as

No. 446a) had been amputated at the shoulder twenty-seven months previously, on account of a sub-periosteal sarcoma growing in its lower third. There was no recurrence in the scar until three months before the scapula was removed. The patient made a good recovery.

446c.—A section of a left humerus showing a periosteal sarcoma. The growth is pyriform in shape, and surrounds the upper two-thirds of the shaft. The whole diaphysis is infiltrated with the growth from the upper epiphysis to within an inch and a half of the lower epiphysis. The upper epiphysis forms a sharp line of demarcation, which limits the growth in its upward direction.

From a boy aged fourteen, in whom the growth had been noticed for three months. The arm was amputated at the shoulder-joint, but before the wound had healed the scapula became affected. The scapula and an inch of the clavicle were therefore removed, and the patient made a good recovery. The recurrent growth in the scapula is preserved in No. 446d.

448.—Section of a femur and of a tumour surrounding the lower part of its shaft. The tumour consists principally of spindle cells intermixed with fibro-cartilage, with spicula of bone dispersed through it. At its posterior part are some thick-walled membranous cysts which were filled with coagulated blood. The injection of the limb has displayed minute vessels distributed irregularly through the tumour. The walls of the femur enclosed within the tumour are diseased, softened, and thinned to the extent of about two inches, and in this situation the shaft is broken, and the cancellous tissue is filled by a morbid structure similar to that which surrounds the bone. A section of the tumour, with a drawing, is contained in the Microscopical Cabinet (No. 22).

ENDOSTEAL SARCOMATA.

An endosteal sarcoma springs from the deeper layers of the endosteum, usually near the articular ends of the long bones. The tumour grows slowly, and causes expansion of the bone until it may form no more than a shell; this eventually gives way, and the tumour then commences to grow more rapidly, and behaves like a periosteal sarcoma. Endosteal sarcomata rarely affect the articular cartilages. Spontaneous fracture may occur as a result of their growth, as in 475a.

453. --Section of a tumour and of part of a tibia. The tumour occupies the situation of the head and the upper third of the shaft of the tibia. It apparently originated in the interior of the bone, and distended the wall around it as it grew. At the upper part the articular surfaces of the tibia and the ligamentum patellæ may be recognised. The tumour consists in part of a white, solid, and very firm substance, and in part of a more vascular and spongy substance, in which there are large cysts that were filled by a gelatinous fluid. From a man, aged forty. The limb was removed by operation. A section of the tumour, with drawing, is contained in the Microscopical Cabinet (No. 25).

The patient was twenty-two years old, an opera-dancer, and the disease had existed about seven months. The tumour grew rapidly and with much pain. He died shortly after amputation of the limb, and no other part was found diseased.

475a.—A portion of the shaft of a femur excavated by the growth of an endosteal sarcoma. The femur is hollowed out into a conical cavity, filled by the firm tapering mass of new growth. At its upper part the bone has been sawn across at a point immediately below the great trochanter, whilst the lower portion has sustained an irregular transverse fracture. The medullary canal is closed by a deposit of sclerosed bone, except at its centre, where the new growth has caused absorption. At one spot the shaft of the femur is thickened so as to form an oval swelling. Microscopically the new growth is a fibro-sarcoma, which is in places undergoing calcification. No myeloid cells were found.

The patient, a gentleman aged twenty-eight, had suffered pain in his right thigh for four months. On examination a tumour was discovered in the long axis of the femur. Shortly afterwards, whilst turning in bed, the femur broke. Amputation was performed, and the patient made a good recovery.

475b.—A section of the head and upper portion of the shaft of the femur. The medullary cavity of the shaft and neck nearly up to the epiphysis is infiltrated by a new growth. At the lowest part of the femur the growth has extended beyond the bony wall, invading the surrounding muscle and connective-tissue, and in parts has ulcerated, so as to leave an irregular cavity. Microscopically the growth is a spindle-celled sarcoma.

From the same case as the preceding (No. 475a). Disarticulation of the head of the femur was performed seventeen months after the amputation in the middle third of the thigh. The patient died

of secondary deposits in the glands five months after the second operation. A microscopic specimen is preserved in Series *lv.*, No. 21b. See also 441b.

THE MYELOID SARCOMATA.

The myeloid sarcomata are a variety of the endosteal sarcomata. They are the myeloid tumours of Paget, and were so called because their minute structure resembles that of marrow. They nearly always begin in the medulla, rarely between the periosteum and the bone. Their favourite seats are the articular ends of long bones and the upper and lower jaws. When they begin in the medulla they expand the bone around them, often rendering it so thin that it gives the sensation of egg-shell-like crackling to the touch; or they completely destroy it in places, so that they are covered only by the periosteum. They are usually of an ovoid or spheroidal shape, or more rarely, as when they begin between the periosteum and the bone, irregular and lobed. They vary from a firm or fleshy to a soft or jelly-like consistency. They are neither elastic nor tough. On section they appear uniformly smooth, succulent, shining, semi-translucent, but not fibrillated. In colour they vary from greenish-white to livid crimson blotched with brighter patches of pink or darker red. They are soft and dry, not yielding any milky juice like cancers. Although usually but moderately vascular, they sometimes pulsate, this pulsation being communicated to them by the arteries of the bone in which they lie. Masses of cartilage are frequently found in them, but ossification is rare. Cysts also occur with great frequency, and often attain a large size. They are generally of slow growth and non-malignant; after removal, however, they have been followed by the more malignant forms of sarcomata.

Under the microscope a number of large, multi-nucleated cells (myeloid) are seen scattered through a basis substance which is composed in great part of spindle cells and of a less number of small round cells.

Myeloid tumours in the ends of long bones.

The ends of the bones forming the knee-joint are those most frequently affected, and of these the lower end of the femur rather than the upper end of the tibia. Beginning in the cancellous tissue, the tumour expands the bone around it, destroying the lamellæ and so hollowing out the articular extremity into a thin-walled cyst. In some instances, however, more or fewer of the lamellæ may escape destruction, and then the cyst-like expansion has a multilocular appearance. By the older pathologists the former condition was called "*Spina ventosa*," the latter "*malignant exostosis*;" these terms are, however, obsolete. Sooner or later the expanded bone gives way, and the tumour, thus released from the restraining influence of its bony case, sprouts out into the soft tissues, where it grows with increased rapidity, and finally reaching the skin, sets up ulceration and protrudes in the form of a fungous mass, as in **No. 473**.

The articular cartilage is seldom involved in the disease, but appears sunken, as it were, into the substance of the tumour, a condition in part due to the growing up of the sarcomata around the cartilage, and in part to the actual sinking of the cartilage from the yielding of the tumour to the superincumbent weight of the body, the supporting bony trabeculæ having been destroyed.

Mucoid degeneration and hæmorrhages, leading to the formation of cysts, are common, but calcification and ossification are rare.

Recurrent growths after the removal of a myeloid sarcoma are not common, but when they do occur they are not usually myeloid like the primary tumour, but may be composed of any other variety of sarcomatous tissue. Thus, **No. 463** is a specimen of a spindle-celled sarcoma which recurred in the axillary glands of a patient from whom the head of the humerus was removed because it was invaded by a myeloid sarcoma.

467.—Sections of the lower part of a fibula, with the tibia and

astragalus. The walls and periosteum of the lower end of the fibula, including the malleolus, are distended into a thin osseous and fibrous capsule by the internal growth of a myeloid tumour. The tumour contained much cartilage, grew slowly, and pulsated distinctly.

468.—A section of the upper part of a tibia, and of a large myeloid tumour which has formed within it. The tumour consists partly of a soft brown, fibrous-looking substance, and partly of coagulated blood, and there are some small cysts in it. A thin crust of the expanded walls of the bone surrounds the tumour. Upon the upper part of the tumour, in the articular surface of the tibia, there is a deep excavation, which lodged one of the condyles of the femur. A section of the tumour, with drawing, is contained in the Microscopical Cabinet (No. 34).

471.—Section of the upper part of a tibia, within the head of which a nearly spherical tumour, about four inches in diameter, has grown. The greater part of the substance of the bone has wasted during the growth of the tumour, round which its remains are distended into a thin cyst of bone and periosteum. The articular surface is unchanged, but almost all of the layer of bone beneath the cartilage is absorbed. The chief part of the tumour consists of close-set thin-walled cysts, the cavities of which were filled with bloody fluid. Other parts around and between the cysts consist of soft opaque-white, brownish, and yellow substance, variously tinged with blood. A few bands and thin plates of bone traverse the space thus filled with cysts and solid growth. The upper part of the shaft of the tibia, immediately below the part which is extended round the growth, appears to be healthy.

The microscopic structures in the solid parts of the tumour, and in the walls of many of the cysts, were chiefly multi-nucleated cells, like those characteristic of myeloid tumours.

The patient was a woman twenty-four years old. The first sign of the disease was severe pain in the head of the tibia. This was observed eighteen months before the removal of the limb, and after it had existed ten months a swelling appeared. The swelling rapidly increased, the pain rather diminished, but the limb became constantly more feeble and unequal to the support of the body. Recovery followed amputation.

472.—Section of the lower part of a tibia, and of a tumour contained within it. The tumour consists of a brain-like medullary substance with blotches of blood effused in it, and is almost com-

pletely surrounded by a thick osseous cyst, which is continuous with the wall of the tibia. The arteries of the limb are injected; some of their branches pass through the morbid growth. A section of the tumour, with drawing, is contained in the Microscopical Cabinet (No. 35). See also Nos. 465 and 466.

529.—Portion of a femur, of which the lower extremity is expanded into a large cyst, which was filled by liquid and coagulated blood and a small quantity of brain-like substance. Below, the cyst is bounded by the articular cartilage, of which the texture is unaltered; above, by the shaft of the femur, which terminates abruptly just before it is expanded into the cyst.

From a gentleman thirty years of age, in whom the tumour had been two years in progress. Four years after the amputation of the limb he was in good health.

Myeloid tumours of the jaws.

457.—Section of the anterior part of a lower jaw, and of a myeloid tumour formed within it.

458.—Myeloid tumour of the upper jaw.

Other specimens of myeloid tumours will be found described in the section on diseases of the jaws.

Myeloid tumour of the skull.

455.—Portion of the upper part of a boy's skull, and of a large myeloid tumour involving it and pressing inwards upon the brain. The section was made transversely from ear to ear through the skull, tumour, and brain. 456.—The other half of the specimen.

MELANOTIC SARCOMATA.

Melanotic or pigmented sarcomata are rare in the bones. The three following specimens, however, are examples:

483.—Sections of lumbar vertebræ with melanotic sarcomata scattered through the cancellous texture of their bodies.

484.—Sections of a rib with melanotic matter in its interior.

485.—Portions of a parietal and a frontal bone, displaying the deposition of melanotic material in the diploë. In all these specimens the melanotic matter is deposited in circumscribed spots, like so much black pigment, in the bones. It does not form tumours, nor does the tissue of the bone in which it lies appear at all altered.

The three preceding specimens were taken from a woman in whom melanotic matter was abundantly found in various parts of the body—the lungs, liver, ovaries, mammary gland, dura mater, and other tissues.

Cases like the preceding were formerly called melanotic cancers.

SECONDARY CHANGES OCCURRING IN SARCOMATA.

Various secondary changes occur in connection with the growth of sarcomata. The commonest of these is the deposit of earthy matter in them, when they are called ossifying or calcifying sarcomata (480a), or the formation of fibrous tissue (475a). The ossifying periosteal sarcomata frequently have well-marked secondary deposits in the lungs (1728b). As a result of the rapid growth of sarcomatous elements, necrosis of portions of the cancellous tissue of the bone occasionally occurs (450).

Many of the growths formerly called osteoid cancer were probably osteo-sarcomata.

477.—Section of a femur, of which the lower half is surrounded by an ossifying sarcoma. The tumour extended around the whole circumference of the femur. It has an elongated form, is thin where it abuts on the articular margin of the bone, but in the rest of its extent rises to between two and three inches from the surface of the shaft. The periosteum appears to be involved in the tumour, and the popliteal artery and vein run through it near its surface. The walls of the femur appear thickened and hardened, and large portions of morbid substance, like that which forms the tumour external to the walls, exist in the cancellous tissue and medullary canal. The greater part of the substance of the growth, both without and within the walls of the bone, consists of a very firm, dense, and compact tissue, pale yellowish, and obscurely fibrous; that part which is attached to the femur is chiefly osseous, its tissue having peculiarities which are better shown in the following specimen. The outer surface of the tumour is unequal and knobbed, and a few portions of similar substance lie adjacent to, but distinct from, the chief mass. Microscopically the tumour appears to be of the nature of an ossifying round-celled sarcoma intermixed with fibrous tissue and cartilage. A section of the

tumour, with drawing, is contained in the Microscopical Cabinet (No. 38).

478.—The other section of the same femur dried after maceration.

The preceding specimen was taken from a man forty-five years old, of unhealthy aspect.

476.—The femoral artery, together with several bony tumours which occupied the situation of the lymphatic glands in the ham and groin of the patient from whom the ossifying sarcoma, seen in Nos. 474 and 475, were taken. The tumours consist of a hard osseous substance, which is displayed by a section of one of them. The femoral artery is sound, but its popliteal portion is compressed and altered in its course by its connection with the bony tumour. The ligature upon the artery, about three inches below the origin of the profunda, was placed around it in consequence of the tumour in the ham having a pulsation and other characters like those of an aneurysm. The patient was a man, thirty years old. A section of one of the tumours, with drawing, is contained in the Microscopical Cabinet (No. 37).

Such secondary ossifying sarcomata infiltrating the femoral glands are not uncommon in some forms of ossifying sarcomata occurring in the bones of the lower extremity. This, it will be noticed, is an exception to the general rule, that sarcomata do not affect the neighbouring lymphatic glands.

CANCER.

Cancer never originates in bone. It is always secondary, and it always commences in the medulla or cancellous tissue. All varieties of cancer occur secondarily in bone.

SECONDARY MEDULLARY CANCER.

The medullary or encephaloid is a not uncommon variety of secondary cancer in bone.

508.—Section of a tibia and of a firm, white medullary cancer, which covers a large part of the anterior surface, and nearly encompasses the rest of the shaft. Portions of the growth extending through the front wall are continuous with a similar growth occupying the medullary canal and protrude through the posterior

wall. A section of the tumour, with drawing, is contained in the Microscopical Cabinet (No. 47).

507.—The upper half of a femur, round a portion of which a thin, flat, nodulated, medullary growth, of a soft, spongy, and obscurely-fibrous texture formed. The shaft at the part enclosed by the diseased structure was broken by a slight force. Its texture at this part appears soft, and is perforated by many small apertures.

From a woman, forty-three years old, whose right breast had been removed, with a medullary tumour in it, three months before death. A section of the tumour, with drawing, is contained in the Microscopical Cabinet (No. 45). See also 500a.

SECONDARY SCIRRHUS, OR HARD CANCER.

As a secondary affection, scirrhus cancer in bone assumes two forms, the infiltrating and the nodular. In the former the cancer is disseminated through the cancellous tissue and compact walls of the bone, and as it grows expands the lamellæ and converts the bone into a fine network of bony plates or spicula.

The nodular variety occurs in distinctly circumscribed, round or oval masses, which, as they enlarge, destroy and ultimately make their way through the wall of the bone. Whether nodular or infiltrating in form, the cancer appears hard, gray and shining, markedly resembling scirrhus of the breast. Fractures of bones thus affected are common; the callus produced for their repair is composed of cancerous elements.

The infiltrating variety.

556.—The upper part of a femur, in which an oblique fracture, about an inch below the lesser trochanter, has united with an angular deformity, the superior portion lying behind and across the inferior one. In the upper portion, in the place of the natural structure of the walls of the femur, there is only a fine network of bony plates and fibres; and the osseous part of the medullary portion is formed of fine spongy and porous bone. The same change has taken place, though to a less degree, in the lower part.

The diseased portions of bone, as well as the bond of union of the fracture, were filled, as if infiltrated, with tough, gray, cancerous matter.

The patient was a woman forty-seven years old. Two years before death her breast was removed on account of hard cancer. Sixteen months afterwards, when the disease in the breast had returned and ulcerated, in stepping from a cabriolet, she fractured her femur. The fracture was united in six weeks, but she did not regain the use of the limb. She died eight months after the fracture with extension of the cancerous disease of the breast.

The nodular variety.

510.—Sections of the humerus of a man who died with scirrhus cancer of the mammary gland. Large portions of the medullary cavity are filled with a compact, very firm, grayish substance, like that of the common form of scirrhus cancer. Where this substance has developed the medulla and the cancellous bone of the interior of the humerus have completely disappeared. The walls of the bone are also in some parts thinned, and in some parts destroyed and penetrated by the cancerous substance growing within them. The bone immediately bounding the cancerous substance appears healthy, and the borders of all the cancerous masses are well defined.

The patient was a strong, muscular man, in whom a hard cancer of the breast appeared twelve months before death. In the last two months of his life both humeri were fractured by slight force. Cancerous disease, like that here shown, existed in the sternum and in several dorsal vertebræ preserved in 1131. See also 510a.

SQUAMOUS-CELLED EPITHELIAL CANCER.

Secondary growths of squamous-celled epithelioma, due to the extension of the disease from the soft parts to the bone, are not uncommon. The cancer, commonly the result of long-continued ulceration of the soft parts or irritation of a sequestrum, invades the bone through the Haversian canals, dilating the medullary spaces and reducing the trabeculæ to irregular spicula of bone, which afterwards appear embedded in the substance of the cancerous mass. The cutaneous surface of the growth either

appears as a sprouting fungus or as a cavernous ulcer emitting a foul discharge.

Epithelioma of bone, like epithelioma of other parts, does not, as a rule, affect internal organs.

486.—Section of a leg, exhibiting a growth of soft, vascular, warty fungus from its front part. The base of the growth is consolidated with the periosteum, which for some distance above and below has become soft and spongy and has its connections with the bone loosened. The bone itself is healthy, except that there has been an irregular ulceration of its external surface.

488.—Section of a tibia, with the soft parts covering it, exhibiting the effects of epitheliomatous ulceration. The section was made longitudinally through the middle of the tibia; the other half of the tibia and the fibula are preserved in 489. By viewing the two preparations together, it will be seen that the ulcerative process has extended completely through the body of the tibia, in a great part of its length, and has reached the fibula, as is evinced by the peculiar excavated appearance of its surface. No attempt has been made to restore the lost bone: there is merely a slight deposit of bony matter upon the surface of the fibula, opposite to that which is in process of ulceration. The interosseous ligament is in part converted into bone. The integuments around the hollow which has been left by the ulceration are much changed in structure; they are swollen, and the margins of the hollow are formed by very vascular, coarse, and hard, warty granulations. It was taken from a man fifty-three years old. Thirty years before the amputation of the limb, a heavy piece of timber fell on his leg; he recovered from the injury, and was well for twenty years, when he had a second blow on the same part, which was followed by ulceration of the integuments and discharge of small pieces of bone. The ulceration extended in both width and depth till the limb was removed. The principal arteries of the limb were ossified.

A rare form of cancer is sometimes found in bone, apparently identical in structure with the thyroid gland, in which the primary growth is found.

The Museum possesses no specimen of this form of cancer.

HYDATIDS IN BONE.

Hydatids in bone are very rare. There is only one specimen in the Museum.

Case F. 541.—Half a pelvis, exhibiting the effects of the growth of hydatids within the bones. The walls of the ilium are separated, and are in many places absorbed, so that there are large apertures in them, which open into a cavity extending through its whole interior. The same cavity communicates with that of the pelvis by a large opening in the acetabulum, and, by other openings, with a cavity in the interior of the sacrum, and with the spinal canal. There are several apertures in the posterior part of the sacrum. All these cavities are filled with hydatids, which had also protruded through the apertures in the walls of the bones, and were contained in cysts formed by the thickened periosteum and other tissues.

542.—Part of the acephalocyst hydatids which were contained in the above bones.

ANGIOMA OF BONE.

Vascular erectile tumours are occasionally met with in the bones of the skull. They resemble the nævi of soft parts.

543.—A portion of the skull-cap of a child, which is very much thickened, and so soft in its texture as easily to be cut with a knife. It has throughout an appearance of great vascularity; and the soft parts covering it had the aspect of a nævus. This condition existed from the birth of the child, and extended over the left side of the head and face and the left arm and shoulder.

SECTION II.
INJURIES OF THE BONES.
FRACTURES.

GENERAL PATHOLOGY.

A FRACTURE is defined as a solution of continuity of a bone.

VARIETIES OF FRACTURE.

Fractures may be divided into simple, compound, incomplete, comminuted, and complicated.

Simple, when the bone is broken into two pieces (799a).

Compound or open, when an external wound communicates with the broken fragments (755, 755a, 871).

Incomplete or greenstick (only occurring in children), when the bone is partly broken and partly bent. (No specimen.)

Comminuted, when the bone is broken into more than two fragments (743, 767, 888, Case H. 934a).

Complicated, when the fracture is combined with some other injury (755, 1146).

CAUSES OF FRACTURE.

The determining causes of fracture are muscular action or external violence. The violence may be direct or indirect. As the causes of fracture belong more to the study of clinical surgery than to that of pathology, we may dismiss them with the above brief reference.

STATE OF THE PARTS.

The state of the parts, *i.e.*, the condition of the ends of the fragments and of the parts around, will be described and illustrated under "Special Fractures."

PROCESS OF REPAIR IN FRACTURE.

The process of repair in simple fracture will first be described, and afterwards the modifications observed in compound fracture.

REPAIR IN SIMPLE FRACTURE.

The process in the human subject differs somewhat from that in the lower mammalia. In the latter it has been very completely studied by producing artificial fractures and killing the animal at varying periods afterwards; it is well illustrated by the beautiful but unfortunately incomplete series of specimens prepared by Mr. Stanley. The student should first master the process as it occurs in the lower animals, and then compare with it that which occurs in man.

In animals (dogs and cats).

General outline of the process.—The method of union is similar to that observed in the healing of soft tissue by first intention. Immediately after the fracture blood is effused about the ends of the fragments, but in a few days it is in great part absorbed and replaced by a small-cell-infiltration, the result of the simple inflammation set up by the injury. The blood is believed by some, however, to become organized, and to assist in the formation of the callus.

This small-cell-infiltration, which is produced in part by the inflamed bone, and in part by the periosteum and other adjacent soft tissues, is called callus, and occurs in three situations—around the ends of the fragments for some distance above and below the line of fracture (ensheathing

callus); between the ends of the fragments (intermediate callus); and within the medullary canal (internal callus). It is at first composed almost entirely of small round cells (granulation tissue); these are converted into fibrous tissue, then into cartilage, and finally into bone, which firmly unites the fragments. The ensheathing callus and the internal callus are after a time almost completely absorbed, so that but little, if any, trace of the fracture remains. They are therefore called *provisional* or *temporary* callus. The intermediate callus is called the *definitive* or *permanent* callus.

Appearances at different periods after fracture.

First day.—(Specimen wanted.) The soft parts immediately around the fragments are more or less bruised and lacerated. Blood in varying quantities is effused in the lacerated tissues about the ends of the fragments, and in the medullary canal. The periosteum is generally torn across at the line of fracture, but is not, as a rule, much lacerated or stripped off from the fractured ends.

Third or fourth day.—(Specimen wanted.) The extravasated blood is partly absorbed, the periosteum is softened, infiltrated with inflammatory material, and blended with the adjacent soft tissues, forming with them a spindle-shaped swelling around the seat of fracture.

Ninth or tenth day. 769.—Section of the tibia of a dog, ten days after fracture of the shaft. The line of fracture is distinctly visible. The extravasated blood has disappeared, and a ring-shaped mass of cartilaginous substance (temporary or ensheathing callus) is seen around and for some distance above and below the fracture, between the bone and what appears to be the periosteum. A few minute specks of earthy matter appear in the centre of the callus. A similar mass of cartilaginous substance (internal callus) occupies the medullary canal at the place of fracture.

770.—The other half of 769. The periosteum is turned downwards, and completely separated from the cartilaginous substance deposited upon the bone around, above and below the line of fracture.

The following specimens were prepared by Mr. Stanley, who supposed that callus was produced by the periosteum

only. In 773, in which portions of both bone and periosteum were removed, new bone was not produced; but it was formed in considerable quantities in 774, where a portion of bone alone was removed.

773.—The radius and ulna of a dog. A portion of the middle of the shaft of the radius, in its entire thickness, including its periosteum, was removed ten weeks before the dog was killed. In the upper part of the bottle is the piece of bone which was thus removed. The shaft of the ulna opposite to and corresponding with the interval in the radius is considerably enlarged by the deposit of osseous substance beneath the periosteum, but the vacant space itself was found filled by soft cellular tissue, no bone having been formed there.

774.—The radius and ulna of a dog, on which an experiment was performed similar to that described in 773, with this exception, that the bone alone was removed, the periosteum being divided and separated by a scalpel from the bone, to admit of the removal of the latter from within it. The vacant space in the radius is here completely filled by newly formed osseous substance. 775.—A similar specimen.

Fourteenth to eighteenth day. 771.—Section of the tibia of a dog which was fractured a fortnight before death. New osseous substance is thinly deposited in a ring beneath what appears to be the periosteum, but at the line of fracture the osseous union is incomplete.

772.—A similar specimen, exhibiting the process of union on the eighteenth day after a like fracture. Ossification is slightly more advanced; otherwise the appearances agree with those observed on the fourteenth day.

A considerable time after fracture. 768.—A femur and tibia of a cat. A fracture of the femur near the middle of the shaft is united by complete ossification of the callus formed around and between the ends of the overlapping fragments.

A very long time after fracture.—(Specimen wanted.) Most, if not all, of the ensheathing callus has disappeared, the cortical layers of the shaft are firmly united by bone, and the internal callus has been in great part absorbed, so that the medullary canal is again patent.

Process of repair in man.

The repair of fracture has been less perfectly investigated in man than in the lower animals. Although the process on the whole appears to be very similar, there are some well-marked differences which must here be noticed.

In the case of man, as in that of lower animals, extravasation of blood occurs about the ends of the fragments, and is followed after a short period by slight inflammation, which in a few days subsides. In man, however, no ensheathing callus is, as a rule, formed. In animals, as before remarked, callus is produced around and between the ends of the fragments and within the medullary canal; in man, between the ends of the fragments only, and this is still the case even when the fragments overlap, as also when they are slightly separated or placed at an angle with each other.

Although we have described union in man as taking place without the intervention of ensheathing callus, this is not always the case, as in fractures not kept at rest, the irritation consequent on the constant movement of the fragments gives rise to abundant production of ensheathing callus, as in animals. Thus, it is always produced in the ribs, the constant movement of which is unavoidable, and generally in the clavicle, where it is difficult to keep the fragments at rest, and occasionally in other bones, but only when the fracture has not been properly secured in splints. It is also met with in all fractures in young subjects, even though splints have been carefully applied and the fragments kept absolutely immovable.

The manner in which the callus is converted into bone constitutes another difference between the process of repair in man and animals. In animals the callus passes through a cartilaginous stage before becoming ossified; whereas in man, after having been transformed into fibrous tissue, it normally undergoes ossification without passing through any intermediate condition.

THE NORMAL PROCESS OF REPAIR IN ADULTS ; *i.e.*, WITHOUT
ENSHEATHING CALLUS.

When the fragments are in accurate apposition. Case H. 791.—Section of a humerus in which a fracture of the shaft at the attachment of the deltoid muscle has been exactly united, so that both the walls and the cancellous tissue are uninterruptedly continuous ; and except by a slight deviation of its axis, the situation of the fracture could hardly be discerned.

After osteotomy. 807a.—The left knee-joint seventeen months after the performance of Ogston's operation of chiselling through the internal condyle of the femur for the relief of genu valgum.

See also 807b, 807c, and 807d.

When the fragments overlap. 799a.—Sections of the tibia of a middle-aged woman, which was fractured through the junction of its middle and lower thirds sixteen weeks before death. The ends of the two portions overlap each other for nearly an inch, and a firm union of them is effected by new bone, formed between those surfaces which in their overlapping were apposed and partly in contact with each other. No new bone or callus is formed at any other part. The periosteum and the tissues adjacent to the bones appeared healthy, except in having small effusions of blood in them.

When the fragments are separated. 802.—Section of a femur, showing that even where there is much displacement no ensheathing callus is formed. The section was made after softening the bone in dilute hydrochloric acid. The fracture is firmly united, with the upper portion of the bone projecting in front and on the inner side of the lower. The uniting medium consists of bone placed between the adjacent surfaces of the displaced portions of the femur ; and in this new bone there are formed cancellous tissue of healthy aspect and an outer thick wall of compact tissue. This wall of the uniting medium of new bone is connected with the surfaces of the two portions of the femur, and with the layers of compact new bone by which their medullary canals, exposed by the fracture and not placed in apposition, are covered in. The other section is preserved in Case H. 803. See also Case H. 812, 813, 815, and 816.

When the fragments are placed at an angle to each other. 928.—Sections of a radius. At its carpal end there has been a transverse fracture immediately above the line of the epiphysis, and the

posterior or dorsal margin of the upper fragment has been driven into the cancellous tissue of the lower one. The fracture is united, and a buttress of new bone has formed on the dorsal and radial sides of the displaced portions. See also **Case H. 759, 824** ; and **930a**.

THE EXCEPTIONAL METHOD OF REPAIR IN ADULTS ; *i.e.*, WITH
ENSHEATHING CALLUS.

In the ribs. **779.**—Parts of two ribs, which were fractured a fortnight before death. The extremities of the fractured portions are in close contact, and are surrounded by a broad ring of callus, partially ossified. A section of one of the ribs shows the periosteum continued over the exterior of the callus.

In the clavicle. **780.**—The outer portion of a clavicle divided longitudinally, from a boy aged nine years. It was fractured about three weeks before death. Note the abundant ensheathing callus.

In bones (other than ribs and clavicle) when the fragments have not been kept at rest. **781.**—Section of a humerus, in which a fracture of the middle of the shaft occurred five weeks before death. The ends of the bone are not united, but they are held firmly together by a ring of rough osseous substance deposited on the whole circumference of their outer surfaces, and extending some way above and below the fracture. **782.**—The other half macerated.

801.—A fractured femur, with abundant production of ensheathing callus around the fractured ends, probably the result of the fragments not having been properly kept at rest by splints.

THE NORMAL PROCESS OF REPAIR IN YOUNG SUBJECTS ; *i.e.*,
WITH ENSHEATHING CALLUS.

783.—Sections of a child's femur, which was fractured thirty days before death. The sharp extremities of the fragments are projecting, but except at these ends they are in close apposition. Both fragments, to a distance of between one and two inches from the line of fracture, are surrounded in a layer of new bone (ensheathing callus). The fragments thus ensheathed and held together almost immovably by the new bone are not directly united ; the line of fracture is still evident between them, but some new bone appears in the medullary cavity of each. The child was two years and ten months old. The fracture was treated in the usual

manner. Splints were kept on for three weeks, and being removed, the limb was maintained at rest.

To sum up: Repair in man is generally accomplished by intermediate callus, even when the ends overlap, or are separated by a slight interval. But union takes place by ensheathing callus when the fractured ends are not kept constantly in one position, *e.g.*, in the ribs, which are subject to continuous movement; in other bones when immobility is not attained, and in the bones of young subjects.

CHANGES SUBSEQUENT TO UNION OF THE FRAGMENTS.

After the fragments have been firmly united by some of the methods above described, further changes occur, providing for the symmetry of the bone (Paget). Sharp and projecting angles in badly united fractures and rough ends of overlapping fragments are absorbed and rounded off; whilst the exposed ends of the medullary canal are closed by a layer of new bone. Ensheathing callus, when this has been produced, is in great part or wholly absorbed; the bony callus between the fractured ends, at first spongy, gradually becomes compact; whilst that in the medulla becomes more and more cancellous, till at last the continuity of the canal is restored.

When the fragments overlap and the ends of the medullary canal have become closed, the continuity of the canal is restored by absorption of the intervening walls of the contiguous and overlapping fragments.

Case H. 815.—Section of a femur which has been broken near the middle of its shaft. The fragments have overlapped considerably. The bone forming the medium of their union has a cancellous texture with compact walls. The medullary cavity is closed at both the fractured ends of the bone. See also **Case H. 803, 816, 818, 901, 902, 911.**

DEVIATIONS FROM THE ORDINARY PROCESS OF REPAIR.

FIBROUS UNION.

Some fractures are seldom or never united by bone, but remain merely bound together by ligamentous or fibrous tissue. These include fractures extending into joints, and are as follows :

Intra-capsular fracture of the humerus and femur, and fractures of the patella, olecranon, coronoid process, condyles of the humerus, and tips of the acromial and coracoid processes.

UNUNITED FRACTURE.

An ununited fracture is one in which the fragments remain totally separate, or are bound together only by fibrous tissue (846, 846b). As this definition stands, it includes the fractures enumerated under the previous heading. But as fibrous union, in their case, appears to be the normal method of repair, they have been placed under the head of fibrous union rather than that of ununited fractures. When, however, union by fibrous tissue occurs in those fractures in which bony union is the normal method of repair, the fracture is said to be ununited.

The condition of the fragments in ununited fracture varies. In a few instances the bones are found completely separated, the ends rounded off, and the medullary canal closed. In other instances they are found connected by fibro-cartilaginous material, a kind of ensheathing callus. Instances in which it is probable that union, although retarded, might have taken place at a later period, should be considered rather as examples of *delayed union* than of ununited fracture. In other instances, again, the fragments are bound closely together by tough fibrous tissue, which allows of but little movement, or by thin, elongated, pliable ligamentous-like bands, permitting of considerable movement.

Occasionally, after union has taken place in the ordinary

way, the osseous material uniting the fractured ends is absorbed; in such a case the fracture is sometimes called *disunited*, to distinguish it from the ordinary form of ununited fracture in which bony union has never occurred.

Case H. 859.—Part of a right femur just above its middle, representing the extremities of an ununited fracture. There are deposits of new bone scattered over either portion, the medulla being closed by a compact layer of dense bone-tissue. The apertures indicate the spots selected for the introduction of ivory pegs. The depressions are lined with new bone, from which spicula irregularly project. See also 869 and Case H. 971.

FALSE JOINT (PSEUDARTHROSIS).

This is merely a variety of an ununited fracture, in which the ends have been rounded off and covered by a layer of fibrous or fibro-cartilaginous material and enclosed in a strong fibrous capsule formed by the condensation of the surrounding soft tissues. A fluid resembling synovia has been occasionally observed within the capsule. Two main varieties of false joint exist, one resembling the hinge, the other the ball-and-socket joint. The former is more common in fractures of the articular ends, the latter in those of the shafts of the long bones. The existence of a false joint implies that there has been a considerable amount of movement of one fragment upon the other.

846b.—A humerus with an ununited fracture at the junction of the middle and lower thirds. The broken ends are rounded, the lower fragment being drawn up behind the upper, and separated from it by a small mass of tough degenerate muscle. The fragments are enclosed in a firm, fibrous capsule, which cannot be separated from the surrounding muscle.

From a man whose arm had been broken about ten years previously. Notwithstanding the ununited fracture, the limb was a useful one. See also 846a.

861.—Portion of a humerus, in which fracture of the shaft occurred many years before death. The ends of the bone did not unite: they are somewhat enlarged, and are covered by a substance like fibro-cartilage, and connected by a distinct membranous

capsule, which is smooth upon its internal surface, and serves as a kind of capsular ligament to the false joint which is formed between the ununited portions of the bone. See also 866 and Case H. 1032.

862.—Portion of a humerus, in the middle of the shaft of which a fracture occurred four years before death. The ends of the bone did not unite, but are enlarged, have become accurately adapted to each other, and have acquired a hard polished surface on those portions between which there was friction during the movements of the arm.

It will be noted that all the above examples of false joint are in the humerus, the bone in which ununited fracture is most common. This is probably due in great part to the difficulty in keeping the fragments in apposition and at rest, and in part to the imperfect blood-supply of the lower fragment when the fracture occurs below the entrance of the nutrient artery into the bone.

REPAIR IN COMPOUND FRACTURE.

When the wound leading to the seat of fracture is small, and has been closed early, the process of repair is much the same as in simple fracture. When, however, the wound is large, suppuration ensues, and union of the fragments is effected by granulations springing from the ends of the bones and from the periosteum, the process being analogous to the so-called union by the second intention of soft parts. If there is much comminution of the bone and bruising of the soft parts, the loose fragments and injured tissues are cast off in the process of suppuration. The granulations uniting the fractured surfaces undergo direct ossification, or first pass through a fibrous stage. When large portions of bone are denuded of periosteum, the portions thus bared die, and are cast off from the living, as in the separation of a sequestrum. Sometimes, however, the dead bone becomes deeply embedded by ossification of the parts around, and remains as a source of irritation for years.

756 —A knee-joint. The upper fragment of the fractured femur

was forced downwards by the side of the patella, and a few days after the fracture protruded through the integuments and could not be replaced. In this situation it has become firmly fixed by bone to the condyles. An inch and a half of the protruding portion is undergoing necrosis and would have formed a sequestrum. The fracture in this instance was rendered compound by the sloughing of the soft tissues over the protruding fragment. Such a cause as this, however, is not of common occurrence.

805.—Section of a tibia, from a case of compound fracture, in which amputation was performed eleven weeks after the occurrence of the injury. The two portions of bone are held firmly together by osseous substance deposited around the torn edges of the periosteum and in the contiguous cellular tissue. The union of the fractured surface of the walls of the bone and of its medullary tissue is not yet complete, the uniting medium here consisting of granulations growing from the exposed ends of the bones.

871.—Section of a tibia, in which a compound fracture occurred six months before death. The fractured surfaces, displaced and overlapping, are consolidated by bony matter. The extremity of one of the portions of the fractured bone, separated either by the fracture or by exfoliation, lies loose in a cavity between the fractured surfaces. The portion of bone at the bottom of the bottle was found loose in the same cavity. The other half of the bone is preserved dry in **Case H. 872.**

See also 755a, 869, and 870.

SPECIAL FRACTURES.

FRACTURES OF THE BONES OF THE FACE.

The bones of the face most liable to fracture are the nasal, the inferior maxillary, and the malar bones.

Fracture of the Nasal Bones.

Fracture of the nasal bones is always produced by direct violence. The fracture is usually transverse in direction, and generally accompanied by considerable displacement, and at times by emphysema. Interest attaches to this fracture from the fact that it is liable to extend to the perpendicular plate of the ethmoid, and through this to the base of the

skull, occasionally giving rise to inflammation of the brain. The lateral cartilages may be depressed at their junction with the nasal bones, or variously bent or displaced to one or other side.

895.—Nasal bones, exhibiting the union of a transverse fracture just above their lower borders.

Case H. 893.—Section of the skull, in which there has been a transverse and comminuted fracture of the nasal bones. The fracture has united with considerable lateral displacement of the lower portion of the bones. See also 895a.

Case H. 894.—Portion of skull, in which there has been a fracture extending across the nasal bones. The fracture has united firmly, but with lateral displacement and overlapping of the lower portions of the bones.

Fracture of the Malar Bone.

Fractures of the malar bone, with depression of the zygomatic arch, are not uncommon in severe smashes of the face. The rectification of the parts is often difficult, and much deformity may remain. Necrosis, however, even although much comminution may occur, is rare, since the vascular supply of the part is very abundant.

Case H. 896.—Part of a skull, in which a depression of the zygoma into the temporal fossa appears to indicate that there has been a fracture near the junction of its malar and temporal portions.

Fractures of the Inferior Maxilla.

Fracture of the inferior maxilla is always due to severe and direct violence. Although any part of the bone is liable to fracture, the most common position is on one or other side of the symphysis, and frequently, as seen in 897a, between the canine and first bicuspid teeth. When the alveolar border of the bone is involved, the mucous membrane of the gum is torn, rendering the fracture compound; nevertheless, union nearly always occurs, as in simple fracture. There is not, as a rule, much displacement of the fragments. A

specimen of fracture of the body of the bone follows. There is no specimen of fracture of the ramus, angle, condyle, or neck of the jaw in the Museum. These varieties, therefore, are not described.

897a.—A fracture of the inferior maxilla. The jaw is broken in the most usual position, between the canine and the first bicuspid teeth on either side. From a boy aged fourteen who was crushed between the rollers of a printing machine.

897b.—A lower jaw with the tongue and muscles attached to it. The bone has been fractured immediately to the right of the symphysis, between the central and lateral incisor teeth, and the coronoid process has been separated by a fracture passing obliquely through its base. From a man aged thirty-five, who had sustained many other serious fractures of the skull.

FRACTURE OF THE RIBS AND COSTAL CARTILAGES.

Fractures of the ribs may be the result of direct or indirect violence. In the former case the fracture occurs at the seat of the violence, and the fragments are driven inwards towards the chest, frequently injuring the pleura and lungs. In the latter case, the rib generally gives way at its weakest part: that is, at the greatest convexity of its curve. Union normally takes place by means of a ring of ensheathing callus, as in animals.

779.—Parts of two ribs which were fractured a fortnight before death. The extremities of the fractured portions are in close contact, and are surrounded by a broad ring of callus, partially ossified. A section of one of the ribs shows the periosteum continued over the exterior of the callus.

798.—Section of a fractured rib, which has reunited with displacement and overlapping of its ends. The firm union of the two portions of the rib has been effected by the abundant deposit of osseous substance in the texture of the periosteum and contiguous cellular tissue around, and for some way above and below the fracture. A spiculum of bone projects from one side of the rib; this was probably a fragment separated by the fracture and reunited to the outer surface of the rib.

Case H. 753.—A rib which has been fractured in three distinct

situations—at the angle and at two places in the middle of the shaft. The fractured ends are firmly united in nearly exact apposition. See also **Case H. 900** and **900c**.

900b.—Portion of the chest-wall of a child who was run over. The heads of the third, fourth, fifth and sixth ribs have been separated from their tubercles. The lung has been lacerated by the fractured ribs.

Fracture of the costal cartilages.

The costal cartilages, unlike the ribs, are rarely fractured, owing to their greater elasticity. Union is generally effected by ensheathing callus, which subsequently ossifies, so that the two cartilaginous fragments appear united by a ring of bone. Occasionally, however, the callus remains cartilaginous.

Fracture may sometimes occur through the line of union of the cartilage and the ribs. Repair in this case takes place by a ring of bony callus, situated partly under the periosteum and partly under the perichondrium.

1014.—Portions of costal cartilages. There has been a fracture of the cartilage of one of the false ribs. The portions overlap and are firmly united by bone.

1015.—Section of the cartilage of a rib, which has been fractured and is firmly united. The uniting medium consists of a substance like cartilage with small deposits of bone in it.

1016.—Section of the cartilage of a rib, which appears to have been fractured and reunited by new cartilaginous substance placed in the angles between the ends of its overlapping portions. See also **1016a**.

Separation of a rib from its cartilage.

1013.—Section of a rib with its cartilage. The rib had been separated from the cartilage, but has reunited to it. The union is effected by an abundant deposit of osseous substance, apparently in the texture of the periosteum and perichondrium, and in the contiguous cellular tissue around and for some distance above and below the line of separation.

FRACTURE OF THE STERNUM.

The sternum, notwithstanding its exposed situation, is rarely fractured, as its position between the elastic cartilages enables it to resist any but severe and direct violence. The fracture is nearly always transverse, and usually single. One or more ribs are generally broken at the same time.

Case H. 899.—A sternum, fractured transversely through its second portion near its union with the manubrium.

Case H. 898.—A sternum, fractured transversely through the gladiolus near its junction with the xiphoid cartilage. See also Nos. 898a and 898b.

FRACTURES OF THE UPPER EXTREMITY.

FRACTURE OF THE CLAVICLE.

The clavicle may be fractured through the shaft or through either end. The former fracture is common; the latter fractures are rare.

Fracture of the shaft.

Fracture of the shaft usually occurs near the middle of the bone. The inner fragment, although it appears to be displaced upwards, really retains its normal position in consequence of the antagonistic action of the sterno-mastoid above and the pectoralis major below; the costo-clavicular ligament will also tend to prevent the inner fragment from being displaced upwards. The outer fragment is displaced downwards, forwards, and inwards, by the weight of the arm and the contraction of the pectoral muscles.

Union is generally accomplished by ensheathing callus, as it is impossible to keep the fragments in position unless the patient submits to lie flat on the back for a few weeks.

785.—Section of a clavicle, exhibiting a fracture which occurred while the patient was holding a weight above his head.

799.—A clavicle of a man seven weeks after fracture.

Case H. 901.—A clavicle which has been broken near the middle of its shaft.

The fracture is united with the scapular end of the bone beneath its sternal end.

Case H. 790 and 902.—Clavicles which in each case have been fractured obliquely near the middle of their shafts. The fractures have united with scarcely any irregularity of the surface of the bone.

Fracture of the acromial end.

Fractures of the acromial end are generally productive of but little displacement, as the strong coraco-clavicular ligaments retain the fragments nearly in position.

860.—The scapular end of a clavicle, with a small portion of bone united to it by a distinct joint. It is, however, uncertain whether this portion of bone was separated by fracture.

780.—The outer portion of a clavicle, divided longitudinally, from a boy aged nine years. It was fractured about three weeks before death. See also **Case H. 828 and 904a.**

FRACTURES OF THE SCAPULA.

Fractures of the scapula may be divided into the following classes: Fractures of the body, coracoid process, acromion, glenoid cavity, neck, and inferior angle.

As there are no specimens in the Museum of the last two fractures, they will receive no further mention.

Fractures of the body.

Fractures of the body are due to direct violence. The fracture usually takes a transverse direction across the infra-spinous fossa; but the bone may be split longitudinally, or it may be starred. The union takes place by bone.

Case H. 903.—A scapula, which has been broken transversely through its infra-spinous region. It has also received other injuries, which will be referred to further on. The fracture has united by bone.

Fracture of the acromial process.

Fracture of the acromion usually occurs through the apex; it may, however, occur through the middle or through

the base. When the fracture is through the apex, the union is fibrous; when through the base, bony; when through the middle, either fibrous or bony.

836.—Portion of a scapula, exhibiting a fracture through the apex of the acromion, which has united by fibrous tissue.

See also **Case H. 903** and **903a**.

Case H. 906.—In this specimen the acromion, at one inch from its extremity, is completely divided transversely, but in the recent state the fragment was maintained in its proper position by means of ligamentous tissue, so that no displacement had occurred. At a distance of three-quarters of an inch further on towards the spine the acromion is again almost completely divided in a transverse direction, the two portions being held together by two narrow bridges of bone. The glenoid cavity exhibits the appearances commonly observed in osteoarthritis.

Specimens similar to the above are believed by Dr. Robert Adams and Professor Smith to depend, not upon fracture, but upon a separation of the acromial epiphysis consequent upon osteoarthritis. From the fact, however, as seen in the above specimen, that the separation may take place at some other part of the acromion than in the position of its epiphysial line, Mr. Marsh doubts whether there is any physiological connection between this separation of the acromion and its former condition as an epiphysis.

Fracture through the coracoid process.

Fractures of the coracoid process are rare. They are always due to direct violence, such as a blow on the shoulder. There is usually but little displacement, the fractured portion being held in position by the strong ligaments connecting it to the clavicle and the acromion. The fracture most commonly extends through the base, when it is often complicated by fracture through the body of the scapula. When the fracture is through the apex, union is fibrous.

Case H. 905.—A scapula. The extremity of the coracoid process is seen separated from the rest of the bone, probably in consequence of fracture. There has been no attempt at bony union; the fragments are kept in position by dense fibrous tissue.

Case H. 909.—A scapula, with part of the humerus, from a young person. The fracture extends through the base of the coracoid process and through the body of the scapula. See also **Case H. 906.**

Fracture through the glenoid cavity.

This is an extremely rare form of fracture; it apparently occurred in the following specimen:

Case H. 907.—A scapula, in which there seems to have been fracture of the lower margin of the glenoid cavity.

FRACTURES OF THE HUMERUS.

These may be divided into fractures of the upper end, shaft, and lower end.

I. FRACTURES OF THE UPPER END.

These may be classed as—

1. Intra-capsular (anatomical neck), impacted and non-impacted.
2. Extra-capsular (surgical neck), impacted and non-impacted.
3. Fracture of the greater tuberosity.
4. Fracture through the line of the epiphysis.

1. *Intra-capsular fracture, or fracture of the anatomical neck.*

Intra-capsular fracture extends through the anatomical neck, and, as its name implies, is within the capsular ligament. It may be impacted or non-impacted. In the impacted variety the upper fragment or head is always driven into the lower fragment; that is, between the tuberosities.

Union, when it occurs in the non-impacted variety, is ligamentous. In the impacted it is bony.

Case H. 907.—A scapula and humerus, in which there has been a dislocation of the head, with an intra-capsular fracture of the neck of the humerus. The head of the bone was found resting

against the anterior border and concave surface of the scapula, close to the glenoid cavity, and below the coracoid process.

2. *Extra-capsular fracture, or fracture of the surgical neck.*

The line of fracture in this injury extends through the upper part of the shaft below the tuberosities, but above the insertion of the three muscles into the bicipital ridges of the humerus. The upper fragment is displaced outwards by the action of the three muscles inserted into the greater tuberosity, whilst the lower fragment is drawn inwards by the three muscles inserted into the bicipital ridges, and upwards by the deltoid.

Like the intra-capsular fracture, it may be impacted or non-impacted; but in the impacted variety it is the lower end which is driven into the upper, not the upper into the lower, as in the intra-capsular.

845.—A shoulder-joint, exhibiting an ununited fracture of the neck of the humerus. The fracture extends transversely through the humerus, immediately below its head and below the tuberosities, and it communicates with the cavity of the shoulder-joint. From a man aged seventy-five. The injury occurred ten years before death.

Case H. 908.—Bones of a shoulder-joint, exhibiting a fracture of the surgical neck of the humerus, just below the tuberosities. See also Case H. 827.

3. *Fracture of the greater tuberosity.*

908a.—An extra-capsular fracture of the right humerus. The greater tuberosity has been entirely separated, whilst the shaft of the bone is fractured spirally. From a man aged seventy-two, who was knocked down and run over by a van a week before his death.

4. *Separation of the epiphysis and fracture through the line of the epiphysis.*

These injuries can necessarily only occur in young subjects, *i.e.*, before the epiphysis has become united and consolidated with the shaft. A good specimen follows.

Case H. 909.—A scapula and humerus from a young person, exhibiting the separation of the head from the shaft of the humerus in the line of the epiphysial union.

II. FRACTURES OF THE SHAFT.

Fractures of the shaft may be caused either by direct or indirect violence ; it has been known to occur from violent muscular action. The usual situation of the fracture is a little below the insertion of the deltoid. The line of fracture may be transverse or oblique : in the latter case it generally runs downwards and outwards. In transverse fracture but little displacement occurs, but in the oblique the lower fragment is drawn upwards and to the inner side of the upper by the action of the biceps and triceps muscles, while the upper fragment is abducted and rotated outwards by the action of the deltoid and external rotator muscles. This is the most common situation for ununited fracture.

Case H. 800.—Part of a humerus, fractured transversely. The fractured ends overlap each other.

Case H. 910.—Section of a humerus, which has been fractured obliquely just above the middle of its shaft and just below the insertion of the deltoid.

Case H. 911.—Section of a humerus, which has been fractured obliquely just below the middle of its shaft.

Case H. 915.—A humerus, which has been fractured in several directions, but chiefly obliquely downwards, just above the condyles. The fragments are firmly united, but an aperture remains in the line of one of them.

Case H. 1027.—In this specimen, the fracture has occurred just below the insertion of the deltoid.

III. FRACTURES OF THE LOWER END.

Fractures through the lower end of the humerus generally extend transversely across the bone immediately above the condyles and vertically between the condyles into the elbow-joint. Either condyle may be broken off without any other part of the lower end being affected. Separation of the lower epiphyses is also met with in young subjects.

Case H. 913.—The bones of an elbow-joint. A fracture extends in two directions through the internal condyle of the humerus into the elbow-joint. The fragments are not united by bone. See also **Case H. 1033.**

Case H. 914.—The bones of an elbow-joint. The humerus has been fractured obliquely between the condyles and transversely a little above them.

916.—Portion of a humerus, in which distinct fractures extend vertically through both condyles into the elbow-joint. The fractured surfaces are united by fibrous tissue.

FRACTURES OF THE BONES OF THE FOREARM.

These may be divided into fractures of the radius, fractures of the ulna, and fractures of both radius and ulna.

FRACTURES OF THE RADIUS.

Fracture of the radius may occur through the neck, lower end, or any part of the shaft. Fracture of the neck is very rare. Fractures of the shaft and lower end are common.

Fracture of the neck.

Fracture of the neck is nearly always due to direct violence. The upper fragment is displaced outwards by the supinator brevis; the lower fragment is drawn upwards and forwards and at the same time supinated by the biceps.

The pronator radii teres is not supposed by Mr. Callender to have much influence in determining the position of the fragments. He attributed the deformity to the biceps and pronator quadratus.

There is no specimen in the Museum.

Fracture of the shaft.

Fracture of the shaft may be produced by direct violence, but more frequently by a fall upon the hand. The fracture may occur in any situation, but is most common near the middle of the shaft. The upper fragment is drawn forwards by the biceps, and inwards by the pronator teres,

and is held in a position, by the opposing action of these muscles, midway between supination and pronation. The lower fragment is drawn inwards and pronated by the pronator quadratus, the inward inflection being aided by the supinator longus dragging on the styloid process.

Case H. 818.—A radius, which has been fractured near the middle of its shaft. The fracture is united with a little overlapping of the ends of the bone.

Case H. 922.—A radius and ulna. The radius has been fractured at the middle of its shaft. The ends of the bone projecting forwards and inwards close to the ulna have been smoothly united in this position.

Fracture of the lower end (Colles' fracture).

This is nearly always the result of indirect violence, generally a fall upon the palm of the hand. The line of fracture is usually transverse, and about half an inch to an inch above the articular surface of the wrist-joint.

Although this fracture is exceedingly common, opportunities of examining the parts after death seldom occur. There is consequently much difference of opinion as to the condition of the fragments and the cause of their displacement. According to Dr. R. W. Smith, the lower fragment is drawn upwards and backwards by the combined action of the supinator longus, the extensors of the thumb and the radial extensors of the carpus; by others, however, the displacement is believed to be the result of impaction, which, they maintain, nearly always occurs. The latter opinion had the support of Mr. Callender, who explained the displacement as follows: "The radius is first broken, and then, by the momentary continuance of the force in the direction of the falling body forwards and outwards, the shaft is driven into the carpal end, burying itself chiefly from the dorsal surface towards the palm and towards the outer or the inner side. In a great number of cases this impaction so fixes the fragments that they cannot be unlocked, and the deformity is permanent." The following specimens will be seen to bear out this view.

The upper fragment is generally approximated to the ulna and is in a state of pronation.

The lower fragment is often comminuted.

925.—The carpal extremities of a radius and ulna, showing a comminuted fracture of the former bone, extending into the wrist-joint. A very small amount of displacement exists as the result of the injury, which during life was indicated solely by pain, and inability to move the affected part.

The fracture was consequent upon a fall on the palm of the hand. The man received at the same time such severe internal injuries that he died a few hours after his admission.

926.—Portions of a radius and ulna. The radius has been fractured a little more than an inch above its carpal end. The union is firm, but there is a prominent angle on the dorsal aspect of the radius in the line of fracture, and an elevation of new bone on the corresponding part of the palmar surface, where it is probable that the palmar margin of the upper fragment was driven into the cancellous tissue of the lower one. The triangular fibro-cartilage was almost completely separated from the radius. See also **Case H. 930.**

927.—Section of the radius of a young man, which has been fractured three-quarters of an inch above its carpal articular surface. The posterior or dorsal margin of the upper fragment is driven into the cancellous tissue of the lower one; their palmar margins are in contact, but a projecting angle is here formed, in front of the wrist, at the line of fracture.

928.—Sections of a radius. At its carpal end there has been a transverse fracture immediately above the line of the epiphysis, and the posterior or dorsal margin of the upper fragment has been driven into the cancellous tissue of the lower one. The palmar margin of the upper fragment projects forwards, or in the direction of the palm, and the dorsal surface of the lower fragment projects far backwards, similarly to that in **No. 927**, but differently from that in **926.**

928a.—A dissection of left forearm and hand, exhibiting the deformity characteristic of a recent Colles' fracture. The lower articular end of the radius is separated from the shaft by a fracture, and displaced backwards with the carpus upon the posterior surface of the radius and ulna. A prominence upon the palmar surface of the wrist is occasioned by the projection of the

extremities of the radius and ulna, and another a little lower upon the dorsal surface by the displacement backwards of the carpus. The cuneiform is dislocated from the ulna, and the internal lateral ligament is ruptured.

Cast No. 26 shows the deformity resulting from a recent Colles' fracture.

SEPARATION OF THE LOWER EPIPHYSIS OF THE RADIUS.

758a.—A section of the lower end of the radius of a child. The epiphysis, as the result of an injury, has been incompletely separated from the diaphysis. The separation is complete along the radial border, but towards the ulnar side the line of injury has run obliquely, and consequently a piece of the bone has been torn off. This incomplete separation is not of uncommon occurrence. See also **Case H. 931** and **932**.

FRACTURES OF THE ULNA.

Fractures of the ulna may be divided into fractures of the olecranon process, fractures of the coronoid process, and fractures of the shaft.

Fracture of the olecranon process.

Fracture of the olecranon process may be caused by a blow or fall upon the elbow, or by a violent action of the triceps muscle. The fracture may extend through the base, middle, or apex of the process, in either a transverse or an oblique direction. The detached fragment is generally widely separated from the rest of the bone by the contraction of the triceps, but when, as occasionally happens, the periosteum and the tendinous expansion of the triceps covering the olecranon are not torn, or when the fracture is very oblique, little or no separation occurs. Union is generally fibrous, but in the more exceptional cases in which little or no separation of the fragments occurs, union usually takes place by bone. The elbow-joint is generally involved.

918.—An elbow-joint, exhibiting a transverse fracture extending through the base of the olecranon which extends into the cavity of the joint.

Case H. 919.—The bones of an elbow-joint, exhibiting a recent fracture of part of the olecranon extending into the interior of the joint. See also **Case H. 918a.**

Fracture of the coronoid process.

Fracture of the coronoid process is generally the result of a violent contraction of the brachialis anticus muscle. The line of fracture may extend through either the base or the apex of the process; the detached fragment is drawn to some distance from the rest of the bone by the contraction of the brachialis anticus. This injury is generally associated with dislocation of the ulna backwards.

There is no specimen of this fracture in the Museum.

Fracture of the shaft.

Fracture of the shaft of the ulna is nearly always caused by direct violence, and is less common than fracture of the shaft of the radius, on account of the protected position of the ulna on the inner side of the forearm and its indirect connection with the hand. The fracture commonly occurs in the lower third of the shaft (its weakest part). The upper fragment suffers no displacement, but the lower is drawn outwards towards the radius by the action of the pronator quadratus.

Case H. 792.—An ulna, in which a fracture through the middle of its shaft has been exactly united, but with a small, sharp process of bone growing on its outer side.

749.—Portion of an ulna from an adult, split and detached by a fracture, which was occasioned by the arm being caught in machinery. The fractured portion, about four inches in length, comprises in its whole extent about one-half of the circumference of the ulna.

It is remarkable that the bone was splintered to so great an extent longitudinally without the fracture passing at any part through the entire thickness of the shaft. The interval left in the bone by the removal of this fragment was filled by granulations, but whether these granulations ossified could not be satisfactorily ascertained.

SEPARATION OF LOWER EPIPHYSIS.

Case H. 932.—Fracture of the lower end of the radius. The epiphysis of the ulna is separated from the shaft, and is broken into several pieces. From a boy aged fourteen years.

FRACTURES OF BOTH BONES.

Fracture of both bones may be the result of direct violence, such as a blow or fall upon the forearm, when each bone will be broken across in the same transverse line. Or it may be the result of indirect violence, such as a fall on the hand, when the fracture will occur at a different situation in each bone: the radius, first receiving the shock from the hand, gives way at its weakest part (its upper third), and the shock is then transmitted to the ulna, which likewise gives way at its weakest part (its lower third). The lower fragments are drawn inwards towards each other by the pronator quadratus, whilst the upper fragment of the radius is drawn towards the ulna by the pronator teres.

837.—A radius and ulna which were fractured a considerable time before death.

Case H. 829.—A radius and ulna which have been fractured near their upper ends. The fractures are both firmly united. A large quantity of new bone has been formed around the seats of union. The surfaces of the bony callus on the radius and of that on the ulna, meeting in the interosseous space, have been roughly adapted to each other, but have not coalesced.

Such a condition as the above is best prevented by putting up the fracture with the hand in a position midway between pronation and supination—a position in which the greatest space between the bones is obtained.

Case H. 920.—A radius and ulna, the former fractured about its middle, the latter at a corresponding point and also at its lower third.

Case H. 921.—A radius and ulna, both of which have been fractured about three inches above their carpal extremities. The ends of the bones overlapping have united in this position with a considerable shortening and deflection towards the ulnar side.

923.—Portions of a radius and ulna. Both bones have been fractured just above their carpal ends, in several directions, both vertically and transversely, as indicated by the bristles placed in the soft substance like cartilage, with which the lines of the fracture are filled.

FRACTURES OF THE CARPUS AND METACARPUS.

Fracture of the carpus is not uncommon as a complication of Colles' fracture.

924.—Parts of a radius and ulna, with the adjacent carpal bones. The scaphoid is broken across about its middle, and between the two fragments the tendon of the extensor carpi radialis brevior was firmly gripped and is still held.

The following specimen of fracture of a metacarpal bone is the only example of these injuries in the Museum.

Case H. 933.—Bones of a carpus and metacarpus. The base of the metacarpal bone of the thumb has a widely expanded and flattened surface, by which it articulated with a similarly deformed surface on the trapezium. It is probable that these changes were the consequences of a fracture of the metacarpal bone extending into the joint.

FRACTURES OF THE LOWER EXTREMITY.

FRACTURES OF THE PELVIS.

These are the results of great violence, such as the passage of the wheel of a heavy van over the part. They are generally complicated by injury of the internal viscera. Frequently the sacro-iliac or pubic symphyses are wrenched apart by the force. If the patient does not succumb to injury of the internal organs, union usually takes place. The acetabulum is sometimes fractured from a fall on the hip, giving rise to symptoms of fracture of the neck of the femur.

Case H. 934a.—A comminuted fracture of the pelvis. The right os innominatum is more completely broken than the left. The right acetabulum is broken into several pieces, and the right femur has sustained an extra-capsular fracture of the neck, involving the great trochanter. The right lateral mass of the sacrum is

completely separated, whilst on the left side the horizontal ramus of the pubes and the ascending ramus of the ischium are fractured. From a man aged fifty-eight, whose diaphragm and peritoneum were ruptured, and who had in addition five fractured ribs. He threw himself from a window on to the pavement, a distance of about twenty feet.

Case H. 937.—An os innominatum exhibiting fractures radiating from the centre of the acetabulum in various directions through the bone. See also **Case H. 938.**

935.—Portion of an os innominatum exhibiting an ununited fracture with absorption of bone, in the bottom of the acetabulum. The fracture extended in several directions from the centre of the acetabulum to its circumference.

The fracture was caused by a fall on the trochanter major a few months before death. See also **Case H. 934** and **939.**

1039.—A fracture extending through the acetabulum, the result of jumping out of a window.

1041, 1042.—Sections of the head and neck of a femur, with the os innominatum of a man in whom dislocation of the femur and fracture of the acetabulum occurred fifty years before death.

Separation of symphyses.

Case H. 1056.—Separation of the pubic and the sacro-iliac symphyses, from a child.

FRACTURES OF THE FEMUR.

Fractures of the femur may be divided into fractures of the upper end, of the shaft, and of the lower end.

FRACTURES OF THE UPPER END OR NECK.

Fractures may occur through any part of the upper end or neck of the femur. They often extend outwards through the trochanters, but seldom inwards through the articular surface of the head.

As pointed out by Professor Pirrie, the articular surface presents a remarkable difference as to its tendency to disease and its liability to fracture; it is very prone to disease, but is scarcely ever fractured.

Fractures of the neck may be divided into :

1. Intra-capsular fracture.
2. Extra-capsular fracture.
3. Fracture of the great trochanter and separation of the epiphysis of the great trochanter.
4. Separation of the epiphysis of the head.

I. INTRA-CAPSULAR FRACTURE.

Intra-capsular fractures are very common in advanced life, especially in women ; they are rare in persons under fifty. **No. 787** is a remarkable specimen of this injury in a lad of eighteen.

They are generally caused by indirect and commonly very slight violence, such as slipping off the kerbstone ; they have even been known to occur from catching the foot in the blanket when turning in bed. The chief predisposing causes would appear to be the atrophy and fatty degeneration of the neck of the femur, so common in old people, but the more horizontal position which the neck is believed to assume in old age is regarded by some as an important factor.

STATE OF THE PARTS.

The fracture may occur at any part of the neck within the capsule, and the line of fracture may be transverse or oblique ; the cervical reflexion from the insertion of the capsular ligament to the circumference of the head may or may not be torn, and the fragments may be impacted or non-impacted. The capsular ligament is seldom ruptured.

Situation and direction of the line of fracture.

The situation of the fracture is of interest, as upon it depends to some extent the degree of absorption of the neck, and consequent shortening of the limb that will subsequently take place. For as that portion only of the neck which is in connection with the shaft is absorbed, whilst that in connection with the head remains unaffected, it follows that

the nearer the fracture occurs to the head the greater will be the shortening, and *vice versa*. The direction of the fracture is also of some interest, as it is thought by some authors to determine the everted or the inverted position assumed by the limb after fracture. Thus, they maintain that when the fracture runs obliquely from before backwards and from without inwards, so that part of the lower fragment is behind the upper, eversion will occur; but when it runs from before backwards and from within outwards, inversion will occur. The fracture is generally transverse, and near the margin of the head.

787.—Portion of a femur exhibiting a fracture of its neck. The plane of the fracture extends from the upper margin of the head obliquely through the neck to the outer part of its lower border.

838.—Portions of the upper part of a femur in which a transverse fracture occurred through the middle of the neck. The portion of the neck which was connected with the shaft is nearly absorbed; the portion connected with the head remains, and its lower margin rests on the trochanter minor and the cancellous tissue within it. See also No. 964.

Case H. 851.—Portions of a femur of which the neck was fractured transversely near the margin of the head. The whole of the neck remained in connection with the shaft, and has been nearly absorbed.

Condition of the cervical reflexion of the capsular ligament.

The cervical reflexion of the capsular ligament may be completely torn so that all connection is severed between the head and the rest of the bone; or it may be but partially torn, in which case the rent may occur either in front or behind. Upon the extent of rupture will depend not only the amount of displacement of the fragments and consequent shortening of the limb, as well as the kind of union which will occur, but also the everted or inverted condition of the limb. Eversion, it is maintained, occurs when the anterior portion is ruptured, inversion when the posterior. Although it seems quite evident that non-rupture of the

anterior part may prevent eversion, it is not so evident how rupture of the posterior part could produce inversion.

847.—Portion of a femur, exhibiting an irregular fracture through the base of its neck, which occurred about five months before death. The periosteal and cervical reflexions are torn upon only the *posterior* part of the neck of the bone ; upon its anterior part they are entire.

The patient, a middle-aged man, fell in the street, and his hip struck against the kerbstone. Immediately afterwards the limb was *inverted*, and an inch shorter than the other ; but no crepitus was felt. In the suspicion that dislocation existed, repeated attempts at reduction were made.

944.—Portion of a femur in which a fracture of the neck within the capsule occurred a short time before death. The cervical reflexion of the capsular ligament and periosteum are torn upon only the *anterior* part of the neck ; upon its posterior part they are entire.

945.—Portion of a femur, exhibiting a vertical fracture of recent occurrence through that part of its neck which is within the capsule. Upon the *anterior* half of the circumference of the neck of the bone the periosteal and cervical reflexions are torn ; upon the posterior half they are entire.

946.—Portion of a femur, exhibiting a fracture through its neck, just beyond the base of the head. The periosteum and the reflexion of the capsular ligament covering the neck, as is usually the case, are torn in only the *anterior half* of its circumference : upon the other half the membranes are entire and still connect the two parts of the bone, which may thus, as well as by the mutual adaptation of the uneven surfaces of the fracture, have been held together with very little displacement.

Impaction or non-impaction of the fragments.

In the intra-capsular fracture, impaction takes place by the lower fragment being driven into the upper, *i.e.*, the sharp and narrow neck into the round expanded head ; in the extra-capsular fracture the neck or upper fragment is driven into the lower, *i.e.*, between the trochanters.

In intra-capsular fracture of the humerus, on the contrary, the upper fragment is always driven into the lower, and in

the extra-capsular the lower into the upper; *i.e.*, the sharper and smaller fragment, whether it be the upper or the lower, is impacted between the tuberosities.

In some cases of intra-capsular fracture of the femur, however, the fragments are mutually interlocked.

The non-impacted variety of intra-capsular fracture of the femur is by far the more common.

839.—Sections of the upper part of a femur fractured almost vertically through the neck, at the base of the head and wholly within the capsule. The neck and upper part of the shaft have been drawn a little upwards, and the lower part of the fractured surface and margin of the neck has been driven tightly into the cancellous tissue of the head. The patient was a very old woman. The fracture occurred about three months before death.

Case H. 949.—Portions of a femur, which was fractured vertically through the neck, at the base of the head, a few weeks before death. The plane of fracture is irregular, and the fragments were locked together; so that the principal indications of fracture were absent. See also 949a.

With the exception of the above, all the specimens of intra-capsular fracture in the Museum are examples of the non-impacted variety.

Condition of the capsular ligament.

The capsular ligament is seldom or never ruptured; but after the fracture has existed some time, it becomes thickened, and otherwise altered by inflammation following the injury.

942.—A hip-joint, exhibiting a vertical fracture of recent occurrence through that part of the neck of the femur which is covered by synovial membrane. The capsule is thickened, and a portion of it, which is detached and turned downwards, exhibits inflammatory products upon its internal surface.

943.—A hip-joint, exhibiting fracture of the neck of the femur. The fracture extends vertically through the neck just beyond the base of the head. The capsule is much thickened, and the neck of the femur is absorbed.

METHOD OF UNION.

Union, when it occurs, is nearly always accomplished by fibrous tissue, very rarely by bone. In the majority of cases, however, no union occurs, the ends of the fragments being merely held together by fibrous bands produced by the thickening of the capsular ligament and its cervical reflexion.

Fibrous union.

By fibrous union is here meant the actual union of the fragments by the interposition of fibrous tissue between the fractured ends, in contradistinction to the mere binding together of the ununited fragments by fibrous bands and thickening of the capsule around them.

838.—Sections of the upper part of a femur, in which a vertical fracture occurred through the middle of the neck, within the capsule. The fractured surfaces are united by a thick layer of tough fibrous tissue, permitting a slight degree of motion between them.

839.—Sections of the upper part of a femur, exhibiting an intra-capsular fracture. The fractured surfaces, without any absorption of the neck, have been united by a thin layer of tough fibrous tissue, which permitted them to be slightly moved on each other.

965.—Sections of the head and neck of a femur from an aged woman. A white line is visible on the surface of each section, which extends obliquely from above downwards and inwards. The line marks the section of a thin layer of fibrous tissue, and appears to indicate that a fracture of the neck of the femur has been united by fibrous tissue.

Bony union.

Bony union is exceedingly rare; indeed, some authors maintain that it never occurs. The following specimens, however, appear to be undoubted examples of it.

787.—Portion of a femur, exhibiting fracture of its neck. The plane of the fracture is vertical, extending from the upper margin of the head straight downwards through the neck to the outer

part of its lower border. Bristles are introduced between the fractured surfaces, which are in close apposition, and it will be observed that the attachment of the capsule to the bones is *entirely beyond* the line of the fracture. That portion of the neck of the bone which remained connected with the trochanters is partly absorbed, and the union of the fractured surfaces, though not complete, is by *osseous matter* inlaid between them. The individual from whom this specimen was taken was eighteen years of age. In a fall from a cart he injured his right hip, and such symptoms ensued as gave rise to the belief that he had dislocated the head of the femur into the foramen ovale. Efforts at reduction were accordingly made. About three months after the injury he died of small-pox.

793.—Sections of the upper part of a femur, from a man aged eighty-two, who was believed to have received a fracture of the neck of this bone two years before death.

“The history of the case is clearly that of fracture of the neck of the femur; the appearances of the bone show that there has been a fracture which has reunited by an osseous medium; and the direction of the fracture is such as, in my opinion, can permit no doubt that it was confined to the portion of the neck of the bone covered by synovial membrane, consequently, that it was wholly within the capsule. The fracture extends through the basis of the head of the bone, in the line of its junction with the neck. As in other cases of the same kind, a great part of the neck of the bone has disappeared, and, in consequence, the head is proportionately nearer to the trochanter major and shaft of the bone; its reunion has, in fact, taken place, in part to the remaining portion of the neck, and in part to the shaft. This union is certainly osseous. In addition to the first maceration of the bone with its surrounding soft parts, it was subsequently immersed for several days in a strong solution of carbonate of potash; and one half of the bone has been boiled in water for three hours without the slightest yielding perceptible in the line of the fracture.”

Description of the specimen by Mr. Stanley, in the “Medico-Chirurgical Transactions,” vol. xxiv., p. 13.

964.—Sections of the head and neck of a femur from an aged woman. On the surface of each section a white line is visible, which extends obliquely from above downwards and inwards, in a plane which would include the base of the neck at its upper part, and the base of the head at its lower part. The line marks the section of a thin layer of fibrous tissue, and appears to indicate

that a fracture of the neck of the femur has been united partly by fibrous tissue and partly by bone. The head of the femur is below the great trochanter, and there is an accumulation of bone on the posterior surface of the neck, in a line corresponding with the direction of the presumed fracture.

965.—Sections of the head and neck of the other femur of the same woman. They present the same appearances as those last described, but the line of fibrous tissue is here uninterrupted, while in the preceding it is in some places interrupted by small portions in which the osseous tissue is continuous as if the fracture had in them united by bone.

These preparations were taken from a body supplied for dissection, of which no history could be obtained.

No union.

In the majority of cases no *actual* union of the ends of the fragments takes place, but the neck of the bone becomes absorbed, and the head is merely held in position by fibrous bands produced by the thickening of the cervical reflexion of the capsular ligament, and by the thickened capsule itself. The ends of the fragments either remain rough and uneven; or they become rounded off, polished, and eburnated, and in some cases covered by a layer of fibrous tissue. The space between the trochanters produced by the absorption of the neck frequently becomes modelled into a smooth cup-shaped cavity, in which the rounded extremity of the lower end of the upper fragment freely moves (*false joint*). Irregular osseous deposits are often produced in these cases around the fractured surface of the head and the space between the trochanters.

840.—Portion of a femur in which fracture of the neck occurred many years before death. The neck of the bone is absorbed: both the fractured surfaces are thinly covered by fibrous tissue; and that of the head has become firmly united to the lower part of the thickened capsule by a broad band of fibrous tissue.

848.—A hip-joint, exhibiting fracture of the neck of the femur within the capsule, which occurred many years before death. The neck of the bone is absorbed. Bristles are passed beneath three thick fibrous bands, which extend from the fractured surface of

the head of the bone to the capsule. The capsule is generally thickened, and the fractured surfaces are covered by thin smooth layers of fibrous tissue.

849.—Portion of a femur in which fracture of the neck occurred many years before death. There has been complete absorption of the neck of the bone. The surfaces of the head and of the space between the trochanters which have been in contact, and which probably moved freely on each other, are very hard, polished, and ivory-like.

Case H. 852.—Portion of a femur, exhibiting fracture of its neck, of which no union has taken place. The neck of the bone is almost completely absorbed, and the surfaces by which the fractured portions were in contact are rough and hard. Deposits of osseous substance have taken place around the base of the head of the femur.

From an old woman, in whom the fracture occurred nineteen years before death. See also **Case H. 850, 851, 853, 948.**

Intra-capsular fracture simulated by osteo-arthritis.

Care must be taken to distinguish osteo-arthritis of the hip-joint, which is frequently accompanied by depression and shortening of the neck of the femur, from intra-capsular fracture united by bone. In osteo-arthritis the head of the femur is smooth, polished, eburnated, flattened, and surrounded by nodular, flat osteophytes, and the neck on section presents no indications of fracture having occurred.

Case H. 968.—Portion of a femur, exhibiting a depression and shortening of the neck, with flattening of the head, and formation of bone around its margin.

From an aged person. It was believed, from the circumstances of the case, that the neck of the femur had been fractured in a fall, but there are no indications of a fracture having been united, and it appears on the whole more probable that these changes are due to osteo-arthritis. See also **No. 676.**

II. EXTRA-CAPSULAR FRACTURE.

Extra-capsular fractures are generally caused by direct violence, such as a severe blow or a fall upon the great trochanter. Though more frequent in the old than in the

young, they are not, like intra-capsular fractures, essentially an injury of old age; thus, they are frequently met with between the ages of forty and fifty, whereas intra-capsular fractures hardly ever occur in persons under fifty.

Several varieties of extra-capsular fracture occur. They may be divided into the impacted and non-impacted.

The impacted variety.

This form is by far the more common, and is nearly always associated with fracture through the great trochanter. Indeed, Dr. R. W. Smith believes that all extra-capsular fractures are, in the first instance, impacted and accompanied by fracture through the trochanter. Specimens, however, of extra-capsular fracture unaccompanied by either of these conditions are occasionally met with.

The many minor differences which exist in the impacted variety are comprehended under the three following types.

In the first and most common, the neck is fractured through its base and driven between the trochanters, detaching more or less of the great trochanter from the bone, as in—

752.—Portion of a femur. A fracture extends through the base of the neck and obliquely through the trochanter major, detaching the posterior and upper part of that process from the shaft.

The line of fracture through the trochanter varies slightly in different specimens; it commonly extends from near the anterior part of the upper border of the trochanter major obliquely backwards and downwards over its outer surface, and terminates by passing through the trochanter minor.

This typical direction is well seen in the above specimen, and in Nos. 953, 954, and several others.

953.—Portion of a femur, exhibiting an extra-capsular fracture of its neck. Two distinct lines of fracture may be traced, one across the base of the neck, the other passing obliquely through the trochanter major and trochanter minor.

Slight variations in the line of fracture are seen in Nos. 865, 952.

In the second and much less common type, the neck is fractured through the base and impacted between the trochanters, but the trochanters themselves are not fractured.

951.—Section of the upper part of a femur from an old woman exhibiting an impacted extra-capsular fracture *unaccompanied by fracture of the trochanters*. The base of the neck is in great part absorbed.

Case H. 967.—Portion of a femur, exhibiting a fracture through the base of the neck. The lower margin of the fractured neck is impacted into the cancellous tissue between the trochanters, but no sign of fracture is visible where the upper margin of the neck joins the trochanter major.

Specimens resembling the one last described have been considered by some as examples of partial fractures; *i.e.*, that the lower part of the neck has been fractured, the upper merely bent. Others, however, deny the existence of partial fractures altogether, and consider, with the author that specimens like the above are examples of complete fracture, in which, while the lower portion was impacted, the upper remained in accurate apposition, and has united without a trace of ensheathing callus. In **Case H. 963**, however, the great trochanter has been fractured.

In the third type the neck is fractured through its base and impacted between the trochanters, splitting the trochanter major into several pieces.

Case H. 961.—A femur, exhibiting an extra-capsular fracture; one line of fracture extends through the base of the neck, the other through the trochanter major, splitting it into several fragments. See also 959a.

The non-impacted variety.

Non-impacted extra-capsular fractures are rare. Dr. R. W. Smith says that they only occur as the result of great violence, and that they are always accompanied by fracture through the trochanter. For, believing as he does that all extra-capsular fractures are at first impacted, he maintains that they can only become non-impacted by the splitting

asunder of the parts of the trochanter between which the neck is wedged, in consequence of the neck being driven in still further, wedge-wise, between the trochanters.

There is no specimen of the non-impacted variety of extra-capsular fracture in the Museum.

Method of union.

Union in extra-capsular fractures is generally bony, and thus differs materially from that in intra-capsular, which is nearly always fibrous. In the majority of cases bony callus is produced, consolidating the fractured portions. In other cases the fractured portions of the trochanter may become united so as to form a cup-like depression, in which the neck of the femur rests, the neck itself either being united to the excavated surface of the trochanter by fibrous tissue, or remaining totally disunited, in which case the opposed surfaces become evenly ground down by mutual friction, so giving rise to a species of false joint.

Union by intermediate callus.

955.—Portion of a femur, in which there has been a fracture of the neck and of the upper part of the shaft. The head and neck of the femur are driven downwards and impacted into the cancellous tissue between the trochanters; and in this position the fractured portions are firmly united.

Union by much callus around the fragments.

Case H. 830.—Section of a femur, in which there has been a fracture extending through the base of its neck, and through its shaft between the trochanters. There is firm union of the fractured surfaces, with shortening of the neck and an apparent descent of it below its natural situation. The union has taken place with a great accumulation of bone about the line of fracture.

Case H. 962.—Portion of a femur, in which there has been a fracture extending through the base of its neck and obliquely through the base of the trochanter major. The fractured surfaces have firmly united, but the shaft has been drawn upwards and forwards, so that the head and neck of the femur appear much below their natural situation. In this position a bridge of bone has united the

base of the head of the femur to the margin of the posterior intertrochanteric ridge.

Trochanters united by bone, forming a cup-like depression for the neck.

The Neck united by fibrous tissue to the surface of the cup.

865.—Section of a femur, exhibiting an extra-capsular fracture. The fracture extends through the base of the neck and upper part of the great trochanter. The neck was driven into the upper part of the shaft between the trochanters. In this situation a layer of compact bone has been formed on the whole of the broken surface of the cancellous tissue of the shaft and trochanters, in such a manner as to form a smooth excavation in which the neck of the femur rests. To this excavated surface the neck of the femur, itself also covered with compact bone, was connected by ligamentous tissue. The fracture through the trochanter is completely united by bone.

III. FRACTURE OF THE GREAT TROCHANTER AND SEPARATION OF THE EPIPHYSIS OF THE GREAT TROCHANTER.

No specimen in the Museum.

IV. SEPARATION OF THE EPIPHYSIS OF THE HEAD.

This can only occur in the young, *i.e.*, before the epiphysis has united with the shaft. There is no specimen in the Museum.

FRACTURES OF THE SHAFT.

Fractures through the shaft of the femur are generally the result of indirect violence, occasionally of direct, and in rare instances of muscular action.

The fracture may be transverse or oblique in direction, and may occur in the upper, middle, or lower third of the shaft.

Upper third.

In fractures through the upper third the upper fragment is usually tilted upwards and forwards by the psoas and iliacus muscles, causing a swelling in the groin; at the same time it is slightly everted and abducted by the external rotators and glutei. The lower fragment is generally drawn

upwards by the muscles proceeding from the pelvis to the parts below the fracture, *i.e.*, by the rectus and hamstrings. It is likewise adducted and rotated slightly outwards by the adductors. Union usually occurs with a considerable overlapping of the upper fragment.

Although the form above described is the common displacement, almost any variety may occur.

Case H. 812.—Sections of a femur, in which a fracture extends transversely through the shaft immediately below the neck. The lower portion has been drawn upwards and backwards, so that its upper end is on a level with the trochanter major; and in this position it is firmly united by bone to the back of the trochanter and to the base of the neck.

Case H. 797.—Sections of a femur, in which there has been an oblique fracture of the shaft, extending from an inch below the trochanter minor. The fractured ends overlap considerably, the lower end being drawn upwards *in front of the upper*. This is a rare form of displacement.

Case H. 820.—A femur, which has been fractured at the junction of its upper and middle thirds. The fractured ends overlap considerably, the upper portion lying across the lower, and the lower being much rotated outwards.

Case H. 821.—A femur, which has been fractured transversely, immediately above the trochanter minor. The upper portion has been drawn forwards and upwards, and is firmly united to the top of the shaft, forming nearly a right angle with it.

Case H. 822.—Portion of a femur, which has been fractured about three inches below the trochanter minor. The fracture was a comminuted one, and the portions of bone have been displaced so that a considerable angle, projecting forwards, is formed at their union.

Case H. 970.—A femur, the shaft of which has been fractured very obliquely, from before backwards and from above downwards, a little below the trochanter minor. The fracture is firmly united, with the upper portion of the bone projecting backwards, behind and to the outer side of the lower portion.

Case H. 975.—Sections of a femur, which has been fractured about four inches below its upper end. The fracture is firmly united with some displacement of the ends of the bone.

Middle third.

This is the most common situation for fracture of the shaft of the femur.

The upper fragment is drawn forwards by the psoas and iliacus muscles, everted by the external rotators, and abducted by the glutei. The lower fragment is displaced backwards by its own weight, upwards principally by the rectus and hamstrings, and inwards by the adductors. It is at the same time rotated outwards by the adductors and by the natural tendency of the limb to roll outwards.

Case H. 816.—Section of a femur, which has been broken about the middle of its shaft. The two portions have overlapped considerably, and are united in this position. See also **Case H. 803, 810, and 814.**

Case H. 974.—A femur, which was fractured through the middle of its shaft. The fracture is firmly and smoothly united, with the upper portion of the bone projecting slightly forwards and the lower portion rotated outwards.

Lower third.

In fractures through the lower third the upper fragment is rotated slightly outwards, and at the same time drawn forwards by the psoas and iliacus, and approximated towards the middle line by the adductors. The lower fragment is drawn backwards into the popliteal space by the gastrocnemius, and upwards behind the upper fragment by the rectus and hamstrings.

Case H. 754.—Portions of a femur fractured in two places by a wheel passing over the limb. One fracture is about one third from its upper end, and the other at the same distance from its lower end.

Case H. 823.—The bones of a knee-joint. There has been a transverse fracture through the lower third of the shaft of the femur above the condyles. The upper end of the bone, which protruded downwards and backwards into the popliteal space, has, in this position, become firmly and extensively united to the condyles. There is a complete osseous ankylosis of the patella to the femur, and of the condyles of the femur to the head of the tibia.

976.—Section of a femur in which there was an oblique fracture through the lower third of the shaft near the condyles. The upper portion of the bone projects far down in front and on the inner side of the lower portion ; but their adjacent surfaces are firmly united by intermediate new bone. See also Nos. 846 and 857.

FRACTURE OF THE LOWER END.

Fracture through the lower end or condyles necessarily involves the knee-joint. The line of fracture generally extends in several directions ; in most cases it runs transversely through the lower end of the shaft, just above the articular surfaces of the condyles, and vertically or obliquely between the latter into the knee-joint. The lower end of the upper fragment is frequently impacted between the separated condyles. In young subjects the fracture is apt to occur in the line of the epiphysis. Fracture through the condyles frequently leads to destructive inflammation of the knee-joint. The union of the fracture between the condyles is accomplished by fibrous tissue.

Case H. 747.—Portion of a femur fractured in its lower part. The fracture extends in several directions through the lower third of the shaft a little above the condyles, and downwards between the condyles into the knee-joint. Several small pieces of bone were completely detached. See also **Case H. 978 and 979.**

Case H. 750.—Portion of a femur which has been fractured transversely through the middle of the shaft, and in which there is an extension of the fracture downwards through the lower half of the shaft and through the internal condyle.

756.—A knee-joint, exhibiting the consequences of a fracture in the lower part of the femur. The fracture extended transversely through the shaft a little above the condyles, and downwards between the condyles into the joint. The upper portion of the bone was forced downwards by the side of the patella, and a few days after the fracture it protruded through the integuments, and could not again be replaced. In this situation it has become firmly fixed by bone to the condyles and the lower part of the shaft. An inch and a half of the protruding portion of the femur perished, and its separation from the living bone had commenced ; a shallow

groove is formed between them. The articular surfaces of the knee-joint are ankylosed.

Case H. 980.—Portion of a femur which has been fractured in its lower part. The fracture extends transversely through the shaft, and obliquely between the condyles into the knee-joint. The lower end of the shaft is driven in between the displaced and separated condyles.

SEPARATION OF THE CONDYLES OF THE FEMUR THROUGH THE LINE OF THE EPIPHYSIS.

Case H. 758.—The lower portion of a femur, from a boy fourteen years old. The condyles of the femur have been separated from the shaft at the line of their epiphysial union.

981.—Portion of a femur, exhibiting a separation of its shaft from the lower epiphysis, and a fracture extending between the condyles into the knee-joint. The violence of the injury has also occasioned the stripping off of the periosteum from the shaft of the femur to the extent of many inches, and the shaft protruded through the muscles on the inner side of the thigh. Parts of the periosteum, which were stripped from the shaft, remain attached to the condyles. From a boy aged sixteen. The injury was produced by a rope entangled round the leg. See also **Case H. 982.**

FRACTURES OF THE PATELLA.

Fractures of the patella are generally caused by muscular action, the bone being snapped across by a sudden contraction of the quadriceps extensor muscle, such as is exerted by a person in the attempt to regain the erect position when he feels himself slipping backwards. They are also caused by direct violence, such as a blow or fall upon the knee.

The direction of the fracture when due to muscular action is transverse; when due to direct violence it is generally vertical or starred, or, in rare instances, transverse. The amount of displacement depends upon the direction of the fracture and the integrity of the aponeurotic and periosteal coverings of the bone. When the fracture is transverse and the aponeurotic coverings are much torn, the upper fragment will be drawn some distance from the lower by the action of the quadriceps extensor, while the lower is held in position

by the ligamentum patellæ; but when the aponeurotic coverings are but slightly torn, or altogether uninjured, little or no separation occurs. When the fracture is vertical or starred, the aponeurotic coverings are seldom torn, and hardly any separation of the fragments takes place.

In all cases of fractured patella, the fracture extends into the joint, and there is an immediate effusion of blood.

Method of union.

This will depend upon the condition of the fragments. In transverse fracture from muscular action, in which the aponeurotic coverings are generally torn and the fragments much separated, the union will be either ligamentous or membranous, according to the amount of separation, but in those rare instances of transverse fracture from direct violence, where the aponeurotic coverings are only slightly injured, and the fragments consequently remain nearly in apposition, true bony union may occur.

In the vertical and starred fractures, where the fragments are usually but little separated, bony union may be said to be the normal method of repair.

FROM MUSCULAR ACTION.

I. Ligamentous or fibrous union.

841.—Section of a patella that has been fractured transversely. There is no bony union, and no production of new bone. The surfaces of the fracture have undergone but little change. In consequence of the insertion of the extensor tendon and ligamentum patellæ chiefly into the free and external surface of the bone, the fragments have been drawn asunder to a greater extent externally than at their articular surfaces; so that a wedge-shaped interval exists which in front measures one inch and a half, although towards the joint surface it is only six-tenths of an inch. Ligamentous material has been produced from the whole of both fractured surfaces; but in front this has undergone stretching, while towards the surface it constitutes a strong, thick, and wide connecting band between the fragments.

988.—Section of a patella, in which there has been a transverse fracture. The fractured surfaces are united by a thick portion of

ligament about an inch in length, which is smoothly lined, as if by a continuation of the synovial membrane. See also Nos. 987, 988a and 989.

II. *Membranous union.*

843.—Two patellæ from the same person. Both bones have been fractured transversely. The fractured portions of each, having been separated to a distance of five inches from each other, are connected only by a thin aponeurotic membrane. The fragments are all, but not equally enlarged.

855.—A knee-joint from a person who fractured the patella many years before death, and recovered complete use of the limb, although no union of the fragments took place. The portions of the patella separated by transverse fracture are about four inches apart when the joint has been extended almost to its full extent. Their broken surfaces are turned obliquely forwards and are smooth, and thinly covered with fibrous tissue, whilst their posterior borders are tightly connected with the synovial and fibrous capsules of the joint, and these hold them in their places; there is no direct or new-formed bond of union between them.

FROM DIRECT VIOLENCE.

I. *Bony union—common.*

985.—A patella, fractured in three lines radiating from the centre to the circumference. The portions are completely and closely united by bone and with very little displacement, the lower portion alone being pushed somewhat forwards. Some new bone is deposited along the lines of fracture on the anterior surface of the patella; the posterior surface is smooth, and presents no new bone; the margin of one of the fractures has still the appearance of a fracture of recent occurrence.

It is probable that the fracture was caused by a blow upon the patella. See also No. 795.

II. *Ligamentous union—rare.*

842.—Section of a patella which has been fractured into three pieces. The portions are united by a thick ligamentous substance and are all enlarged; the upper fragment alone is as large and has the same form as an ordinary adult patella. See also No. 984.

983.—A patella, in which a vertical fracture occurred a short time before death. The tendinous covering of the anterior surface of the bone is entire. Union of the fracture has not yet commenced.

The articular cartilage is in part absorbed, but this had, probably, occurred before the fracture.

FRACTURES OF THE BONES OF THE LEG.

Fractures of the leg may be divided into—fractures of both bones, fractures of the tibia alone, and fractures of the fibula alone. Of these, fractures of both bones are by far the most common.

FRACTURES OF BOTH BONES.

Fracture of the tibia and fibula may be caused by direct or indirect violence. When it is the result of direct violence, the fracture may of course occur at any part; but when it is the result of indirect, only at the weakest part. Both bones may be fractured in the same transverse line, but more commonly the fibula is fractured higher up the shaft than the tibia.

The line of fracture may be transverse or oblique. In the former case but little displacement occurs; in the latter the lower fragments are generally drawn backwards, upwards, and a little outwards, the line of fracture commonly extending downwards, forwards, and a little inwards. Fracture of the lower end of the tibia, combined with fracture of the fibula a few inches above the external malleolus, is a common variety of fracture of both bones.

Fracture of both bones in the same transverse line.

Case H. 825.—A tibia and fibula, fractured through the middle of their shafts. The fractures are firmly united, but with displacement of the fragments, so that in each bone there is a considerable angle directed inwards.

Case H. 993.—A tibia and fibula, which were fractured somewhat obliquely near the middle of their shafts. The several portions are firmly united, but with lateral displacement, both the lower fragments being placed on the outer side of the upper ones. See also **Case H. 996, 997.**

Fracture of both bones, but in different situations.

Case H. 991.—A tibia and fibula. The tibia has been fractured in its middle, and the fibula near its upper end. Both fractures

are firmly united, with displacement and overlapping of the fractured ends, so that the tibia at the seat of fracture forms an angle directed backwards, and the fibula an angle directed outwards. Both the bones are also atrophied, and very slender.

Case H. 995.—A tibia and fibula. The tibia has been fractured about one-third from its lower end, and the fibula near its upper end. Both fragments are firmly and smoothly united, but with a slight lateral displacement, the lower fragments converging in the interosseous space.

Fracture extending into the ankle-joint.

Case H. 748.—Portions of a tibia and fibula. There is a comminuted fracture of the tibia about two inches above the ankle, and two lines of fracture extend downwards into the ankle-joint. The fibula is fractured about four inches above the ankle.

Case H. 834.—Portions of a tibia, fibula, and the astragalus. Both the tibia and the fibula were fractured about three inches above the malleolus, and the fracture of the tibia extends downwards into the ankle-joint. The fractures are all firmly united with little displacement, but with much thickening and induration of the bones, and with osseous union of the tibia and fibula, and of both of them to the astragalus.

Case H. 1005.—Portions of a tibia and fibula. Fractures extend in several directions through the shaft and articular end of the tibia into the ankle-joint. The fibula also is fractured through the base of the malleolus.

FRACTURES OF THE TIBIA.

Fracture of the tibia alone may be caused by direct violence; or by indirect violence, such as a fall upon the foot, when the tibia, receiving the shock transmitted from the foot, gives way at its weakest part, in the same manner as the radius from a fall upon the hand. The fracture is usually situated at the lower part of the bone, and is generally transverse and accompanied by but little displacement, the fragments being held in position by the fibula, which plays the part of a splint. Fracture may also occur through the lower end and extend into the ankle-joint, in which case the lower fragment along with the foot may be displaced. Fracture of the upper end extending into the

knee-joint also occurs (990a). In the young, separation of the lower epiphysis has been recorded.

Fracture of the upper end of the shaft extending into the knee-joint.

990a.—The head of the right tibia, which has sustained a comminuted fracture with impaction. The lower fragment or shaft of the tibia has been driven upwards and forwards into the head of the bone, whilst a longitudinal fracture runs across the articular surface of the internal tuberosity. This fracture is longitudinal and simple until it reaches the posterior border of the tibia, when it divides into two branches, one running directly backwards, and the other running outwards splits off a small portion of the articular surface of the external tuberosity. The head of the fibula is broken into several pieces.

From a woman, aged seventy-six, who fell downstairs with her leg doubled under her. She died a fortnight after the accident.

Middle of the shaft.

Case H. 835.—A tibia, fibula, and astragalus. The tibia has been fractured at the junction of the upper and middle thirds of its shaft. Its two portions, displaced laterally, have been firmly united. The fibula in adaptation to the altered form of the tibia, to which also it is united by two bridges of new bone, is bent and flattened, as in rickets.

Case H. 994.—A tibia, which was fractured very obliquely through the middle of its shaft. The fractured portions are firmly united, and so exactly that on the posterior aspect of the bone the line of fracture is not discernible. The shaft in the neighbourhood of the injury is thickened, and new bone is deposited on many parts of its surface.

Fracture extending into the ankle-joint.

1008.—The lower extremities of a tibia and fibula. A recent fracture extends through the articular surface and cartilage of the tibia. The communication of this fracture with the ankle-joint is closed by a thin layer of inflammatory material, firmly adhering to all the parts of the articular cartilage through which the fracture extends.

Case H. 1009.—Bones of an ankle-joint, exhibiting a double fracture of the internal malleolus, separating it from the tibia, and splitting it into two portions.

FRACTURES OF THE FIBULA.

Fractures of the fibula may be caused by direct or indirect violence. When due to direct violence the fracture necessarily occurs at the seat of injury; when due to indirect violence, such as a twist of the foot outwards or inwards, the fracture occurs three or four inches above the external malleolus. When the fracture is the result of an outward twist (*Pott's fracture*) the foot is usually dislocated outwards (**Case H. No. 1002**), the external lateral ligament is intact, and the internal ligament is ruptured, or the internal malleolus is torn off (**Case H. No. 1004**), the ligament remaining intact. When it is the result of an inward twist of the foot, the external lateral ligament is intact, but an outward angle is formed at the seat of fracture, and the internal malleolus is fractured or the internal lateral ligament ruptured.

Fracture of the shaft.

Case H. 817a.—Portion of a fibula which had been fractured at the junction of its lower and middle thirds long before death. The two portions of the bone overlap: they have been firmly united by bony substance deposited between their two surfaces.

Fracture of the lower end (Pott's fracture).

Case H. 1002.—The lower extremities of the tibia and fibula, with the foot, of an elderly woman, exhibiting the effects of an injury which occurred several years before death. The foot is dislocated outwards, so that only the outer half of the articular surface of the tibia is in apposition with the astragalus. There has been a comminuted fracture, extending in various directions through the lower end of the fibula and the adjacent margin of the tibia. The separated portions of bone have been completely reunited.

Case H. 1003.—A foot, with parts of the tibia and fibula, exhibiting the effects of fracture and dislocation ten months before death. The foot is dislocated outwards, and the tibia is partially separated from the fibula; the internal malleolus projects an inch on the inner side of the astragalus. The astragalus also is partially separated from the scaphoid bone. The fibula has been broken into several pieces just above the malleolus. These portions are firmly reunited, and there is an accumulation of bone both before and behind the articulation between the tibia and the fibula.

The patient was a lunatic, forty years old. The dislocation was not reduced till a month after its occurrence, and the patient's restlessness prevented the tibia from being maintained in its proper place ; but he finally regained complete use and power in the foot. See also **H. 1006**. The appearances presented by the foot in cases of unreduced Pott's fracture are well seen in **Casts 31 and 32**.

FRACTURES OF THE BONES OF THE TARSUS.

Fractures of the tarsal bones are rare ; they are for the most part the results of great violence. They generally occur either in the os calcis or astragalus, the smaller tarsal bones being almost exempt from fracture. The posterior part of the os calcis may be broken off by muscular action, the bone yielding instead of the strong tendo Achillis (**No. 1012**).

FRACTURE OF THE OS CALCIS.

Case H. 1010.—The foot of a child, exhibiting a partial dislocation of the astragalus from the os calcis, together with a fracture of the superior and anterior margins of the latter bone, in consequence of the passage of a carriage-wheel over the foot.

Case H. 1011.—A comminuted fracture of the os calcis.

1012.—An os calcis, fractured transversely through its posterior part. The plane of the fracture extends from the posterior border of the upper articular surface to the middle of the posterior surface of the tuberosity.

The patient fell from a height, but did not strike his heel. It appears certain that the fracture of the os calcis was produced by the action of the muscles of the leg.

FRACTURE OF THE ASTRAGALUS.

1009a.—An astragalus, removed by operation, with a fracture extending transversely across the bone near its posterior margin. The extremity of the external malleolus, separated by a fracture, is attached to the astragalus. From a man who fell from a scaffold near the top of a house. The astragalus was dislocated forwards and outwards, and projected from a vertical slit in the skin on the outer side of the ankle. After an unsuccessful attempt at reduction the bone was removed. The patient recovered with a useful limb.

GUNSHOT INJURIES.

Gunshot injuries of the bones are rare in civil practice. The following are specimens of these injuries. The specimen in **Case H. 761c**, is especially worthy of examination since it shows the peculiarities of the apertures of entrance and exit of a bullet wound. The aperture of entrance is seen to be small and well defined, with a bevelling of the inner table; whilst the aperture of exit is larger and more irregular, the inner table being sharply cut and the outer bevelled.

761.—A skull. A bullet has passed through the squamous portion of the right temporal bone, at its junction with the parietal.

763.—Portion of a sternum, fractured upon its internal surface by a bullet, which has become firmly embedded in the surface of the bone and in new bone deposited so as to form a shallow pit beneath it.

763a.—Portions of three right ribs, with the corresponding vertebræ. There is a comminuted fracture of the ninth rib between the angle and the articular end, produced by a conical pistol bullet, which is seen *in situ*. It had not penetrated the muscles of the back. Above, portions of the skin and muscles, from the anterior wall of the thorax, are suspended; a glass rod is inserted into an oblique channel through which the bullet entered the chest, between the fifth and sixth ribs. The right lung, which was penetrated by the ball, is preserved in **Series xi., No. 1759a**. The patient was about fifteen yards from the man who shot him. He survived the injury three days.

Case H. 764.—A right innominate bone; on the outer side of the ilium is a large circular aperture, and around it are many indentations, in some of which the shot producing them are seen impacted in the osseous tissue. From a boy, who died sixteen days after having been accidentally shot. A probe introduced along the track of the shot detected bone denuded of periosteum; it being suspected that pus had formed on the pelvic aspect of the ilium, the surface of that bone was exposed, and the opening, conspicuous in the preparation, was made with the trephine.

Case H. 765.—Part of a femur, from the body of a Russian whose limb was carried off by a round shot at the battle of Cherneya. See also **Case H. 761a, 761b, and 766; and 768**.

SECTION III.

DISEASES OF JOINTS.

SYNOVITIS.

SYNOVITIS is the name given to inflammation of the joints beginning in the synovial membrane. It may be acute or chronic.

ACUTE SYNOVITIS.

Acute synovitis is generally the result of exposure to cold and damp, or of an injury, such as a sprain or blow—*acute traumatic synovitis*; it may also arise from constitutional causes, such as rheumatism, gout, gonorrhœa, or pyæmia—*acute infective synovitis*.

In the early stages the synovial membrane is red and injected, and the synovial fluid slightly increased in quantity. Later, the membrane loses its shiny appearance and becomes infiltrated and slightly thickened, and the fluid turbid from admixture with inflammatory products. In the majority of cases the inflammation, after having reached this point, subsides, the effused fluid is absorbed, and the synovial membrane assumes its normal appearance. If, however, resolution does not occur, the inflammation either passes into the chronic form, or runs on to destruction of the joint. Under the latter circumstances the synovial membrane becomes more intensely injected, swollen, and infiltrated, and pus is formed in its tissues and in the cavity of the joint. The inflammation spreads to the cartilages, which are rapidly destroyed, and the bone beneath becomes

superficially ulcerated. The capsular and other ligaments are softened and stretched, allowing the articular surfaces to be more or less separated by the action of the muscles. The surrounding soft tissues are infiltrated with the inflammatory material, which, breaking down in places into pus, gives rise to abscesses—*acute arthritis*.

Should the patient survive this total disorganization of the joint, the pus and other inflammatory products make their escape externally, and the contiguous ulcerated surfaces of the bones become covered with granulations, which subsequently unite, and after passing through a stage of fibrous tissue, undergo ossification, leaving the patient with a stiff joint (*bony ankylosis*). The muscles, which normally act upon the articulation, undergo partial atrophy and fatty degeneration from want of use.

In pyæmia, and in some forms of synovitis in children, the inflammation runs an extremely rapid course, and the joint may be found distended with pus in a few hours.

The successive changes in the synovial membrane, cartilages, bones, and structures surrounding the joint, should next be studied in detail by the aid of the following specimens.

Changes in the synovial membrane.

a. Increased vascularity and slight swelling of the synovial membrane. Effusion of serum into the cavity of the joint.

b. Intense vascularity and great swelling of the synovial membrane from inflammatory infiltration. Formation of pus in the cavity of the joint.

576.—A knee-joint. The synovial membrane is very vascular, and is covered upon its internal surface by inflammatory products. The inflammation was the result of necrosis of a portion of cancellous tissue in the head of the tibia. See also 576a.

Changes in the cartilages.

a. Invasion of the cartilage by the bloodvessels of the synovial membrane and of the underlying bone. Opaque

white appearance and loss of translucency and smoothness of the cartilages.

582.—A knee-joint. The synovial membrane is thickened and increased in vascularity. The encroachment of the vessels of the synovial membrane upon the cartilages is well seen. Upon the patella, as well as upon the outer condyle of the femur and head of the tibia, the free surface of the articular cartilage is extensively destroyed. The patient was a boy aged fifteen. The disease had been only of two months' duration.

b. Destruction of portions of cartilage; the margins of the remaining portions either abrupt and smooth, as if cut by a chisel, or thinly prolonged over the surface of the bone (No. 579a).

584.—The articular portions of a femur and patella, exhibiting partial destruction of the articular cartilages and loosening of their connection with the bones. The cartilage upon the patella has been destroyed in its centre, and it was readily separable from the bone, except at its border, where it still maintains its natural firmness of connection. Upon the posterior part of the condyles of the femur, the whole thickness of the cartilage is destroyed: the exposed surface of the bone is rough and very vascular.

587.—A patella, from which nearly all the articular cartilage has been removed by ulceration. The ulceration appears to have extended from the free surface towards the bone; the margins of the remaining peripheral part of the cartilage are either abrupt and smooth, as if cut with a curved chisel, or, in parts, thinly prolonged over the surface of the bone. All the cartilage that remains has retained its natural firm connection with the bone. The part of the surface of the patella which is exposed by the ulceration of the cartilage is itself superficially ulcerated.

589.—An astragalus, from the superior articular surface of which nearly all the articular cartilage has been removed; a small portion remains closely adherent to the bone, and very thin. The exposed surface of bone is healthy, except at one small portion, which is superficially ulcerated.

On microscopical examination the above-mentioned changes in the cartilages, which were formerly spoken of as ulceration, are seen to consist in the growing into the cartilage of capillary bloodvessels from the synovial membrane and

bone; in the enlargement of the cartilage-capsules; in the multiplication and escape of their cellular contents; and in the softening and liquefaction of the matrix.

Changes in the bones.

a. Superficial ulceration of the surfaces exposed by the destruction of the cartilages.

565.—A hip-joint. The cartilages have been completely separated from the head of the femur and from the acetabulum, and some shreds and remnants of it are loose in the cavity of the joint. The exposed bones are superficially but smoothly ulcerated.

The patient was a sailor, forty years old. Inflammation of the joint was the result of a fall upon the hip.

590.—An ankle-joint, from which nearly all the articular cartilages have been removed; the small portions which remain are thinned, and their connection with the bones is loosened. The bones are superficially ulcerated and very vascular. The posterior surface, by which the astragalus articulated with the os calcis, is similarly diseased.

The changes that occur in ulceration of the articular surfaces of bone will be found described in detail under "Simple Caries," page 17.

b. Partial or complete dislocation of the articular surfaces from muscular contraction. Softening and elongation of the ligaments.

631.—A knee-joint, in which, as a result of disease, the tibia has been dislocated backwards and outwards. The external and internal lateral ligaments retain their normal attachments, but are much elongated.

c. Formation of granulations on the contiguous surfaces of the affected bones; union of the two layers of granulations; transformation of the united layers into fibrous tissue and bone (*bony ankylosis*).

639.—Section of a knee-joint, the articular surfaces of which are united by fibrous tissue and bone. The patella is united to the inferior part of the outer condyle of the femur, and their

respective cancellous tissues have coalesced. The tibia and fibula are drawn backwards under the femur. The direction of the external lateral ligament is changed and it is elongated.

The other section of the joint is preserved in **Case G. 656**. See also **Case G. 649**.

d. Formation of new bone as stalactitic spicula under the periosteum around the ulcerated articular surfaces.

596.—Bones of an elbow-joint, exhibiting the effects of inflammation, which probably commenced in the joint. The texture of the bones has become porous and spongy, their articular surfaces are ulcerated, and upon the external surface of each bone there is an irregular deposit of new bone in ridges and sharp processes.

Compare these stalactitic formations with the nodular osteophytes of osteo-arthritis (**Case G. 696**).

Changes in the parts around the joint.

Thickening, softening, and ulceration of the capsular and other ligaments; formation of abscesses around the joint.

599.—A hip-joint, in which the articular cartilage covering the acetabulum and head of the bone is completely destroyed. The exposed surfaces of bone are ulcerated, and the acetabulum is thereby enlarged. The ligamentum teres is also in great part destroyed; but shreds of it remain, and retain their connection with the bones. The capsule is thickened, and its inner surface is thinly lined by inflammatory products.

Acute inflammation of the synovial membrane may also follow pyæmia (**No. 567b**), wounds of the joint (**No. 740**), the bursting of an abscess into a joint (**Nos. 564, 576a, and 1205e**), the spread of suppuration from the neighbouring parts (**No. 582**), necrosis of the cancellous tissue (**No. 576**), acute infective periostitis (**No. 34**), epiphysitis (**No. 621**), osteo-myelitis (**No. 33**), or osteitis (**No. 100**). In these cases, however, the inflammation usually affects at the same time the capsule and other parts entering into the formation of the joint, and is by some authors spoken of as acute arthritis. As the changes, however, which occur in

the various structures are similar to those above described, except that they do not follow one another in the same order, a separate description of so-called acute arthritis has not been thought necessary.

CHRONIC SYNOVITIS.

Chronic inflammation of the synovial membrane may be the sequel of acute synovitis, or it may be traced to a sprain or other slight injury, or to rheumatism, exposure to damp, and similar agencies. Chronic synovitis occurring in so-called strumous subjects will be described under tubercular disease of the joints.

On opening the joint, the synovial membrane is seen slightly thickened, and the synovial fluid increased in quantity, but the cartilages are but little if at all affected. The inflammation may terminate in resolution or in an acute attack.

The well-known condition of the joints, formerly called *hydrops articuli*, in which the synovial membrane is greatly distended by clear serous fluid, but is little, if at all, altered in structure, is thought by some to be of the nature of chronic synovitis. Many assert, however, that it is of non-inflammatory origin, and merely a passive effusion into the joint depending upon the loss of balance between the absorbing and secreting action of the synovial membrane. The affection, which is unattended by pain or other inconvenience except the weakness it occasions in the joints, may last for years.

CHRONIC TUBERCULAR DISEASE.

Tubercular disease, also called strumous arthritis, tumour albus, white swelling, fungous inflammation, etc., is characterized by a gradual and uniform enlargement of the joint, unaccompanied by redness or much increase of synovial secretion. The term "strumous" is that by which the disease in question has hitherto been best known.

The affection appears to be always associated with the development of tubercular lesions in the synovial membranes or bones, in which the tubercle bacillus can readily be demonstrated by appropriate staining. It therefore begins either as a tubercular synovitis or a tubercular caries.

BEGINNING IN THE SYNOVIAL MEMBRANE—TUBERCULAR SYNOVITIS.

The synovial membrane, which at first appears red and swollen, gradually becomes thickened and œdematous, and ultimately pulpy, gelatinous, fatty-looking, and indistinguishable from the capsule and surrounding parts. The synovial fluid is but little increased in quantity, and is generally muco-purulent. The synovial tufts, at first soft and flocculent, gradually assume the form of granulations (No. 569c), and grow over the cartilage from the sides till they cover it completely, lying upon it like a veil. Prolongations from this veil of granulations, compared by Billroth to roots of ivy penetrating a wall, insinuate themselves into and spread in all directions through the cartilage, which they ultimately destroy, and then in like manner invade the bone, setting up tubercular caries. This inflammation of the synovial membrane is preceded by the formation of miliary tubercles in the membrane itself.

Fungous granulations invade the tissues around the joint, and, breaking down in places into pus, give rise to abscesses, which may open both externally and into the cavity of the joint. The ligaments become softened and destroyed, allowing the articular surfaces to be dislocated by the contraction of the muscles. The muscles and bones, partly from want of use, and partly from the debilitating nature of the disease, undergo atrophy and fatty degeneration.

Should the patient survive this total disorganization of the joint, the abscesses and sinuses heal, granulations form upon the ulcerated articular surfaces of the bones, the two layers of granulations unite, and osseous or fibrous ankylosis ensues, leaving the patient with a stiff joint.

The above-mentioned changes in the synovial membrane, cartilages, bones, and surrounding parts, should next be studied in detail by the aid of the following specimens :

Changes in the synovial membrane.

a. Swelling and redness of the synovial membrane ; the synovial tufts puffed up, elongated, soft, and succulent ; the synovial fluid slightly increased in quantity, cloudy, and muco-purulent.

570a.—The left hip-joint, showing the changes which occur at an early period of tubercular arthritis. The cartilage covering the head of the femur is eroded on its anterior surface close to the neck. The ligaments are softened, and the synovial membrane is slightly thickened, but it was not hyperæmic.

From a woman aged thirty-three, who died of exhaustion consequent upon necrosis of the sacrum. At the time of her admission to the hospital, there was considerable thickening of the tissues about the great trochanter. The movements of the hip-joint were good, except that external and internal rotation were limited.

b. Thickened, softened, and œdematous condition of the synovial membrane from inflammatory infiltration ; villous-like appearance of its internal surface ; and encroachment of the synovial tufts in the form of granulations upon the cartilages.

567.—A knee-joint. The synovial membrane, which is thickened, has been injected to show its greatly increased vascularity. It appears villous and flocculent on its internal surface, and has grown over and into the articular cartilages at their margins, from which it can be raised by a needle, showing that these structures are superficially eroded.

c. Blending of the synovial membrane with the capsule and surrounding parts. Œdematous, fatty, gelatinous, and pulpy condition of the synovial membrane, and still further encroachment of the synovial tufts in the form of red pulpy masses of granulations upon the cartilages.

569c. — A knee-joint exhibiting typical tubercular synovitis (*pulpy degeneration*). Nearly the whole of the articular surfaces

are overgrown by the thickened synovial membrane. The articular cartilages everywhere appear healthy, and no morbid change is visible in the bones.

From a man aged thirty-four, whose left knee became swollen and painful two years before the amputation was performed. See also Nos. 569b and 633.

Changes in the cartilages.

a. Loss of translucency; erosion and perforation of the cartilages by fungous granulations from the synovial tufts.

567.—A knee-joint. The cartilages are superficially eroded by the overgrowing synovial tufts. See also No. 633.

b. Complete destruction of the cartilages by the fungating granulations.

591.—An ankle-joint. The cartilages are completely destroyed, and the bones are covered by fungating granulations.

The minute changes that occur in the destruction of the cartilage (formerly called ulceration) consist in the proliferation of the cartilage-cells in consequence of the increased nourishment which they receive from the vascular ingrowing synovial tufts, and in the blending of the proliferating cartilage-cells with those of the synovial ingrowths, and the consequent softening and liquefaction of the matrix by the combined proliferating mass.

It will be thus seen that the destruction of the cartilage, as pointed out by Billroth, takes place in the same way as the destruction of bone, with the difference, however, that the cartilage-cells themselves possibly take an active part in the destruction of the intercellular substance, while the bone-cells remain inactive, the absorption being effected solely by the exuberance of the cells (inflammatory material), in the Haversian canals.

In some instances the bones become inflamed before the cartilages have been perforated by the fungating growth from the synovial membrane. In such instances a similar fungating mass of granulations springs from the bone, and invades the deeper layers of the cartilage, so that the

cartilages become loosened from the bone, and lie partly movable between the upper and lower layer of granulations.

572.—Bones of a knee-joint, exhibiting the effects of inflammation. Parts of the free surface of the cartilage upon each bone have been destroyed. There has also been a more extensive erosion of the deep or attached surface of the cartilage, so that its connection with the bone was loosened, and it was readily separable from it. Where the absorption of the deep surface of the cartilage has taken place, granulations have arisen from the bone.

591a.—An astragalus. The cartilage upon the superior articular surface is penetrated by several apertures, produced by ulceration. From some of these apertures fistulous passages pass into the bone, which is carious around them. Portions of glass rod are inserted into the carious channels. From a patient whose foot was amputated for disease of the ankle-joint.

Changes in the bones.

a. Invasion of the bone by the proliferating granulations derived from the inflamed synovial tufts; inflammation and subsequent ulceration of the bones (*tubercular caries*).

577.—The inner section of an ankle joint. The articular surfaces of the tibia and astragalus are extensively destroyed and covered by granulations. There is a cavity in the lower end of the tibia, which is filled up by fibrous tissue. The bone above it is condensed, and the astragalus immediately beneath the eroded surface is similarly hardened. The synovial membrane is pulpy. The other bones of the tarsus are soft, but not carious, and the joints are healthy.

From a woman aged 58, whose ankle became swollen and painful without evident cause two years before her admission to the hospital.

The minute changes in the bone are essentially the same as those which occur in acute synovitis running on to destruction of the joint (No. 596a), viz., rarefying osteitis and caries, but the osteitis and subsequent ulceration following tubercular synovitis appear generally to be induced by the proliferating synovial granulations which

invade the bone; there is also greater destruction of the affected bone, and less tendency to ankylosis and the formation of new bone around. The destruction, however, though more extensive than after acute synovitis, is less extensive than when the inflammation begins in the bones themselves.

b. Dislocation of the ulcerated articular surfaces of the affected bones.

625.—A hip-joint, from an adult, exhibiting the effects of inflammation. The head of the femur is dislocated from the acetabulum. It is drawn upwards and backwards upon the dorsum of the ilium, where it rests surrounded by a capsule formed, probably, in part by the diseased capsule, and in part by the surrounding tissue thickened and consolidated.

c. Ankylosis of the bones entering into the formation of the affected joint.

Case G. 653.—The bones of a hip-joint, in which the head of the femur, after superficial ulceration, has been displaced on the posterior border of the acetabulum, and is there firmly united by bone. New bone has also been formed on all the adjacent parts of the os innominatum. The acetabulum was deeply ulcerated. See also **Case G. 650a, 650b, and 651.**

As a result of the dislocation backwards, the flexion, and the rotation outwards, the knee-joint in cases of cured tubercular synovitis which has not been properly treated assumes the position of "*triple displacement*," which is well seen in—

Case G. 656a.—A portion of the femur and tibia with the patella. The bones are fused together by the process of bony ankylosis. The tibia is dislocated outwards and backwards, as the result of long-standing joint-disease. The specimen, therefore, illustrates the form of "*triple displacement*" which so often succeeds chronic inflammation of the knee-joint, for the articulation is flexed, dislocated backwards, and rotated outwards.

Such a favourable termination as ankylosis is much less common after tubercular disease than after destructive inflammation of the joint consequent upon acute synovitis.

d. Atrophy and fatty degeneration of the affected bones from prolonged rest and faulty nutrition.

115.—Section of the bones of a diseased elbow-joint, from a boy in whom the disease had lasted three years. Their whole texture is very light and brittle.

Case G. 638.—Pelvis and femora, from a young man. The head of the femur and the acetabulum on the left side exhibit changes consequent on long-continued disease of the hip-joint. The left os innominatum and femur, atrophied probably in consequence of their disuse, are considerably thinner and smaller in all their dimensions than the bones of the opposite side, and the left side of the pelvis is contracted by the nearly vertical position of the ilium.

TUBERCULAR DISEASE BEGINNING IN THE BONES—ARTICULAR CARIES.

When the disease has its origin in the bones, it begins as a chronic inflammation (*tubercular caries*) of their articular ends. The fungous granulations (*inflammatory material*) filling the carious bone gradually make their way into the joint, loosening, eroding, or perforating the cartilages, and setting up inflammation in the synovial membrane. After the synovial membrane has become involved, rapid disorganization of the joint ensues, accompanied by similar phenomena to those already described. The destruction of the bones, however, is more extensive, and the disorganization of the joint consequently more complete.

Changes in the bones.

The changes that occur in the bones previously to the joint becoming involved will be found described in detail under "Caries," p. 17, and "Tubercle in Bone," p. 52. The following specimens may also be studied as further illustrations of these changes. In No. 583 the cartilage has been removed to show the disease in the articular end of the bone. See also No. 580.

135.—A wrist-joint. The lower ends of a radius and ulna, with the bones of the carpus and metacarpus, exhibiting extensive

disease in and about the carpus, with necrosis of the lower end of the radius. A considerable portion of the end of the radius, already deeply ulcerated, died and was in process of exfoliation. The cartilage between the ulna and the bones of the carpus is completely destroyed. The ulna and the bones of the carpus have their cartilaginous surfaces destroyed by ulceration, and ankylosis has taken place between them, both by the adhesion of their surfaces and by the thickening and consolidation of the surrounding parts.

627.—A hip-joint, from a boy ten years old. The head of the femur has been dislocated from the acetabulum on to the dorsum of the ilium. Ulceration of the capsule had taken place, and the head of the bone was contained in a cavity formed by the remains of the capsule and by the surrounding muscles. Within this cavity, as well as in the acetabulum, was a mixture of a large quantity of pus and tuberculous matter. The section of the head of the femur shows tuberculous matter deposited in its cancellous texture. There is also a collection of tuberculous matter in the walls of the acetabulum, communicating with its cavity and with the cavity of the pelvis. An abscess had formed between the periosteum and the shaft of the bone just below the trochanter. The ischiatic nerve is seen upon the tuberosity of the ischium, near the dislocated head of the bone.

600.—A hip-joint, from a child, in which, by a further progress of the inflammation shown in the preceding specimens, both the acetabulum and the whole of the head and neck of the femur have been destroyed by ulceration. See also Nos. 601 and 621b.

Changes in the cartilages.

Invasion of the cartilages by the fungous granulations (*inflammatory material*) springing from the surface of the inflamed and ulcerating bone.

583.—Section of a femur, exhibiting the effects of inflammation of the cancellous texture and articular surface of one of its condyles. The increased vascularity of the bone is evinced by the degree in which its vessels have received injection. The connection of the articular cartilage with the bone was so loosened, that it was readily separated.

585.—Sections of the condyles of a femur. The articular cartilage is thinned, and its connection with the bone is so loosened

that its separation was readily effected. Portions of the cartilage have been detached and turned downwards, to show that parts of the surface which was connected with the bone are unnaturally rough. The exposed surface of bone is very superficially ulcerated and thinly covered by granulations.

Changes in the bursæ surrounding the joint.

In a certain proportion of cases of tubercular arthritis, as well as in osteo-arthritis, the earlier stages of the disease appear to be accompanied by a passive effusion of fluid into the bursæ surrounding the joint. These enlarged bursæ are the so-called "Baker's cysts"; they are often of large size, and, owing to their slow formation, they may extend a considerable distance along the intermuscular planes (No. 1205f). The enlarged bursæ may be independent of the joint (Nos. 1205e, and 1205f) but more frequently open into it (No. 1205a). In a few cases it appears as if the cyst resulted from a dilatation of a hernial protrusion of the synovial membrane of the joint (No. 1205a).

1205a.—The lower third of the right thigh and the upper portion of the right leg, exhibiting a general enlargement of the bursæ in the neighbourhood of the knee. An irregular cystic swelling, which contained serous fluid, in which floated a large number of melon-seed bodies, lies upon the inner side of the joint, occupying in part the position of the bursa, between the semi-membranosus and semi-tendinosus tendons. The cyst is lined throughout by a thin membrane, which forms its wall. It is irregularly hour-glass in shape, the two swellings lying opposite the inner condyle of the femur and the upper and inner part of the calf respectively, the constriction between the two parts being apparently due to the passage across the cyst of the sartorius and gracilis tendons. Immediately beneath the inner hamstring tendons, the constricted portion of the cyst opens by a tortuous passage into a second dilatation, situated immediately beneath the popliteal vessels and nerve, in close contact with, but not opening into, the bursa, which lies under the inner head of the gastrocnemius. From this point the cyst can be traced beneath the gastrocnemius muscle, where it dilates into a terminal sac. The popliteus muscle is greatly stretched and thinned owing to the dilatation of the bursa beneath it. This dilated bursa is separated

from the one previously described by the popliteus muscle, and it does not appear that the two in any way communicate. Neither of the cysts communicates with the knee-joint.

The knee is almost typically affected with tubercular synovitis. The cartilages everywhere appear to be healthy, except for some slight roughening over the external condyle and the corresponding articular surface of the patella. There are neither osteophytes nor ecchondroses. The ligaments, however, are much frayed and softened, so that they are easily torn. The semilunar cartilages are in part worn away. The synovial membrane is remarkably affected, for from the neighbourhood of the *mucosum et ligamenta alaria* protrude large, soft, flattened, and leaf-like synovial fringes. Some of the processes measure as much as 1 inch or $1\frac{1}{2}$ inches in diameter. Microscopic examination shows that these fringes are the results of tuberculous inflammation, and that they contain masses of tubercle, and in some cases even the tubercle bacilli.

From a man aged forty-one, a valet by occupation, who died of general tuberculosis. Ten months before his death he observed a swelling to the inner side of his right knee. The swelling was said to have attained its maximum size in two or three days, and the patient was certain that it was not the result of an injury. The cyst was aspirated on two occasions, and synovial fluid with flakes of mucus in it was removed.

Drawings of the joint are preserved in **Series lvii.**, **Nos. 45, v** and **w**. See also 1205b; and for the results of suppuration in the cysts, see 1205c, 1205e, and 1205g.

EPIPHYSITIS.

Epiphysitis is an inflammation of the soft growing tissue between the shaft and the epiphysis of long bones. It is necessarily confined to the young, and is most frequent under the age of ten. It usually results from slight injuries, and in the majority of cases is no doubt tubercular in origin. The inflammation, which is either acute or chronic, as a rule terminates in suppuration, and the pus either escapes into the joint after perforating the cartilage or the soft tissues behind the cartilages (**No. 621a**), thereby setting up acute arthritis, or the epiphysis undergoes necrosis and forms a sequestrum in the interior of the joint (**No. 621**).

621.—Portion of a femur from a young subject. Disease, commencing in the hip-joint, has in its progress occasioned a separation of the head of the femur at the epiphysial line. There is also ulceration of a part of the head and neck of the bone.

621b.—The upper two-thirds of the right tibia and fibula from a case of acute epiphysitis. The upper epiphysis of the tibia is completely separated from the shaft of the bone. The shaft is dead, and is undergoing a process of rarefying osteitis for a distance of two inches below the epiphysial line. The epiphysis is also dying, but the necrosis has not yet extended to the articular cartilage. The pus has made its way into the joint by a sinus, which passes immediately behind the attachment of the internal crucial ligament. From a boy aged thirteen years, who had received a blow on his leg twenty-three days before amputation was performed.

621c.—The upper two-thirds of the right tibia and fibula from a case of acute epiphysitis. The upper epiphysis of the tibia is completely separated from the shaft of the bone. The shaft itself is dead, and is undergoing a process of rarefying osteitis for a distance of two inches below the epiphysial line. The epiphysis is also dying, but the necrosis has not as yet extended to the articular cartilage. In the recent state, a quantity of thick greenish lymph occupied the inter-muscular planes in the neighbourhood of the diseased bone. In one place, situated immediately behind the attachment of the internal crucial ligament, a probe has been passed along a sinus by which the suppurating tract communicated with the knee joint. The cartilages are unaffected, and the joint is not yet diseased, although a thin layer of coagulated lymph covered the whole of the edges of the articular surfaces. The posterior tibial artery lay in an abscess cavity, and its walls were almost completely ulcerated through for nearly an inch and a half.

From a boy aged 13 years, who was struck on the back of his leg twenty-nine days before the amputation was performed.

A drawing of the preparation is preserved in **Series lvii., No. 36a.**

There is a variety of tubercular disease of joints, occurring in old people, to which Sir James Paget has given the name of "Senile Struma." It has already been mentioned at page 53, under the heading of "Senile Tubercle."

SACRO-ILIAC DISEASE.

Sacro-iliac disease is rare ; it appears to be of the nature of tubercular inflammation. It has been attributed to injury received during parturition, but its origin is generally obscure.

Case H. 1090a.—A pelvis with the last two lumbar vertebræ, from a case of advanced sacro-iliac disease. The right iliac bone is lighter and more porous than the left, and its muscular ridges are less well marked. The auricular surface is completely devoid of cartilage, and is honeycombed by a process of carious inflammation to such an extent that a large circular aperture has been formed through its centre. The rough surface for the sacro-iliac ligaments has undergone a similar absorption, though to a less extent. The caries extends forward along the inner and middle lips of the crest of the ilium for nearly two-thirds of its extent, and downwards as far as the brim of the true pelvis.

In the sacrum the whole of the right ala and lateral mass has undergone absorption, and the caries has extended across the anterior surfaces of the first and second sacral vertebræ as far as the sacral foramina of the left side. As a result of the inflammatory changes, spicules of new bone connect the fifth lumbar vertebra with the first piece of the sacrum on the right side, and the terminal piece of the sacrum with the coccyx. Posteriorly the caries has caused destruction of the spine of the first sacral vertebra. The left sacro-iliac synchondrosis appears to be normal, and the symphysis pubis is healthy. From a man aged nineteen, a bricklayer. Nineteen months before his death he had an attack of "rheumatism" in his right hip, and a month later he first felt pain in his sacrum. On admission to the hospital a year later an abscess had formed over the right buttock, and great pain was experienced on pressing the ilia together. After opening the abscess, bare bone could be felt over the posterior part of the ilium, and it was subsequently ascertained that the whole of the right side of the sacrum was carious. About two months before the death of the patient symptoms of amyloid degeneration were observed in various organs.

See also Case G. 598, 646, 647, and 648.

OSTEO-ARTHRITIS.

Osteo-arthritis, also called chronic rheumatic arthritis, or chronic rheumatic arthritis, *malum coxæ senilis*, arthritis deformans, etc., is characterized by the fibroid changes which occur in the cartilages; by the smooth, polished, porcelaineous appearance of the articular surfaces of the bones; by the pedunculated processes which project from the inner surface of the synovial membrane; by the formation of flat nodular osteophytes around the affected joint; and by the rarity of suppuration. The outgrowths of cartilage around the articular surfaces undergo calcification, and give rise to the "lipping" which is so characteristic a feature of the disease. A similar process of calcification takes place in the ligaments, tendons, and other soft structures in the neighbourhood of the affected joints (**Case G. 669b**). It commonly occurs in old age, and may attack any of the joints, but is most frequent in the hip and shoulder.

There is some doubt as to which tissue of the joint is primarily affected, as opportunities for examining the disease in an early stage seldom occur. By some it is believed to begin as a chronic inflammation of the synovial membrane; by others as a fibroid degeneration of the cartilages; by others, again, as an inflammation in the ligaments. In whichever way it begins, the earliest naked-eye changes are found in the cartilage, which undergoes fibroid degeneration, at first presenting a velvet-like appearance (**No. 690a**), and subsequently becoming gradually destroyed. The synovial membrane, which at first is said to be preternaturally dry, becomes slightly thickened and vascular, and moderately distended with thin, cloudy, synovial fluid; whilst its fringes become hypertrophied and assume the form of pedunculated processes (**No. 693**), often containing little masses of cartilage or bone (**No. 692b**), which are very characteristic of the disease. The articular surfaces of the bones become excessively smooth, hard, polished, and porcelaineous (**Case G. 680**) from the friction of the articular

surfaces upon each other in the movement of the joint; characteristic flattened, nodular osteophytes (or, more properly, "ecchondroses," since they consist of calcified cartilaginous out-growths) form around the articular surfaces of the bones and in the soft structures in connection with the joint, rendering the articulation in severe cases completely useless. These changes may be studied in detail by aid of the preparations.

Changes in the cartilages.

Nodular and cracked, and subsequently rough and fibrous appearance of the cartilages.

594.—A patella, exhibiting fibroid degeneration of the articular cartilage. The disease affects only half the cartilage. At the borders of the diseased part there are cracks extending in various directions through the whole thickness of the cartilage, and some of its substance between the cracks is converted into close-set tufts of fine filaments, which float out from the surface of the bone, and are about twice as long as the healthy cartilage is thick. In the centre of the diseased spot, where the morbid change has made most progress, the cartilage has been wholly removed, and the exposed surface of the patella is hard and nodulated. See also Nos. 690a, 690b.

595.—The bones and ligaments of a knee-joint. The anterior crucial ligament is wanting, and small portions of the articular cartilages of the femur and tibia have been destroyed after fibrous degeneration. The opposite joint was similarly and symmetrically diseased.

The destruction of the ligaments in an apparently early stage of the disease, as seen in the two preceding specimens, has led some to believe that the disease begins in these structures.

The above changes, commonly called fibroid degeneration of cartilage, are due to the splitting up of the matrix into fibres; the multiplication, enlargement, and fatty degeneration of the cartilage cells; and the gradual rubbing away of the fibrillated cartilage by the friction of the articular surfaces of the joint upon each other.

It will be thus seen that this fibroid destruction differs very materially from the so-called ulceration of the cartilage accompanying inflammatory joint affections, where the matrix, instead of becoming fibrous, undergoes liquefaction and softening.

Changes in the bones.

Exposure of the bones by the complete removal of their articular cartilages; indurated, polished, and porcelaineous condition of their articular surfaces; distortion of their articular ends; and formation of flat nodular masses of new bone (*osteophytes*) around.

Case G. 680.—Sections of the bones of a hip-joint, in which there has been absorption of the upper part of the head of the femur. The surface of the part thus absorbed, as well as that of the acetabulum with which it was in contact, and on which it probably moved freely, are polished, ivory-like, and worm-eaten in appearance.

Case G. 685.—Part of a femur, exhibiting absorption, hardening, and polishing of the upper and anterior part, with osseous deposit around the margin of its head. See also **No. 696a**, and **Case G. 669a** and **669b**.

The articular surfaces of the bone become smooth, hard, polished, and eburnated or porcelaineous in appearance, and variously altered in shape, changes apparently depending in part on friction and mechanical pressure, and in part on the formation of new bone in the cancellous spaces, whereby the bone is rendered harder, and is, in consequence, capable of receiving a higher polish. Whilst, however, new bone is being formed immediately beneath the polished surface, rarefaction and atrophy are going on a little deeper in the bone, and lead to the shortening and distortion so commonly observed. Hence, for example, the enlargement and flattening of the acetabulum and glenoid cavity and the absorption of the neck and flattening of the head of the humerus and femur, seen respectively in osteo-arthritis of the shoulder and hip. At times the new bone in the

cancellous spaces and Haversian canals is not formed as quickly as the polished layer of bone is worn away, and the open ends of the enlarged Haversian canals give the articular surface a worm-eaten appearance. The flattened nodular osteophytes (**Case G. 669b**), which constantly form around the articular surfaces, present a marked contrast to the stalactitic formations (**No. 596**) so common after inflammatory joint-affections. The various changes in the sockets and heads of the bones may be studied under the heading of "Osteo-arthritis in different Joints."

Changes in the synovial membrane.

Thickening and increased vascularity of the synovial membrane; formation of numerous pendulous growths, containing little masses of cartilage, bone, or fat upon its internal surface; slight increase of synovial fluid; turbidity of the fluid from admixture with particles of disintegrating cartilage.

666.—A shoulder-joint, in which there has been degeneration and removal of the articular cartilage, with hardening of the adjacent bone. The synovial membrane is generally thickened, and there are numerous groups of small pendulous processes of cartilage, and two larger masses of hard, nodulated bone attached to its internal surface.

691.—A knee-joint, exhibiting numerous growths on its internal surface. The growths are of various sizes, nodulated, grouped, and attached, for the most part, by narrow pedicles. They are most abundant about the margins of the articular surfaces of the bones—that is, in the synovial fringes; some of them are cartilaginous, others osseous; and there are some of them which consist of fat. The heads of the bones are enlarged, their articular cartilages are removed, and their exposed surfaces are hard and polished. There were four ounces of fluid, like train-oil, in the cavity of the joint. The disease had existed for more than two years. See also **Nos. 692a, 692b, 693, and 693a**, which are all beautiful specimens of the disease.

The pendulous growths are the hypertrophied synovial tufts; the masses of cartilage are produced by the over-

development of the cartilage cells which the tufts normally contain (No. 712). The little masses of cartilage sometimes become detached by the absorption or breaking of their peduncles, and are then found loose in the joint (No. 692a).

Changes in the tissues around the joint.

Formation of nodular flattened osteophytes in the ligaments, periosteum, tendons, and even in the muscles around the joint.

Case G. 669a.—Humerus and scapula, showing to an extreme extent the changes which take place as a result of osteo-arthritis. The glenoid cavity of the scapula is convex at its lower part, whilst the upper portion is deeply grooved and its margin is "lipped." There is a considerable deposit of fresh material around the coracoid and acromion processes. The surface of the bone is polished and devoid of cartilage. The head of the humerus is enormously increased in size by a deposit of new bone, but is hollowed out so as to articulate with the convex glenoid surface. Like the scapula, the articulating surface is burnished and devoid of cartilage. In both bones the new deposit appears in the form of small gravel-like bodies. The capsule was much thickened, and contained numerous osteophytes, which were also present to a very considerable extent in the neighbouring muscles. See also **Case G. 696.**

The changes in the neighbouring bursæ appear to be identical with those which have already been described as occurring in cases of tubercular synovitis (see page 155).

OSTEO-ARTHRITIS IN DIFFERENT JOINTS.

The characteristic appearances of osteo-arthritis, dependent upon the movement peculiar to the respective joints, should next be studied.

The hip-joint.

The characteristic appearances in the hip-joint consist in :

(i.) Flattening and widening of the head of the femur with absorption of its neck (**Case G. 681**); (ii.) deepening or widening of the acetabulum (**Case G. 682**); (iii.) destruction of the ligamentum teres (**No. 674**).

The absorption of the neck of the femur has been mistaken for bony union following intra-capsular fracture (No. 676). It may generally be distinguished from fracture by the "lipping," and by the porcelaineous appearance of the articular surface of the head, which often presents a remarkable worm-eaten appearance. The abundant nodular osteophytes around the joint, and the absence of any marked line of union, such as is commonly present after fracture, are also characteristic appearances.

The shortening of the limb which is so often found in aged people after falls, and which has been ascribed to intra-capsular fracture, is more probably due in many cases to the absorption of the neck of the bone, the result of chronic osteo-arthritis which has escaped notice previous to the accident.

Case G. 681.—The bones of the hip-joints of a man aged seventy-one, exhibiting nearly symmetrical changes of structure, the effects of osteo-arthritis. There is an irregular and very abundant deposit of osseous substance ("*lipping*") around the margins of the acetabula and upon the borders of the heads and necks of the femora. Both the width and the depth of the acetabula are thus greatly increased; their articular surfaces, as well as those of the femora, are hard and rough, and a portion of the head of one femur, with the corresponding surface of the acetabulum, is polished and ivory-like. See also **Case G. 678, 680, 682, 683, and 686.**

Case G. 684.—Sections of the bones of a hip-joint, in which the depth of the acetabulum is increased by the deposit of osseous matter around its margin. Its articular surface, and that of the head of the femur, have been absorbed, and the bony surfaces exposed are hard, perforated, and in a few parts polished. A formation of new bone round the margin of the head of the femur corresponds with that on the margin of the acetabulum. See also **Nos. 666, 674, and 675.**

Compare these specimens with those of ulceration following tubercular synovitis (**Nos. 570, 570a, and 571**).

The shoulder-joint.

The characteristic appearances in the shoulder are:

- (i.) Flattening and enlargement of the articular surface of

the head of the humerus ; (ii.) enlargement and deepening of the glenoid cavity ; (iii.) destruction or displacement of the biceps tendon. See **Nos. 704 and 705.**

Osteo-arthritis of the shoulder-joint has been mistaken for old dislocation of the shoulder ; it may generally be distinguished from the latter by the osteophytes around, and by the polished appearance of the articular surfaces.

Case G. 669.—The bones of both the shoulder-joints of an adult. In each joint there has been ulceration, or such absorption as occurs in osteo-arthritis, of the articular surfaces of the head of the humerus and glenoid cavity. The heads of the humeri are flattened and enlarged by growths of bone around their borders ; and the glenoid cavities, enlarged in a corresponding degree and deepened, extend backwards and inwards to the bases of the spines of the scapulæ. The articular surfaces thus enlarged are mutually adapted, and are hardened, perforated, and in some parts polished and ivory-like. The changes of structure are symmetrical, except in that the articular surfaces of the right shoulder-joint are more extensively polished than those of the left. See also **Case G. 667, 669a, 669b, 669c, and 670a.**

Case G. 670.—A scapula and the upper part of a humerus diseased in the same manner as the preparation in **Case G. 706.** The borders of the acromion are thickened and beset by nodules of new bone. A small portion of its inferior surface, indurated and polished, was adapted to a similar surface on the upper part of the head and the great tubercle of the humerus. Around the head of the humerus and on its tuberosities there are deposits of bone similar to those on the borders of the acromion.

Case G. 706.—A humerus and a scapula. There is a deposit of bone upon the end of the acromion, presenting an excavation on its under surface. The great tuberosity of the humerus presents a convex surface, which appears to have been adapted to, and to have moved in, the concavity on the under part of the acromion.

It is probable that these changes followed the destruction of the tendon of the biceps muscle, either by disease or by accidental rupture.

The knee-joint.

The characteristic appearances in the knee-joint are :

(i.) The inclination of the femur and tibia inwards ; (ii.)

the displacement of the patella outwards, so that it rests upon the outer condyle of the femur; (iii.) the vertical grooving of the patella and corresponding surface of the condyle of the femur; (iv.) the destruction of the crucial ligaments.

Case G. 698.—Bones of two knee-joints. There has been a deposit of new bone around the articular surfaces of both the femur and the patella. The patellæ, displaced outwards, have been adapted to the outer condyles; and their articular cartilages having been completely removed, the opposite surfaces of the bone have been absorbed in regular and mutually adapted grooves, and are hardened, polished, and ivory-like.

693.—The articular surfaces of a knee-joint, showing the changes consequent upon osteo-arthritis. From a man, aged 35, who had symptoms of the disease for three years. The synovial fringes are much hypertrophied. The osteophytes at the anterior border of the tibia are well seen. The cartilages are eroded, and the bones are bare and worn.

693a.—Portions of a knee-joint from a case of osteo-arthritis, with numerous growths upon the internal surface of the synovial membrane. Most of the growths consist of fringes of slender and leaf-like processes of a soft fibrous structure; others are firmer, and approach to cartilage in their character, and one is a flattened nodular growth of bone covered by a thin membrane. The articular cartilage are scarred and undergoing fibrillation. See also **Nos. 594, 690, 690a, 690b, 691, 691a, 692a, 692b, 693, and 696a.**

A cast of the appearances presented by a knee affected with osteo-arthritis is to be seen in **Cast No. 20a.**

The elbow-joint.

The characteristic appearances in the elbow-joint are well seen in the following specimens:

Case G. 671.—A humerus, radius, and ulna. In consequence of chronic disease of the elbow-joint, the forearm appears to have been for a long time nearly fixed in a position of extreme flexion, with the hand in extreme pronation. The articular surface of the humerus is much deformed; the internal condyle is reduced in size and pointed; the trochlear cavity is nearly obliterated; the greater part of the articular cartilage was removed; the external

condyle has a part of its surface hardened and polished ; and nodules of new bone have been deposited around the borders of the articular surface.

The outer division of the greater sigmoid cavity of the ulna is hard, polished, and superficially grooved ; the inner division is soft and rough, as if it had been deeply ulcerated. The lesser sigmoid cavity is obliterated ; and just below its place there is a large and deep pit in which the tubercle of the radius rested. The head of the radius is directed backwards from the shaft. The articular surface has lost its cartilage, and new bone is deposited around a great part of its border. The anterior border of the head of the radius, which rested on the front of the external condyle of the humerus, has formed a wide and slightly concave surface, which is covered by hard polished bone, like that on the surface of the condyle itself.

The lower ends of the shafts of the radius and ulna are healthy. See also Nos. 672, 673a, 673b, and 673c.

The temporo-maxillary joint.

See Nos. 664, 665, and Case G. 551.

The articulations of the spine.

Case C. 1089b, Case H. 1089a.—Lumbar vertebræ with osteo-arthritis, more especially of their articular processes.

The joints of the great toe.

699.—The bones of the great toes of an old person, showing the effects of osteo-arthritis.

The hands.

Casts of the deformities in the hands produced by osteo-arthritis are preserved in the **Cast No 20h**.

Suppuration in osteo-arthritis.

In a certain small proportion of cases suppuration takes place in joints affected with osteo-arthritis. In these instances, however, it appears that the disease is associated with other constitutional joint affections, as in—

Case G. 669c.—The shoulder-joint from a case of suppurating osteo-arthritis. The articular extremities of the bones are devoid

of cartilage, and present the appearances characteristic of osteo-arthritis in an advanced stage. From a man aged twenty-five, who had an abscess round the shoulder-joint which had been repeatedly opened. His wrist was excised three and a half years before death for strumous disease.

CHARCOT'S DISEASE, OR TABETIC ARTHRO-PATHY.

Charcot's disease as it is seen in this country somewhat resembles osteo-arthritis. It occurs in patients who are affected with locomotor ataxy, and appears to result from trophic changes occurring in the joints. The pathological changes consist in erosion of the cartilages; softening of the ligaments; disappearance of the articular surfaces and often of the contiguous portions of the shaft of the bone, with alteration in the relative positions of the remaining articular surfaces; thickening, and at times pouching, of the synovial membrane, and the formation of osteophytes. The changes may affect one joint only, or they may occur successively in several joints. The cases differ from ordinary osteo-arthritis in the fact that the changes are much more advanced, and that they take place rapidly, whilst there is not the same "lipping," and eburnation is absent.

Good examples of the disease as it occurs in the knee are to be seen in:

691b.—A right knee-joint affected with Charcot's disease, from a patient aged 50 who had locomotor ataxy.

The joint is very much enlarged. The enlargement is due to a thickening and development of the various folds and processes of the synovial membrane, and to an alteration in the shape of the bones. When first opened, the joint contained a considerable quantity of thin pus.

The lower end of the femur and the head of the tibia have undergone remarkable alterations in shape. The external condyle of the femur has almost disappeared, its place being apparently taken by two irregular nodules of bone, together about the size of a horse-chestnut, lying in the thickened synovial membrane. The internal condyle is remarkably enlarged, being much flattened from side to side. Near its inner and upper surface is a marked projection

caused by the growing out of the bone, and immediately beneath it is a groove formed by the friction of the opposed surface of the head of the tibia. The shape of the lower end of the femur resembles an enormously enlarged external malleolus. At the posterior surface of the internal condyle is a large nodular outgrowth of bone. This latter outgrowth fits into a corresponding cup-shaped surface, formed by an outgrowth from the posterior surface of the tibia.

The tibia has undergone a compensatory alteration. The inner part of the head seems to have been rubbed away by the inner surface of the condyle, whilst the outer side of the head takes the place of the wasted external condyle of the femur. To such an extent has this occurred, that the plane of the tibio-femoral articulation, instead of being horizontal, is almost vertical; whilst the only part of the bones which could serve as a support in standing is the ridge on the femur and the surface on the tibia which corresponded with it.

The patella has undergone less alteration than the other bones, but is irregular in outline. Its articular surface is covered with cartilage in an advanced stage of degeneration, whilst the bone on this aspect is irregular and pitted.

The cartilage has almost completely disappeared from the articular surfaces of the tibia and femur, though patches remain on both bones. The portions of cartilage thus left have undergone fibrous degeneration.

The bone covering the articular surfaces of the tibia and femur is smooth and hard; it forms a continuous layer, but it has disappeared in other parts, and the bone is also pitted and irregular, the cancellous tissue being exposed as in caries.

The development of osteophytes in the soft tissues surrounding the joint has taken place to a remarkable extent.

The osteophytes are infiltrated in the tissues around the ligamentum patellæ and in various parts of the synovial membrane; they are especially well marked in that portion which covers in and protects the lower edge of the elongated condyle. The edge of the head of the tibia is covered by the overhanging and irregular ridges of bone which are so common in museum specimens of osteoarthritis.

The inner surface of the synovial membrane has developed villous outgrowths, some of which are calcareous, whilst others are still soft, of the kind ordinarily found in cases of "osteoarthritis."

The shaft of the femur four inches above the condyles, and the tibia at about the same distance below its head, appear to be in all respects normal.

Casts of the knee are preserved in **Series lvi., No. 20c**, and drawings in **Series lvii., Nos. 45g—i.** A section of the cartilage is preserved in **Series lv., No. 53h.**

691c.—The right knee-joint affected with Charcot's disease, from a patient who had locomotor ataxy.

The synovial membrane is everywhere thickened and pulpy, and is in some parts papillated. The cartilage of the condyles is ulcerated, the ulceration being most marked upon the inner side. On the bones are small pearly concretions like sago grains. The articular surface of the patella is completely covered by thickened synovial membrane.

The whole of the posterior surface of the upper end of the tibia for a depth of three inches is worn away in such a manner as to allow of the dislocation of the bone forwards upon the femur, and a new articulating surface has been formed upon the eroded portion, partly by a moulding of this surface, and partly by the growth of osteophytic processes. A portion of the lower surface of this new articulating cavity is formed by the posterior part of the original articular surface of the head of the tibia, which having been apparently undermined, appears to have slipped down bodily, letting the femur fall, so to speak, and carrying with it a part of the external semilunar cartilage. This part of the original joint surface has, therefore, taken up a vertical instead of a horizontal position.

The posterior crucial ligament, with a portion of the external semilunar cartilage, remains attached to the femur.

The anterior crucial ligament retains its normal connection with the tibia, but it has lost its attachment to the femur, and is connected above with the thickened tissue surrounding the patella.

The margins of the articulating surfaces of the femur and tibia are "lipped" by slightly projecting outgrowths.

A drawing of this joint is preserved in **Series lvii., No. 45l.**

691d.—The left knee-joint from the same patient as the preceding. The synovial membrane is vascular and papillated, the portion below the patella being pulpy. The cartilage covering the internal condyle is ulcerated at one spot. It is thickened, and is clearly undergoing fibrous degeneration over its whole extent, although it still retains its polished surface. The cartilage cover-

ing the external condyle is thickened, except at one part, where it is worn away, leaving dense eburnated bone. The edges of the articulating surfaces of the condyles are "lipped." The semilunar cartilages are intact. The anterior crucial ligament is pulpy, and in part eroded; the posterior is also softened. The patella is "lipped"; it is covered by cartilage undergoing pulpy degeneration. It is not overgrown by thickened synovial membrane. The articular surfaces of the head of the tibia are bare of cartilage. The external surface is undergoing erosion at the point at which it is opposed by the eroded surface of the external condyle of the femur. All the soft tissues are more or less thickened, pulpy, and degenerated.

A drawing of this joint is preserved in **Series lvii., No. 45m.**

GOUTY ARTHRITIS.

After a patient has suffered from a few attacks of gout, and the disease has become chronic, a characteristic chalky-looking material is deposited in the articular cartilages, ligaments, and synovial membrane of the affected joints, and after some time in the connective tissue around. This chalky material consists of urate of soda deposited in the form of acicular crystals in the matrix about and around the cartilage capsules and in the interspaces of the connective-tissue; it is at first soft, like mortar, but ultimately assumes a hard and chalky appearance. The white masses, so common about the knuckles (*chalk stones*), are produced in this way. Gouty arthritis, unlike osteo-arthritis, is principally confined to the smaller joints, and especially attacks the great toe.

709b.—An astragalus, with the external and internal malleoli of the fibula and tibia. The articular surfaces of the bones are coated with an unusually extensive deposit of urate of soda. The specimen was obtained from a subject brought in for dissection. Many of the other joints were equally affected. See also **Nos. 708, 710, 711.**

In some instances gouty arthritis terminates in destruction of the joint, accompanied by ulceration of the articular surfaces of the bones.

700.—The bones of a great toe, in which, in consequence of gout, the articular surfaces of the metatarsal bone and first phalanx are in great part destroyed.

Acute suppuration may occur in gouty joints, though it is of very rare occurrence. An example follows in—

711b.—Section through a knee-joint, from a gouty patient in whom acute suppuration had taken place. The bones are bare of cartilage, rarefied, and superficially ulcerated, without any marked eburnation or “lipping.” The crucial ligaments are gone, the synovial membrane is thick, soft, and in parts destroyed by the suppuration. From a man aged forty-nine, who had suffered for seventeen years from gout.

As a result of the changes produced by gouty arthritis, bony ankylosis of the adjacent articular surfaces sometimes occurs.

645a.—The right hand of a woman which during life exhibited a marked instance of “Heberden’s nodes.” The terminal phalanges are united by bony ankylosis. The two distal phalanges of the fourth finger have been divided longitudinally to show how complete has been the synostosis. In the neighbourhood of the joints deposits of urates can still be seen ; these deposits were much more abundant before the maceration.

From a woman aged sixty-three, who died of cancer of the gall-bladder. During life it was recorded that “the joints of the fingers, and especially of those of the right thumb, have well-marked Heberden’s nodes. These nodes appear to be simply exaggerations of the normal prominences of the phalanges. The joints between the two last phalanges of the index and middle fingers of the right hand, and the same joint in the left hand, are ankylosed. The joints of the metatarso-phalangeal joints of both great toes were somewhat enlarged and glazed. There were no tophi, nor was there any rheumatic or gouty history in the family of the patient.

Sir Dyce Duckworth, when showing the hand before the British Medical Association at Belfast, stated that it was taken from the body of a woman who presented marked examples of Heberden’s nodes, believed to be rheumatic during life, but shown to be, as he believed, solely due to the gouty and uratic diathesis.

Heberden’s nodes are well seen in **Cast No. 23b.**

SYPHILITIC DISEASE OF JOINTS.

Syphilis may affect the joints, giving rise to a chronic synovitis during the secondary stage of the disease; or to gummatous deposits in the synovial membrane and periosteum about the articular ends, during the tertiary stage.

567a.—Syphilitic disease of the knee-joint. A gummatous deposit has taken place all round the lower portion of the femur beneath the muscles. These deposits have involved the upper and outer part of the synovial membrane, and have projected into the joint in the form of ragged ulcerated lumps and fringes. The lower portion of the femur is denuded of its periosteum. A glass rod has been passed behind the gummatous growth into the joint. The joint when it was first opened contained several masses of dark grumous material.

From a man aged twenty-four, who contracted syphilis three years before his death. Gummata were found in the brain and on the face.

HÆMOPHILIA OF THE JOINTS.

Hæmophilia is a condition in which bleeding is prone to occur spontaneously or on very slight provocation. The joints in this disease sometimes exhibit the changes which are well seen in the following specimens.

740a.—The knee and ankle joints from a boy who was a "bleeder," and who died, as the result of a cut in the lip, from continuous hæmorrhage. The synovial membrane is coloured by blood which has been effused into the joint-cavity, and in the knee there has been fibrous ankylosis between the patella and femur. The patient had frequently had swellings of the joints, sometimes as the result of an injury, sometimes without any definite cause.

Drawings of the joints in their recent condition are preserved in **Series lvii., No. 45a.**

740b, 740c, 740d.—The right and left knee-joints and right ankle-joint from a case of hæmophilia. The ankle-joint (**No. 740d**) is the least affected; the synovial membrane is slightly tinged, but there is no structural change in the articulation. When fresh, the joint contained some fresh dark blood, and a small clot. In the left knee (**No. 740c**) traces of effused blood are visible in the russet-brown staining of the lining membrane. The joint contained no blood-

clot. The cartilages are pearly white. At the under surface of the external femoral condyle, where it meets the pressure of the tibia, the cartilage is worn thin and is granular over a space half an inch in diameter. The ligaments are unaltered. The connective tissue of the right knee (**No. 740b**) is deeply stained of a brown colour, and the changes in the cartilages are farther advanced than in the preceding joints. The cartilage is deficient at the points where the pressure was greatest, and a formation of bone thinly covered by cartilage has taken place at the periphery of the joint. About the centre of the under surface of each femoral condyle the cartilage is thin, worn, and rough. It is fissured in various directions and laminated, and has so far lost its attachment to the bone, that a knife can be passed beneath it here and there for a distance of a third of an inch. The edges of the partially detached cartilage are seen when raised to be ragged and fibrous, and are split into layers, as in a case of osteo-arthritis. Around each condyle was a prominent lip of bone, somewhat nodular, and covered by cartilage. Microscopic examination of the cartilage showed a fibroid degeneration of the hyaline matrix, with multiplication of the cells and breaking-up of the capsules. The minute, like the grosser changes, bore a marked resemblance to the alterations which take place in osteo-arthritis.

The specimens were obtained from a boy aged thirteen, who died from epistaxis. He had twice bled previously—once from a small wound on his tongue, and a second time after the extraction of a tooth. He had frequently suffered from painful swellings of his joints and he bruised easily. A brother died of epistaxis. A section of the articular cartilage is preserved in **Series lv., No. 53g**.

ANCHYLOSIS, OR STIFF-JOINT.

Anchylolysis may be divided into the spurious or false, the fibrous or ligamentous, and the bony or true.

SPURIOUS ANCHYLOSIS.

Spurious anchylolysis is the term applied to a fixed condition of joint depending upon rigidity of the surrounding muscles, the contraction of cicatrices following burns, the shrinking of the capsule and synovial membrane, from disease of the joint, etc.

629.—A knee-joint, in which ankylosis has been effected by inflammatory thickening of the synovial membrane. A portion of the adherent synovial membrane is reflected from the front of the joint. The tibia and fibula have been drawn backwards and outwards under the femur.

FIBROUS OR LIGAMENTOUS ANCHYLOSIS.

Fibrous or ligamentous ankylosis is the union of the articular surfaces of the bone by fibrous tissue. It may be the result of joint-disease, as already described, or of keeping a joint in a long-continued state of rest, in which latter case the synovial fluid is no longer secreted, the synovial membrane loses its smooth polished appearance and becomes dry and fibrous, the cartilages atrophy and disappear, and the bones unite by fibrous tissue.

Fibrous ankylosis, after existing some time, nearly always terminates in osseous ankylosis.

631.—A knee-joint, in which, during the course of long-continued disease, the tibia has been dislocated backwards and outwards. Firm ankylosis by fibrous tissue has taken place between the inner half of the upper surface of the tibia and the condyles of the femur.

BONY ANCHYLOSIS.

Bony ankylosis, as just stated, is a further stage of the fibrous. The articular surfaces may be united evenly and uniformly by bone, by irregular ridges of bone, or partly by bone and partly by fibrous tissue. Union may take place with the articular surfaces in contact with each other, either in a straight position or at different angles, or it may occur with one of the articular surfaces dislocated from the other.

Case G. 649.—The bones of a hip-joint, in which the head of the femur rests partly on the acetabulum and partly on the ilium, and in this situation has become firmly and smoothly united by bone.

Case G. 650.—Section of the bones of a hip-joint, exhibiting complete osseous union of the head of the femur with the acetabulum. Their walls and cancellous tissues have coalesced, and are

uninterruptedly continuous. The femur is fixed in extreme flexion.

Case G. 654.—The bones of a hip-joint, exhibiting an osseous ankylosis of the head of the femur to the ilium, similar to that shown in the preceding specimen. A thin band of bone, half an inch wide, is extended between the trochanter major and the upper part of the tuberosity of the ischium.

Case G. 640.—A scapula and humerus united by bone. The head of the humerus has disappeared, and the upper part of the shaft is fixed by an irregular growth of bone to the remains of the glenoid cavity and the base of the coracoid process.

Case G. 641.—The bones of an elbow-joint, in which all the articular surfaces are united and surrounded by bone. The joint is in a half-bent position.

Case G. 642.—Section of the bones of an elbow-joint, in which there is complete osseous ankylosis between the humerus and the ulna.

Case G. 644.—The bones of the carpus, with complete osseous union of their several articular surfaces. See also Nos. 650c, 657b, and 659a.

LOOSE BODIES IN JOINTS.

Loose bodies are not unfrequently met with in the larger articulations, especially in the knee. They generally exist singly, but as many as four hundred and fifteen have been found in one joint; in size they vary from that of a millet-seed to that of a chestnut; in structure they are usually cartilaginous or fibro-cartilaginous, occasionally fibrinous or fatty. Specks of bone are frequently found in the cartilaginous bodies. They may be formed in several ways.

1st. By the development of little masses of cartilage in the synovial fringes, and the subsequent detachment of such masses by the absorption or breaking of the narrow bases of the fringes by which they were attached to the synovial membrane. This is often the case in osteo-arthritis.

692b.—The lower portion of the femur with the patella, showing the changes which result from osteo-arthritis. There is considerable lipping of the bones, and the articular cartilage has almost disappeared from the patella and the internal condyle of the

femur. In the intercondylar notch is a pendulous ecchondrosis, which has a smaller nodule lying by its side.

693a.—Portions of a knee-joint from a case of osteo-arthritis, with various growths upon the internal surface of the synovial membrane. Most of the growths consist of fringes of slender and leaf-like processes of a soft fibrous structure; others are firmer, and approach to cartilage in their character, and one is a flattened, nodular growth of bone covered by a thin membrane. The articular cartilages are scarred, and undergoing fibrillation. See also Nos. 717, 718, 719, 720, and 723.

712.—Portion of an elbow-joint, in which there are several cartilaginous growths from the internal surface of the capsule, immediately above the olecranon. Two of these are closely attached to the capsule. A third is attached to it by a round and thin pedicle, apparently formed by the synovial membrane. One portion of cartilaginous substance, which was found loose in the joint, is at the bottom of the bottle.

720a.—Four hundred and fifteen loose cartilages removed by operation from the knee-joint. They are all of irregular shape, with nodulated, uneven surfaces, and vary in size from a swan-shot to an almond, by far the larger number being midway between these two sizes; the largest and the smallest are suspended at the top of the bottle. They are none of them pedunculated, and were not attached to the synovial membrane. Three of them may be seen to be very nearly divided into two separate portions, which yet remain united by a thin band; none of the others presented a similar appearance. A cut section is smooth and homogeneous, and a microscopical examination showed that they consisted of hyaline cartilage.

From a man aged thirty-one, who had had four attacks of rheumatic fever, while for six years past the knee-joint had been painful and swollen. At the time of the operation the synovial membrane was seen to be rough and vascular like granulation tissue, but there were no appearances of pedunculated growths. An amputation through the thigh was subsequently performed.

723a.—A loose body removed from the knee-joint. It is irregular in shape, and closely resembles the osteophytes which occur in the course of osteo-arthritis. The body is roughly pitted on one side, but is smoother and nodulated upon the opposite surface.

2nd. By a thickening and hypertrophy of the synovial fringes.

712c.—Loose bodies removed from the knee-joint. The bodies are synovial fringes thickened with caseating inflammatory material.

3rd. By the extravasation and subsequent organization of blood in a synovial fringe, detachment afterwards occurring.

716b.—A loose body removed from the knee-joint of a gentleman who received an injury to his knee whilst playing football. It was attached by a very slight pedicle to the synovial membrane. It is about the size of an almond, and consists of organized blood-clot enclosed in a synovial tuft.

4th. By “the breaking off or shedding into the cavity of the joint of a portion of proper articular cartilage, together with a layer, more or less substantial, of the adjacent bone” (Marsh). Professor Humphry has thrown great doubts upon this mode of formation, although the following specimen appears to bear out Mr. Marsh’s statement.

721.—Two portions of cartilage, removed from the knee-joints of a lad eighteen years old. They are almost exactly alike in form and size, each resembling such a piece of cartilage as might be obtained by removing that which covers the posterior surface of one of the condyles of a femur ; and each, as such a piece would be, is smooth and polished on its convex, and rough on its concave, surface.

“The arrangement of the cells in the cartilage in both these specimens is precisely similar to that of articular or encrusting cartilage” (Marsh).

5th. By the precipitation or coagulation of the synovia.

No specimen.

6th. By the organization of inflammatory exudations from the synovial membrane.

No specimen.

7th. By the separation of some of the intrinsic cartilages of the joint.

721a.—A portion of fibro-cartilage which was removed from the knee-joint by an incision carried along the inner side of the knee.

The piece of cartilage measures five-eighths of an inch in length, and one-eighth in thickness. It was firmly attached by one of its ends, and probably formed a portion of the internal semilunar cartilage.

From a man aged twenty-five, who had felt occasional pain and weakness in his left knee for about a year. A month before admission to the hospital, he first noticed a loose body on the inner side of the joint. He had more than once wrenched it severely at football and at cricket.

TREATMENT OF JOINT DISEASE BY EXCISION.

Most of the following specimens, which have been selected to illustrate excisions of the joints, merely consist of the excised articular ends of the bones, and have already been referred to under "Ulceration." They will, therefore, receive no further description here.

Excision of the head of the humerus.

724.—The upper part of a humerus excised for the remedy of disease in it and in the shoulder-joint.

596a.—The head of the right humerus, removed by the operation of excision. The cartilage over the whole articular surface is ulcerated, and at one spot there is a deep carious hole in the bone. The ligaments were completely softened.

From an unmarried woman aged thirty, who had observed some stiffness of the right shoulder-joint for ten years. For two years she had a sinus on the outer side of her right arm.

Excision of the elbow-joint.

725.—The elbow of a girl, aged twenty. The joint was excised for strumous disease ten months previous to the removal of the limb. The girl came to the hospital seven months afterwards. The arm was useless, the forearm falling when not supported. The fingers were stiff, and their motions all but lost. The thumb could be moved with tolerable precision. The sensation of the inner part of the limb was impaired, and the entire limb was colder than its fellow. It was also manifestly smaller, and was just an inch shorter.

The parts around the joint seemed sound. The cicatrix (H-shaped) was soundly healed, and the limb could be moved in any direction without pain or any evidence of roughened bone

within. After three months' perfect rest on a splint, with great attention to the general health, as no improvement took place, the limb was removed.

The muscles around the joint were firm, of good colour, and not evidently smaller than in health. The biceps and brachialis anticus were natural at their insertion; they had contracted new adhesions. The triceps was adherent to the lowest remaining portion of the humerus, especially on the outer side, and its tendon could be traced on to the ulna. This muscle, unlike its antagonists, was pale and wasted, with much fat between the fasciculi.

The extremities of the bones were surrounded by a tough, firm capsule, most marked anteriorly. The capsule was much strengthened by a thick fibrous cord, extending from the internal condyloid ridge to the coronoid process of the ulna, and the flexor muscles had in part their origin from it.

The ulnar nerve could be traced to the internal condyle, but no further, the nerve there blending with tough, matted, fibrous tissue. An inch above this point there was an appearance, but not a satisfactory one, of a continuation of the nerve.

The capsule, when opened in front and turned back, was found composed of dense fibrous tissue attached to the margins of the divided bones. Its surface in places was smooth and glistening. There was no fluid of any kind within.

The cut surface of the humerus was covered everywhere with fibrous bands passing into the capsule. This was more apparent behind than in front; the cut surface of the radius was covered with some thin, delicate fibres running into the capsule at the margins of the bone. These, when removed, showed the cancellous tissue imperfectly walled in. The surface of the ulna, however, was merely covered with a thin smooth layer, and, except at the margins, had no attachment to the capsules. Here the extremity of the bone had been covered with a continuous layer of new osseous tissue. There were no bands of fibres which could be traced running from the bones of the forearm to the humerus, other than those of the capsules which enclosed them externally. See also Nos. 673c, 726, and 727.

725a.—A section through the left elbow, from a case in which excision of the joint had been performed four years previously. The ends of the bones are connected by bands of dense fibrous tissue. The radius and ulna are dislocated forwards upon the humerus.

From a man aged forty-one, who had a freely movable joint.

Excision of the wrist.

728.—The wrist of a man aged twenty-eight, from which eight years previously the greater number of the carpal bones was removed on account of tubercular disease of the joint. The hand retained very considerable power of flexion and extension until the man's death from phthisis.

With the exception of the trapezium, pisiform, unciform, and part of the cuneiform bones, the carpal bones have been removed. The metacarpal bones have become adapted to the radius and ulna, and united to them by dense fibrous tissue, admitting of some motion at the part. This union has been divided. The remaining bones seem healthy.

Excision of the head of the femur.

730, 731.—Portions of bone removed in operations for excision of the head of the femur.

Excision of the knee-joint.

732.—A knee-joint, on which the operation of excision had been performed.

733.—A knee-joint, on which the operation of excision had been performed a considerable time before death. The man was able to walk well with the limb.

737.—A section of the bones of a knee on which excision had been performed. The femur and tibia, where they lie in contact, are firmly united by bone. A large sequestrum lies loose in a cavity in the upper end of the tibia. From a boy aged fourteen years, whose joint was excised on account of tubercular disease. After the operation, as the knee remained large and there were many sinuses discharging pus, amputation was performed. See also Nos. 736 and 738.

739.—Parts removed in an operation for excision of the knee-joint. In flexing the leg whilst opening the articulations the epiphysis of the femur snapped across. The line of separation is seen in the preparation. The specimen also shows the relation of the articular surfaces modified by the backward displacement of the tibia. The patient, a boy aged nine, recovered favourably.

735.—The specimen is one of unsuccessful excision of the knee-joint, from a boy aged five years. Amputation of the thigh was performed five months after excision. The lower end of the femur considerably overlaps the tibia, and absorption of the bones has

occurred where they are in contact. Both soft and hard parts appeared healthy, but there is no formation of callus between the bones.

657a.—A section through the right knee-joint. Excision had been performed eight months previously. There is complete bony union of the tibia and femur. The ivory pegs which were used at the time of the operation to fix the two bones together are seen to be vascularized from the neighbouring cancellous tissue; in the one which has been divided longitudinally, some amount of absorption has taken place, and it is so completely continuous with the bones as to form an integral portion of them. From a man aged twenty-two, who had bony ankylosis of the right hip, knee, and ankle, after an attack of rheumatic fever five and a half years before his death. Excision of the right ankle was performed on January 14, excision of the right knee on February 19, and division of the right femur in its upper third on July 16. The patient died of amyloid disease on October 23 in the same year. On admission to the hospital he had a mitral murmur, but at the autopsy the heart was found to be normal. See also **Nos. 657b, 732a, 734a, 738.**

Excision of the ankle.

659a.—A section through the right tibia and ankle-joint. There is complete bony ankylosis between the tibia and astragalus, and between the astragalus and os calcis. All the bones are much atrophied from disuse. From the same case as **No. 657a.**

ANCHYLOSIS AFTER EXCISION OF JOINTS.

In the knee and hip bony ankylosis with the limb in a straight position is the best result which can be obtained. **No. 657a** is almost an ideal termination for a case of disease of the knee-joint which has rendered excision necessary. In the elbow, on the other hand, fibrous union is desired. Failure of bony ankylosis, after excision of the knee, may be due to the leg not having been kept at rest; to a continuance of the inflammatory process in the bones (**No. 736**), or to necrosis having occurred (**No. 738**).

SECTION IV. INJURIES OF JOINTS.

DISLOCATIONS.

GENERAL PATHOLOGY.

A DISLOCATION has been defined as the removal of the articular surface of a bone from the part with which it is naturally in contact.

VARIETIES.

Dislocations may be divided into :

I. *The congenital*, in which the displacement is the result of some congenital malformation of the articular surfaces of the dislocated bones.

II. *The spontaneous*, in which the displacement is the result of disease.

III. *The accidental*, in which the displacement is the result either of external violence or of sudden excessive muscular action.

The congenital, of which good examples are to be seen in the hips, **Case H. 1050** and in **1050a**, and the spontaneous, which will be found treated of under diseases of the joints (p. 153), will not be further referred to here.

The accidental may be divided into the *Simple*, in which the articular surfaces are merely displaced, and the *Compound*, in which the displacement is accompanied by a wound of the integument communicating with the joint.

SIMPLE DISLOCATIONS.

STATE OF THE PARTS.

The injuries sustained by the joints and surrounding tissues in dislocations may be very extensive or but very slight. Some of the following are generally observed.

The articular surfaces are either partially or completely displaced, the former condition more often occurring in the hinge, the latter in the ball-and-socket joints.

When the displacement is complete, the end of the displaced bone may be found in the situation in which it was driven by the force that produced the displacement, *i.e.*, commonly opposite a rent in the capsular ligament through which it was forced; or it may be found occupying a position removed from that to which it was primarily displaced, *i.e.*, at some distance from the rent in the capsular ligament, having been drawn into such a secondary situation by the subsequent action of the muscles attached to it.

The ligaments are usually either stretched or torn. The capsular ligament and synovial membrane commonly present a ragged or slit-like aperture at one spot, through which the end of the bone has escaped (Nos. 1051a and 1037); in partial dislocations (Nos. 1019 and 1019a), however, the capsule has been found entire.

The inter-articular cartilages, when present, are lacerated or displaced.

The muscles are tightly stretched over the joint (No. 1045), or torn (No. 1036), and in the living they are generally spasmodically contracted.

The arteries are compressed, or occasionally ruptured.

The nerves (No. 1041) are stretched, pressed upon, or torn.

The skin over the joint is frequently stretched; in cases of direct violence it is often bruised, grazed, or cut.

Blood, moreover, in varying quantities is effused among the above-mentioned tissues.

Dislocations are frequently complicated by fracture of one or more of the bones entering into the affected joint.

1037.—A hip-joint, in which dislocation of the femur occurred a week before death. At the back part of the joint a wide laceration of the capsule is seen, which was made by the head of the femur in its dislocation from the acetabulum.

1036.—Notice the lacerated ligamentum teres and obturator internus muscle in this specimen. See also No. 1039.

1040.—A hip-joint, in which a dislocation of the femur, upon the sciatic notch, occurred about three weeks before death. The ligamentum teres has been torn across its middle.

1041.—In this specimen the sciatic nerve is seen flattened in consequence of the altered form of the parts surrounding the dislocated head of the femur.

1045.—The left hip-joint, with dislocation of the femur on to the pubes. The tendons of the psoas and the iliacus muscles are stretched over the joint.

IMPEDIMENTS TO REDUCTION.

In recent cases reduction is impeded by spasmodic contraction of the muscles surrounding the joint, sometimes by the small size of the rent in the capsule, occasionally by the hitching of portions of bone; in old-standing cases by the permanent contraction or shortening of the muscles and ligaments, the formation of adhesions, the healing of the rent in the capsule, and the filling up of the articular cavity with new bone.

Case H. 1023.—A scapula and humerus. The head of the humerus appears to have been dislocated forwards, and to have remained long unreduced just beneath the coracoid process, on the anterior surface and neck of the scapula. A concave surface has been here formed, on which the head of the humerus rested. The pressure of the posterior part of the head of the humerus against the anterior margin of the glenoid cavity has caused them both to be partially absorbed; and the remaining edge of the glenoid cavity, fitting in the recess in the head of the humerus, forms a kind of new joint between them.

Case H. 1027.—A humerus and scapula, exhibiting a dislocation which occurred a considerable time before death. The head of the humerus was displaced upwards and backwards upon the dorsum of the scapula. Its anterior margin rested against the inferior surface and the outer edge of the spine of the scapula, in which

situation a hollow and partially polished surface has been formed in adaptation to it. The neck of the humerus having moved upon and across the inferior half of the glenoid cavity and the adjacent part of the lower border of the scapula, their opposite surfaces are here accurately adapted and highly polished; the surface of the scapula at this part is broad and convex, while that of the humerus is deeply hollowed out. The lower part of the glenoid cavity has disappeared, being comprised in the new joint formed with the neck of the humerus. The head of the humerus is altered in form by the irregular deposit of bone on its surface: the upper half of the glenoid cavity is also flattened and nodular. A fracture through the middle of the shaft of the humerus has been firmly united, but at an angle directed outwards.

For a cast of this shoulder before the removal of the soft parts, see No. 39.

STATE OF THE PARTS AFTER REDUCTION.

After reduction the synovial membrane becomes slightly inflamed, with a moderate effusion of serum into the cavity of the joint. If the parts are kept at rest, the rent in the capsule heals, the inflammation subsides in a few days, and the joint is restored to its normal condition. Sometimes, when perfect rest is not maintained, the rent in the capsule does not heal, but its edges become smooth, allowing the head of the bone to slip in and out of its socket.

In rare instances the joint becomes acutely inflamed and suppurates, leading to the destruction of the articulation and subsequent ankylosis.

1046.—A hip-joint, with the head of the femur and part of the acetabulum, from a man who had a dislocation of the femur on the dorsum of the ilium three years before death. The dislocation was soon reduced, and the only traces of its effects which remain are that there is a strong band or collar of ligamentous tissue around the base of the neck of the femur at its upper part, and that a slip of the ligamentum teres is attached to the notch of the acetabulum external to the cotyloid ligament. But with this exception the ligamentum teres presents no sign of having been torn.

CONSEQUENCES OF NON-REDUCTION.

When a dislocation remains long unreduced, one of two results commonly occurs, the formation of a new joint, or ankylosis; the former condition is most common after dislocations of ball-and-socket joints where a certain amount of mobility is possible and has been kept up, the latter after dislocation of hinge joints where motion is slight or impossible.

Formation of false joints.

I. *After dislocations of ball-and-socket joints.*—The surface upon which the displaced bone rests becomes shaped into a new articular cavity, partly by absorption of the old bone, and partly by the heaping up of new bone around. At the same time the displaced bone becomes adapted by absorption to its new socket, and the soft tissues around become condensed and converted into fibrous tissue, forming a kind of new capsule. The ends of the bone appear either smooth, polished, and porcelaineous, or covered with fibrous tissue, and in some instances with fibro-cartilage. The old socket becomes filled up with fibrous tissue, which usually ossifies. In some instances the new cavity encroaches upon and partially causes the absorption of the old.

1020.—A right shoulder-joint, exhibiting an unreduced dislocation of the humerus of long standing. The head of the humerus, with a great part of its cartilage removed, and its articular surface hardened, rests on the anterior surface of the scapula with a thick layer of fibrous tissue intervening between it and the bone. The glenoid cavity retains its natural form, but its articular cartilage is thin and has numerous shreds, apparently of fibrous tissue, upon it.

1022.—A shoulder-joint, in which a dislocation occurred long before death and was not reduced. Tough ligamentous tissue has been formed on the scapula, beneath the head of the humerus, and a new fibrous capsule surrounded it. The surface of the glenoid cavity is covered by similar fibrous tissue, and that part of the head of the humerus which was in contact with its anterior margin has been absorbed.

Case H. 1023.—A scapula and humerus. A concave surface has

been formed upon the anterior surface of the scapula, upon which the humerus rested. The pressure of the posterior part of the head of the humerus against the anterior margin of the glenoid cavity has caused them both to be partially absorbed; and the remaining edge of the glenoid cavity, fitting into the recess in the head of the humerus, forms a kind of new joint between them. See also **Case H. 907, 1024, and 1027.**

1041.—Section of the head and neck of a femur, with the os innominatum of a man in whom dislocation of the femur and fracture of the acetabulum occurred fifty years before death. The dislocation was reduced; but soon after the head of the bone again escaped from the acetabulum, and was not again reduced. The head and neck of the femur are altered in form; shortened, flattened, and much increased in their vertical diameter; and the cancellous tissue of a thick layer of the head of the femur is consolidated and hard. A new and deep osseous cavity, with very thick walls, extends from the os innominatum, as if growing out from the acetabulum, and encloses the head and part of the neck of the femur. The wall of bone, by which this cavity is separated from that of the pelvis, and which includes the former floor of the acetabulum, is an inch and a quarter in thickness, and is chiefly formed, like the rest of the walls of the cavity, of hard compact new bone. The surface of the cavity, and that of the head of the femur, are covered and partly connected by fibrous tissue; they have no articular cartilage.

II. *After dislocation of hinge joints.*—Although anchylosis is the more common result, a false joint may nevertheless be formed if a certain amount of mobility is kept up. The false joint, however, will be of the hinge variety, the bones merely becoming grooved and adapted to one another, in part by absorption in consequence of mutual pressure, in part by heaping up of new bone around.

1028.—An elbow-joint, exhibiting an unreduced dislocation of the radius and ulna backwards. The articular surface of the humerus was completely covered by a newly-formed capsule, the cavity of which is laid open from the front. The head of the radius and articular surface of the ulna are also enclosed in new capsules separated from each other, and from that which encloses the articular surface of the humerus. The sigmoid cavity of the ulna appears to rest on a prominence of bone extending from the

posterior surface of the trochlea of the humerus. The head of the radius is confined in the place which it now occupies by a thick fibrous cord extending from its upper surface to a process of bone connected with the margin of the humerus, just above the outer condyle.

Case H. 1032.—The bones of an elbow-joint, exhibiting the effects of unreduced dislocation. The head of the radius, misshapen, elongated and flattened, appears to have rested upon and moved obliquely across the front and outer part of the lower end of the shaft of the humerus. A cavity is here formed on the humerus in which the head of the radius fits.

Anchylosis.

When the dislocated parts remain immovably fixed upon each other, their articular cartilages become absorbed, and their place occupied by cicatricial fibrous tissue, which afterwards undergoes ossification. Such a result, as before stated, is more common after dislocations of hinge joints than after those of ball-and-socket joints.

Case H. 1033.—An elbow-joint, in which the head of the radius was dislocated backwards. No reduction of the dislocated bone having been effected, it has become extensively united to the side of the ulna.

1055.—The bones of a great toe. The second phalanx, dislocated upon the upper surface of the first phalanx, has there become firmly fixed by bone.

COMPOUND DISLOCATIONS.

A compound dislocation is one in which the displacement of the bones is complicated by an external wound communicating with the affected joint. In some instances the end of one of the displaced bones protrudes through the wound. If the wound is small and has been early closed, the joint may be restored to its normal condition; if, however, the wound is large, and accompanied with much laceration and bruising of the soft tissues, suppuration may ensue and ankylosis probably result.

A good specimen of compound dislocation of the knee occurs in the following :

1051a.—The left knee-joint, in which the tibia and fibula have been partially dislocated backwards and outwards, whilst the patella was dislocated upwards and outwards. There is a large rent in the capsule of the joint on its inner side, whilst the internal lateral ligament is torn completely across. The vastus internus has been lacerated, and some of the fibres of the sartorius are torn. The whole of the lower end of the femur readily passes through the rent in the capsule. There is much extravasated blood in the tissues. From a man aged thirty-six, who, falling a distance of fifty feet, sustained such severe injuries that he died five days later.

SPECIAL DISLOCATIONS.

Only those dislocations are described that are illustrated by specimens in the Museum.

DISLOCATION IN THE STERNUM.

1018a.—The upper part of the sternum, showing a dislocation of the manubrium backwards upon the gladiolus. From a man aged forty, who was run over by a hansom cab. His ribs on the right side had been fractured from the third to the tenth inclusive, and on the left side from the third to the sixth. In connection with the fracture of the third left rib an abscess had formed, which ruptured into the pleura and set up pleurisy and broncho-pneumonia, of which the patient died. See also Nos. 1057 and 1058.

DISLOCATIONS OF THE UPPER EXTREMITY.

DISLOCATION OF THE CLAVICLE.

Dislocation of the clavicle is rare, whereas fracture of this bone, as we have seen, is especially common. Either end may be dislocated; the sternal end may be dislocated forwards, backwards, and upwards; but these two latter displacements are rare. The scapular end may be displaced upwards or downwards.

Dislocation of Sternal End.

1017.—Portion of a clavicle with the upper piece of the sternum and first rib. The sternal end of the clavicle is dislocated forwards

and downwards. The capsule belonging to its articulation with the sternum is torn ; but the rhomboid ligament is entire. The first rib is separated from its cartilage.

1017a.—Portion of a clavicle with the upper piece of the sternum and the first rib. The sternal end of the clavicle is dislocated forwards and downwards, the rhomboid ligament is torn through, and the head of the bone protrudes between the sternal and clavicular attachments of the sterno-mastoid muscle.

Dislocation of Acromial End.

1018.—A dislocation upwards of the acromial end of the clavicle, with fracture of the shaft. The ligamentous connections between the clavicle and acromion are almost completely broken through. During life the acromial end of the clavicle projected upwards, and there was so much separation that a finger could be inserted between it and the acromion. See also **Cast No. 36.**

DISLOCATION OF THE HUMERUS.

Dislocation of the humerus is very common. The head of the bone may be displaced in the following directions :

1. Forwards and inwards upon the anterior surface of the glenoid cavity (*subcoracoid*).
2. Downwards and slightly inwards on to the anterior costa of the scapula (*subglenoid*).
3. Backwards and downwards into the infra-spinous fossa (*subspinous*).
4. Forwards and inwards beneath the clavicle (*subclavicular*).

A displacement of the bone upwards (*subacromial*), which has been described as a form of dislocation, is more generally believed to be the result of osteo-arthritis.

Other varieties of dislocation of the humerus have also been described, but they are merely slight modifications of those above enumerated.

I. *Subcoracoid.*

The head of the bone is displaced forwards and inwards upon the anterior surface of the glenoid cavity, just below

the coracoid process, the groove between the head and greater tuberosity resting on the anterior margin of the glenoid cavity (Flower). The subscapularis muscle is generally raised by the head of the bone from the subscapular fossa, and the supra-spinatus, infra-spinatus, and teres minor are either tightly stretched or torn completely across at their insertion into the greater tuberosity; or the greater tuberosity may be separated with the above-mentioned muscles, which themselves remain entire. When the muscles are completely torn, or the tuberosity is detached, the head of the bone will be displaced further inwards than when these conditions are not present. In some very rare cases dislocation may take place without rupture of the capsule, but this can only occur where it has been unduly lax, or the capsule with the periosteum has been partially separated from the surrounding bone (Nos. 1019, 1019b).

The long head of the biceps is generally uninjured, whilst the short head, together with the coraco-brachialis, axillary artery and brachial plexus, is displaced slightly inwards and more or less pressed upon by the head of the bone. The circumflex nerve, from its situation, is frequently subjected to severe pressure, causing temporary paralysis of the deltoid.

Case H. 907.—A scapula and humerus, in which there has been a subcoracoid dislocation of the head of the humerus with a fracture of the neck.

Case H. 1023.—A scapula and humerus. The head of the humerus appears to have been dislocated forwards, and to have remained long unreduced just beneath the coracoid process, on the anterior surface and neck of the scapula, where a new joint has been formed.

1020.—A right shoulder-joint, exhibiting an unreduced dislocation of the humerus of long standing. The head of the bone is directly below, and nearly in contact with the coracoid process, just on the inner side of the glenoid cavity, but not below its level; the axillary artery and brachial plexus of nerves are close to it on its anterior and inner aspect. The infra-spinatus, teres minor, and subscapularis muscles are shown retaining their natural connections with the head of the humerus. See also Nos. 1019a and 1022.

1021.—A shoulder-joint with the shaft of the humerus, exhibiting dislocation and fracture. The head of the humerus is thrown forwards beneath the coracoid process. The tendon of the long head of the biceps is entire. The tendons of the supra-spinatus, infra-spinatus, teres minor, and subscapularis muscles are also entire.

1019.—Dissection of a recently dislocated shoulder-joint, which was reduced during life. The deltoid muscle is cut across and reflected; the lower part of the muscle was bruised and separated from the bone to a slight extent. The subscapularis is cut across about one inch from its insertion; its under surface at this point was slightly bruised. Neither this muscle nor the supra-spinatus or infra-spinatus was lacerated. The capsule of the joint was untorn, a small extent of its anterior attachment, with the periosteum with which it was continuous, was detached from the margin of the glenoid cavity and adjacent bone; but the joint was not opened. The capsule has been cut across at its anterior attachment. There is a deep vertical indentation or groove at the posterior margin of the articular surface of the head of the humerus, into which the anterior margin of the glenoid cavity accurately fits. It appears to have been produced by the violent impact of the head against this prominent rim, on which it probably lodged. From a man, aged thirty-six years, who was knocked down by a train whilst at work on the line. On admission he was found to have a subcoracoid dislocation of the right shoulder, in addition to numerous other injuries, from which he died about twelve hours after the accident. The head of the right humerus could be distinctly felt beneath the coracoid process; the axis of the bone was directed considerably outwards and backwards. Reduction was effected extremely easily on slight traction being made in the usual manner.

There is a drawing of the specimen in **Series lvii., No. 55.** See also **No. 1019b.**

The appearances presented by the shoulder in cases of subcoracoid dislocation are well seen in **Cast No. 37.**

The *subcoracoid* and *intracoracoid* dislocations of Malgaigne are merely varieties of the subcoracoid as here defined. In the former the head of the bone is directly under the coracoid process, in the latter a little internal to it; in the former the posterior scapular muscles are

generally entire and on the stretch, in the latter they are torn or detached along with the tuberosity.

II. *Subglenoid.*

The head of the bone is displaced downwards and slightly inwards on to the inferior border of the scapula, a little below and internal to the glenoid cavity. The capsular ligament is always ruptured at its lowest part. The supra-spinatus, infra-spinatus, teres minor, and subscapularis may or may not be torn. The circumflex nerve is, especially in this variety, pressed upon by the displaced head.

There is no specimen of subglenoid dislocation in the Museum.

III. *Subspinous.*

The head of the bone is displaced on to the posterior margin of the glenoid cavity, on to the back of the neck of the scapula, or on to the infra-spinous fossa beneath the spine (Flower). The infra-spinatus is generally torn up by the head of the bone, and the subscapularis is either stretched or ruptured, according to the amount of displacement. The capsular ligament may or may not be torn, and the tendon of the biceps may or may not be displaced from its groove.

1st Variety. Head resting on posterior margin of glenoid cavity.
1026.—A shoulder-joint, exhibiting an incomplete dislocation of the humerus backwards. The head of the humerus, unaltered in form, rests against the posterior border of the glenoid cavity. The tendons of the supra-spinatus and infra-spinatus are detached from the tuberosity of the humerus, but retain their connection with the capsule. The tendon of the biceps is displaced from its groove in the humerus, and retains its attachment to the glenoid cavity. The tendons of the teres minor and subscapularis retain their attachments to the humerus. The capsule of the joint is thickened.

2nd Variety. Head resting on the back of the neck of the scapula.
Case H. 1027.—A humerus and scapula, exhibiting dislocation

which occurred a considerable time before death. The head of the humerus was displaced upwards and backwards upon the back of the neck of the scapula. Its anterior margin rested against the inferior surface and the outer edge of the spine of the scapula, in which situation a hollow and partly polished surface has been formed in adaptation to it. The lower part of the glenoid cavity has disappeared, being comprised in the new joint formed with the neck of the humerus. A cast of this shoulder, before the removal of the soft part, is preserved. See **Cast No. 39.**

3rd Variety. Head resting on infra-spinous fossa.—No specimen in the Museum.

IV. *Subclavicular.*

Very rare. The head of the bone is displaced forwards and inwards beneath the clavicle to the inner side of the coracoid process, under the pectoral muscles, resting upon or between the fibres of the subscapularis. The supra-spinatus and infra-spinatus are generally torn through or detached from the humerus, but may retain their connection to the capsule. The teres minor and subscapularis generally retain their connection to the humerus, but the latter muscle is generally torn up from its origin in the subscapular fossa by the head of the bone. The capsule is generally extensively lacerated, the laceration occurring at its inner side.

1025.—A shoulder-joint, exhibiting dislocation of the humerus which occurred eighteen months before death. The head of the humerus rests on the anterior surface, near the inferior border, of the scapula. The tendons of the supra-spinatus, infra-spinatus, teres minor, and subscapularis muscles are entire. A bristle is passed beneath the tendon of the subscapularis, close to its insertion. A bristle is also passed beneath the tendon of the long head of the biceps, which retains its attachment to the edge of the glenoid cavity. Two bristles are placed beneath the circumflex nerve, which has been compressed by the dislocated head of the humerus, and is, in consequence, flattened and firmly adherent to the capsule of the joint. The dislocation was followed by permanent paralysis of the deltoid muscle.

DISLOCATIONS OF THE RADIUS AND ULNA AT THE ELBOW-JOINT.

The following dislocations of the radius and ulna are commonly described :

Both bones : backwards, forwards, inwards, outwards, backwards and inwards, backwards and outwards, and the radius forwards and the ulna backwards.

The radius alone : backwards, forwards, and outwards.

The ulna alone : backwards.

The above dislocations may be complicated by fracture of the olecranon, coronoid process, or condyles of the humerus. Only those illustrated by specimens in the Museum will receive further notice.

Radius and ulna backwards.

1028 and 1029.—Elbow-joints, exhibiting dislocation of the radius and ulna backwards.

Radius backwards.

Case H. 1033.—An elbow-joint, in which the head of the radius was dislocated backwards. No reduction of the dislocated bone having been effected, it has become extensively united to the side of the ulna. There appears also to have been a fracture of the internal condyle. All the bones are atrophied.

Radius forwards.

Case H. 1031.—The bones of an elbow-joint. A fracture extends in two directions through the internal condyle of the humerus into the elbow-joint. The two portions of the condyle separated by the fracture have not been reunited by bone. The radius was found dislocated forwards in front of the ulna. See also No. 1030.

Case H. 1032.—The bones of an elbow-joint, exhibiting the effects of dislocation and fracture which occurred many years before death, and which were followed by long-continued inflammation of the bones. The head of the radius has been dislocated forwards. The shaft of the ulna has been broken a little below the olecranon. The head of the radius, misshapen, elongated, and

flattened, appears to have rested and moved obliquely across the front and outer part of the lower end of the shaft of the humerus.

DISLOCATIONS OF THE HAND AT THE WRIST-JOINT.

Dislocation of the hand from the radius and ulna is very rare; fracture of the lower end of the radius was formerly mistaken for it.

The hand may be displaced either backwards or forwards; the latter displacement is extremely rare.

1034.—A wrist-joint, exhibiting dislocation of the hand forwards. The radius is arched with a convexity directly backwards, near its lower end, but there is no appearance of its having been fractured.

DISLOCATIONS OF THE DIGITS.

Of the thumb.

The most important dislocation is that of the first phalanx from the metacarpal bone. It is usually displaced backwards. Reduction is often difficult because the head of the metacarpal bone is forced between the two insertions of the flexor brevis pollicis, by which its neck is tightly embraced. The following specimen is an example of the rarer form in which the phalanx is displaced forwards.

1035.—A portion of the left hand of a man who was killed by the fall of an archway. The proximal phalanx of the thumb is dislocated forwards on to the anterior surface of the head of the metacarpal bone. The posterior portion of the capsule of the joint is torn across. Reduction was readily effected by extension.

DISLOCATIONS OF THE LOWER EXTREMITY.

DISLOCATIONS OF THE FEMUR AT THE HIP-JOINT.

Dislocations of the femur may be divided into the regular in which one or both branches of the Y-ligament are intact; and irregular in which both branches are ruptured. In the former the signs are constant, as the intact branch of the Y-ligament compels the bone to assume a certain

definite position. In the latter the signs vary, as both branches of the **Y** being torn the control which it exercises over the position of the bone is lost. In the regular the head of the femur may be displaced in the following directions :

I. Backwards and upwards upon the dorsum of the ilium (*dorsal*, Bigelow).

II. Backwards into the ischiatic notch (*dorsal below the tendon*, Bigelow).

III. Downwards and forwards into the foramen ovale (*thyroid and downwards*, Bigelow).

IV. Forwards upon the pubes (*pubic and subspinous*, Bigelow).

V. (Anterior oblique, Bigelow).

VI. (Supra-spinous, Bigelow).

VII. (Everted dorsal, Bigelow).

The first four of these are known as the classical dislocations of Sir Astley Cooper. The last three are very rare.

In the irregular dislocations, the bone may be displaced in any position, as for instance :—

I. Downwards and backwards into the lesser ischiatic notch (Wormald's dislocation).

II. Downwards and backwards upon the ischium close to its spine.

Several other irregular dislocations are described, for which the student is referred to the larger works on surgery.

I. *The regular dislocations.*

One or both branches of the **Y**-ligament are entire.

A. *Both branches entire.*

Backwards and upwards upon the dorsum of the ilium
(*dorsal*, Bigelow).

In this, the most common form of dislocation of the femur, the head of the bone is thrown upwards and backwards on to the dorsum of the ilium, the articular surface of the head

looking backwards and the great trochanter forwards. The capsular ligament is generally found ruptured behind or below and the round ligament torn, but the ilio-femoral or Y-ligament is uninjured. The glutei muscles are raised up from the ilium by the head of the bone, which, according to Bigelow, is always found above the tendon of the obturator internus. Should the external branch of the Y-ligament, which, according to Bigelow, prevents eversion by the external rotator muscles, be ruptured, the femur will be rotated outwards, so that the head of the bone will look forwards, and the trochanter backwards (*everted dorsal* of Bigelow).

1036.—A hip-joint, exhibiting dislocation of the head of the femur on the dorsum of the ilium, which occurred shortly before death.

Backwards into the ischiatic notch (dorsal below the tendon, Bigelow).

The head of the bone is displaced backwards upon the surface of the ilium in front of the ischiatic notch, but is never, according to Bigelow, actually in the notch. A case is described by Professor Pirrie, however, in which, on dissection, the head of the bone was found resting on the pyriformis—*i.e.*, in the notch. The articular surface of the head looks backwards, the great trochanter forwards, eversion being prevented by the outer branch of the Y-ligament. The tendon of the obturator internus is described by Bigelow as winding over the neck of the bone, and is believed by him to be the great obstacle to reduction by extension. The head of the bone is covered by the gluteus maximus, and the capsular and round ligaments are torn. This form of dislocation is believed by Bigelow to be nearly always secondary. He maintains that the head of the bone primarily escapes through a rent in the lower part of the capsule into the thyroid foramen below the tendon of the obturator internus (Cast No. 46), and is afterwards drawn upwards and backwards towards the ischiatic notch, the tendon of

the obturator internus always remaining above the neck of the bone. In the following specimen, however, the rent in the capsule is posterior, so making it probable that the displacement upon the ischiatic notch in this instance was primary.

1040.—A hip-joint, in which dislocation of the head of the femur upon the ischiatic notch occurred about three or four weeks before death. The ligamentum teres has been torn across its middle; no union of it has taken place. The opening in the capsule through which the head of the bone escaped was situated at the posterior part of the joint. See also Nos. 1038 and 1039.

Downwards and forwards into the foramen ovale (thyroid and downwards, Bigelow).

The head is displaced downwards upon the obturator externus muscle, where it lies suspended by the Y-ligament, and may remain just below the acetabulum, or may be carried more or less inwards towards the perineum, or outwards towards the tuberosity of the ischium. The head of the bone generally looks inwards, the trochanter major outwards. The capsular and round ligaments are ruptured, the former at its lower part. The Y-ligament is entire. The glutei, pyriformis, psoas, and iliacus muscles are stretched. The obturator externus is often torn.

1043.—A hip-joint, exhibiting a recent dislocation of the head of the femur on the lower edge of the obturator externus muscle. The ligamentum teres is torn from its attachment to the head of the femur. The capsule is extensively lacerated at the inner side and lower part of the joint. The obturator externus muscle is lacerated where the femur rests partly on it and partly on the subjacent obturator ligament. See Cast No. 46.

Forwards upon the pubes (pubic and subspinous, Bigelow).

The head of the bone rests below Poupart's ligament, either upon the pubes (*pubic*) or upon the pectineal eminence, beneath the anterior inferior spine of the ilium (*subspinous*).

The head looks forwards and the trochanter major backwards. The capsular, and generally the round, ligaments are ruptured; the Y-ligament is entire, and produces the eversion of the limb characteristic of this variety of dislocation. The psoas and iliacus, together with the anterior crural nerve between them, are stretched tightly over the head of the bone; the femoral vessels are displaced to its inner side.

1044.—A hip-joint, exhibiting dislocation of the femur, which occurred many years before death. The head of the femur has been thrown upwards and forwards, and is lodged in a cavity, formed in part by new bone and in part by what appeared to be the displaced cotyloid ligament, at the margin of the ilium, in the situation of the anterior inferior spine. The ligamentum teres is flattened and elongated, but it retains its natural connections; bristles are placed between the two portions of this ligament, which are attached to the margin of the original acetabulum.

1045.—The left hip-joint of a man, aged forty-six. The head of the femur has left the acetabulum, and is lodged beneath the anterior inferior spine of the ilium upon the pectineal eminence, the great trochanter pointing directly backwards. The tendon of the psoas winds round the head to reach the lesser trochanter, the iliacus muscle is stretched over the inner portion of the head, and between the two muscles lies the anterior crural nerve. The femoral vessels are to the inner side of the head of the bone.

1045.—A left hip-joint. The head of the femur has left the acetabulum, and is lodged beneath the anterior superior spine of the ilium, the great trochanter pointing directly backwards.

Of the two other varieties in which both branches of the Y-ligament are entire, viz., the anterior oblique and supra-spinous, there are no specimens in the Museum.

B. *The outer branch of the Y-ligament ruptured.*

There is no specimen of the everted dorsal in the museum, the form in which the outer branch of the Y is ruptured.

II. *The irregular dislocations.*

Both branches of the Y-ligament ruptured.

Downwards and backwards into the lesser ischiatic notch (Wormald's dislocation).

1039.—A hip-joint, exhibiting a dislocation of the head of the femur downwards and backwards, which occurred twelve hours before death. The head of the bone is situated on the ischium opposite to the lesser ischiatic notch and the upper part of the tuberosity. The tendon of the obturator internus is torn from its muscular fibres; some of the fibres of the pyriformis, gemelli, and glutæus minimus are also torn. There is also a fracture extending through the os innominatum near the acetabulum.

Downwards and backwards upon the ischium, near its spine.

1037.—A hip-joint, in which a dislocation of the femur occurred a week before death. The capsule has been opened in front. At the back part of the joint is the wide laceration in the capsule which was made by the head of the femur in its dislocation from the acetabulum.

It was supposed that the dislocated head of the femur was situated upon the ischium, close to its spine. A portion of the posterior part of the rim of the acetabulum, in the presumed direction of the dislocation, is separated by fracture. Upon the front part of the joint there is also a detached portion of the rim of the acetabulum connected with the capsule. The surface of this piece of bone is very smooth, and is adapted to a corresponding surface of the ilium immediately below the anterior inferior spine; and above this surface there is a deposit of bone, making it probable that the changes in this part of the joint were the result of some injury previous to the dislocation.

DISLOCATIONS OF THE PATELLA.

The patella may be dislocated outwards, inwards, upwards, and edgeways. The outward dislocation is the most common, on account of the greater prominence of the internal condyle of the femur. The upward can only occur when the ligamentum patellæ has been ruptured or divided.

Outwards.

1051.—A knee-joint, of which the patella was dislocated outwards long before death, and was not reduced. The patella rests

on the outer surface of the external condyle of the femur, on which, in adaptation to it, a small articular surface has been formed by a layer of very dense and polished ligamentous tissue. The tendon of the quadriceps femoris lies on the outer side of the femur, and the ligamentum patellæ is directed slightly inwards as well as downwards towards the tibia, which has been rotated outwards, following the displacement of the patella.

The condition of the knee before the soft parts were reflected is seen in **Cast No. 49**. See also **Cast No. 48**, taken from a right knee in which the patella was dislocated outwards.

DISLOCATIONS OF THE KNEE.

This rare form of dislocation may occur in a forward, backward, inward, or outward direction. Compound dislocation of the knee is a most serious injury, the external wound being usually large and ragged, whilst the condyles of the femur protrude through the lacerated soft structures surrounding the joint. An almost typical example of a compound partial dislocation follows :

Backwards and outwards.

1051a.—The left knee-joint, in which the tibia and fibula have been dislocated backwards and outwards, whilst the patella was dislocated upwards and outwards. There is a large rent in the capsule of the joint on its inner side, whilst the internal lateral ligament is torn completely across. The vastus internus has been lacerated, and some of the fibres of the sartorius are torn. The whole of the lower end of the femur readily passes through the rent in the capsule. There is much extravasated blood in the tissues. From a man aged thirty-six, who, falling a distance of fifty feet, sustained such severe injuries that he died five days later.

Cast No. 53.—The right knee, in which complete dislocation of the tibia and fibula has taken place backwards and outwards.

Outwards.

Cast No. 51.—Cast of the inner surface of the left knee-joint of a man aged 48 years. The tibia and fibula were dislocated outwards with the patella, which was partially rotated inwards. The prominence on the inside is the internal condyle of the femur, whilst the

prominence in front is the patella, with the outer edge turned forward.

Inwards.

Cast No. 52.—Cast of a right knee, with dislocation of the tibia and fibula inwards.

SUBLUXATION OF THE KNEE.

Hey's internal derangement of the knee-joint is due to the displacement of a semilunar cartilage. It is said to occur most frequently whilst the limb is slightly flexed, the leg being at the same time rotated either inwards or outwards. The accident is most common on the inner side of the joint.

Cast 50 is taken from a knee in which it was supposed that this accident had occurred. There is a deep crescentic depression of the skin over the situation of the internal semilunar cartilage. The patient from whom the cast was taken was knocked down, and fell with his left leg bent under him, and from that instant was unable to bear his weight on the limb. In examining the joint after the cast was taken, and whilst the knee was bent to its utmost, a sudden crack was heard, the depression of the integuments disappeared, and the mobility of the joint was restored.

DISLOCATIONS OF THE FOOT AT THE ANKLE-JOINT.

The foot—*i.e.*, the astragalus together with the other bones of the tarsus and metatarsus—may be dislocated from the tibia and fibula outwards, inwards, forwards, or backwards.

Dislocation of the foot outwards.

Displacement of the foot outwards is the most common of the dislocations at the ankle-joint. It is generally complicated by a fracture of the fibula about three or four inches above the external malleolus (*Pott's fracture*). The articular surface of the astragalus with the rest of the foot is wrenched from the articular surface of the tibia and fibula, and carried outwards, so that the sole of the foot looks

outwards and the inner edge downwards towards the ground. The foot is at the same time drawn backwards by the tendo Achillis. It may be noted that it is this backward displacement that so frequently gives trouble in reducing the dislocation.

The external lateral ligament is uninjured, and retains the astragalus in contact with the external malleolus, so that the malleolar end of the lower fragment of the fractured fibula is carried outwards along with the astragalus, whilst its upper end is driven inwards, and forms a receding angle with the lower end of the upper fragment.

The internal lateral ligament is ruptured, or it may remain entire, in which latter case the tip of the internal malleolus is torn off. Occasionally "that part of the tibia which enters into the formation of the inferior tibio-fibular articulation" is broken off from the rest of the shaft and remains connected with the external malleolus (Pirrie).

Case H. 1003.—A foot, with parts of the tibia and fibula, exhibiting the effects of dislocation and fracture ten months before death. The foot is dislocated outwards, and the tibia is partially separated from the fibula; the internal malleolus projects an inch on the inner side of the astragalus. The astragalus also is partially separated from the scaphoid bone. The fibula has been broken into several portions just above the malleolus. These portions are firmly reunited, and there is an accumulation of bone both before and behind the articulation between the tibia and the fibula. See also **Case H. 1002.**

Case H. 1004.—Dislocation of the foot outwards, from a man, aged sixty-five. The tibia is separated widely from the astragalus. The fibula is fractured about an inch above the malleolus. The internal lateral ligament is torn. The external lateral ligament is entire.

The characteristic appearances of the foot in cases of Pott's fracture are well seen in the casts numbered 31 and 31b. These casts should be compared with **Cast No. 56**, a specimen of subastragaloid dislocation, which somewhat resembles Pott's fracture.

Dislocation of the foot backwards.

Cast 54.—A cast of a left leg and foot, exhibiting a dislocation of the foot backwards. From a man aged fifty-eight, in whom the dislocation had remained unreduced for four years. At the time when the cast was taken he had a fair amount of motion both in flexion and extension of the foot.

DISLOCATIONS OF THE ASTRAGALUS.

The astragalus may be dislocated (i.) from the tibia and fibula, (ii.) from the os calcis and scaphoid, and (iii.) simultaneously from both the tibia and fibula and os calcis and scaphoid.

(I.) In the first variety the astragalus retains its connections with the other bones of the foot, but together with the latter is dislocated from the tibia and fibula. This form has already been described as dislocation of the foot.

(II.) In the second variety the astragalus retains its connections to the tibia and fibula, but the remaining bones of the foot are dislocated from it. An example of this dislocation follows, and is known as the

Subastragaloid Dislocation.

In this variety the astragalus may be displaced either backwards and inwards or backwards and outwards; more rarely in the opposite directions. In the backward and inward variety (**Cast No. 56**) the foot is inverted, the sole looks inwards, the external malleolus is prominent, the internal is buried by the projection of the os calcis beyond it, and the head of the astragalus forms a distinct prominence on the outer side of the instep, over which prominence the skin is tightly stretched. In the backward and outward variety (**Cast No. 57**) the foot is everted instead of being inverted: the internal malleolus is prominent and the external is buried, whilst the astragalus projects on the inner side of the instep. Compare **Cast No. 57** with **Cast No. 34**, the latter being a good example of Pott's fracture. The absence of the prominent head of the astragalus and the

presence of a slight sulcus corresponding to the situation of the fracture of the fibula in the latter serve as distinguishing features.

1053a.—The lower ends of the tibia and fibula, with some of the bones of the tarsus. Nearly the whole of the ligaments uniting the astragalus to the rest of the bones of the foot have been torn through, and their remains hang in shreds from the bones they unite. The astragalus itself is slightly broken at the attachment of the anterior portion of the external lateral ligament, and a small piece of the scaphoid is torn off. The anterior ligament of the ankle-joint is also partially rent, and the ankle-joint opened. The astragalus maintains its position relative to the tibia and fibula. From a woman who fell out of a second-floor window, and died from other injuries. The whole foot was very loose, and could be displaced in almost any direction.

Cast 56.—Cast of a foot showing a subastragaloid dislocation of the foot inwards. The head of the astragalus forms a prominence on the outer side of the foot.

Dislocation of the Astragalus alone.

(III.) In the third variety the astragalus is partially or completely separated from its connections with the bones with which it articulates—viz., from the tibia and fibula above, the os calcis below, and the scaphoid in front. This variety is what is generally spoken of as dislocation of the astragalus.

Case H. 1010.—The foot of a child, exhibiting a partial dislocation of the astragalus from the os calcis, together with a fracture of the superior and anterior margin of the latter bone.

1052.—An astragalus, which had been dislocated forwards, upwards, and a little outwards, with compound fracture of the external malleolus and displacement of the foot inwards. The bone was excised on the tenth day after the accident.

DISLOCATION OF THE TOES.

1054.—Bones of the first and second phalanx of a great toe. The second phalanx is dislocated, and firmly united by bone to the upper surface of the first phalanx. See also No. 1055.

CONGENITAL DISPLACEMENTS OR DISLOCATIONS.

The congenital dislocations usually depend upon some malformation of the articular surfaces. The congenital dislocation of the hip is the best recognised form. There are two excellent examples of it in the Museum.

Congenital dislocation of the hip.

Case H. 1050.—The pelvis and femora of an adult female. The head of each femur is dislocated upon the dorsum of the ilium. Portions of the capsules of the hip-joints remain, but there is no vestige of either ligamentum teres. The head of each femur has been absorbed, so that each has become irregular and conical in form. On the dorsum of each ilium there is an oblong roughened patch produced by friction of the heads of the thigh-bones in walking. The acetabula are represented by two small triangular cavities.

1050a.—A portion of the right innominate bone, with the head and neck of the femur, from a case of congenital dislocation of the hip. The ilium has been separated from the pelvis by a section carried obliquely through the obturator foramen at a point corresponding with the lower part of the acetabulum. A triangular space occupies the position of the normal acetabular cavity, but unfortunately only the apical portion is preserved. This space is partially covered with a thin layer of cartilage, the bone being in part bare. Upon the dorsum of the ilium, immediately above the apex of the triangle, is an irregularly depressed surface, which, in the recent specimen, was covered by fibrous tissue, upon which the head of the femur rested during life. No attempt at the formation of a socket, however, has been made, nor has any new bone been thrown out in this situation. The iliac segment of the acetabulum, which extends from a point below the anterior inferior spinous process of the ilium obliquely backwards to the ischium is entirely absent, and to this is to be attributed the triangular depression representing the acetabulum. The curvature of the sciatic notch is remarkably altered, owing to the extreme elongation of the lower and posterior portions of the innominate bone. As a result of this elongation, the antero-posterior diameter of the bone extending from the spine of the ischium to the ilio-pectineal line is much shortened. There is a great smoothness and absence of muscular ridges on the ilium. The head of the femur is

diminished in size, and is much altered in shape. It is ovoid, and is flattened posteriorly, but it is everywhere covered by a layer of healthy articular cartilage, which shows no signs of ulceration. The ligamentum teres is completely absent, and there is nothing which would lead to the supposition that it had ever existed. The neck of the bone is shortened, and appears to be twisted slightly backwards upon its axis. Before maceration the head of the bone lay in a well-defined capsular ligament.

From a girl, aged thirteen years, who died in St. Bartholomew's Hospital of a cancer of the stomach. The lameness was observed on admission, and in answer to inquiries after death, when the condition of the hip-joint had been ascertained, the father stated that this was the first child. The labour was easy and natural, no interference being required. Nothing wrong with the leg or hip-joint was noticed before the walking period. The lameness was not very noticeable until she was about three years of age. There had been no accident nor any symptoms or suspicion of hip-joint disease; no pain on motion at any time. No other member of the family had been similarly affected. See also **Cast 47b** and photograph **No. 57a**, where the lateral curvature and the characteristic "saddle-back" resulting from the displacement are well seen.

Congenital Dislocation of the Knee.

In cases of congenital dislocation of the knee the tibia is usually displaced forwards, and it may be complicated by absence of the patella. The flexion may be very limited, but the movement of extension is considerably greater than usual.

1051b.—The femur and tibia from a stillborn child who had "back-knee," and in whom hyper-extension of the joint was possible.

WOUNDS OF JOINTS.

Wounds of joints, when small and early closed, may be completely recovered from; otherwise they generally set up acute inflammation of the synovial membrane, which commonly terminates in suppuration and ankylosis. The appearances presented by the synovial membrane, cartilages, etc., are similar to those already described as occurring in acute synovitis (p. 142).

Wounds of joints are illustrated by only one specimen in the Museum, in which the wound was produced by a needle.

740.—The head of a fibula, with some of its surrounding tissues. Below, firmly embedded in fat and cellular tissue, is part of a needle, about half an inch in length. The structures around are natural in appearance, and free from thickening or induration. The needle had been driven nine years before into the front of the knee-joint when the patient was five years old. For four years it seemed to produce no disturbance; from that time onwards there was almost constantly progressive suppurating disease of the knee-joint. After amputation the patient sank from pyæmia.

SECTION V.

INJURIES AND DISEASES OF MUSCLES, TENDONS, SHEATHS OF TENDONS, BURSÆ, AND FASCIÆ.

INJURIES AND DISEASES OF MUSCLES.

RUPTURE OF MUSCLES.

THE only specimens of ruptured muscle in the Museum are the results of injuries received in dislocations of the hip, or by the evulsion of tendons.

See Nos. 1036, 1039, 1043, 1182.

FATTY DEGENERATION OF MUSCLE.

Fatty degeneration of muscle, in which the muscular fibres are converted into fat, and fatty infiltration, in which globules of fat are deposited between the fibres while the fibres themselves are at first unaffected, are generally included under the term fatty degeneration; they usually co-exist to some extent in the same muscle.

Fatty degeneration is frequently met with in the muscles of the aged, especially in old people who have been long paralyzed or deprived of proper and sufficient nourishment. It is also of common occurrence in muscles which have been subjected to prolonged disuse, as from chronic joint disease, comminuted fracture, lead-poisoning, etc. It also occurs in the muscles of patients who have had anterior poliomyelitis (infantile paralysis).

Specimens similar to the following, in which one or more of the voluntary muscles appear completely converted into fat, are not unfrequently met with in old subjects brought into the rooms for dissection.

1168.—A soleus muscle, completely degenerated into fat. No muscular fibres can be discerned; in their places is a fatty tissue, like that of the ordinary healthy fat, which on the posterior part is arranged in a fasciculate manner, as the muscular fibres were, but anteriorly appears lobulated or granular.

The gastrocnemius and other muscles of the back of the same leg were similarly altered. The muscles on its anterior part were pale and flabby. All its other parts appeared healthy.

1168a.—A portion of the gastrocnemius muscle, which has undergone complete fatty metamorphosis. No muscular fibres are anywhere visible, but the inferior surface is covered by the lustrous tendon.

From the leg of a girl, aged twenty-six, who for many years had suffered from anterior poliomyelitis.

OSSIFICATION OF MUSCLE.

Ossification of muscle is occasionally met with. The muscles most commonly affected are the adductor longus and the deltoid; the former in persons accustomed to excessive riding, the latter in soldiers, from the constant shouldering of arms.

1169.—Part of a vastus internus femoris muscle, with the superficial and deep femoral arteries. Large portions of the muscle are ossified. The largest portion of bone lies so close to the arteries that it probably presented during life the characters of a pulsating tumour. See also No. 1170.

ABSCESS IN MUSCLE.

1171.—Two psoas muscles. Externally they presented an ordinary appearance, but on cutting into them their interior was found to be filled with dried-up pus, which occupied the large cavities shown in the preparation. These, which, with their contents, usurped the place of a great part of the muscles, were lined by an irregular, glistening membrane of an imperfect fibrous structure, not unlike that which often walls in a chronic abscess.

From the body of a middle-aged man brought for dissection.

1172.—Part of the dried-up pus removed from the cavities shown in the preceding preparation.

ULCERATION OF MUSCLE.

1173.—A slough of the tibialis anticus muscle which was separated in a case of diffuse cellulitis of the lower third of the leg, following Syme's amputation. The operation was performed for cancer of the sole of the foot in a man aged fifty-three.

TUMOURS OF MUSCLES.

Tumours in connection with muscle generally have their origin in the connective-tissue planes between the muscular fibres. All varieties of tumours may affect muscles; syphilitic new growths (gummata) are particularly common.

Sarcomata.

1174a.—A portion of a tumour removed from the sartorius muscle. It appears to have grown from the connective-tissue between the muscle-fibres. The section of the new growth appears in part to be of a firm fibrous nature, whilst in part it is soft, and has broken down in such a manner as to leave a cavity. The tumour is enclosed in an incomplete capsule, which has allowed of the extension of the softer portion of the growth. The capsule appears to be formed by the condensation of the surrounding connective-tissue. From a woman aged sixty-two. The tumour was of nine months' duration. It was pyriform and obtuse in shape, situated subcutaneously, and growing rapidly. It was slightly lobulated, and before removal it was semi-fluctuating. Microscopically it was found to be a sarcoma undergoing fibroid change. The growth recurred in the neighbourhood of the scar, and extended upwards into the groin. It ulcerated through the skin, bled severely at times, and death by exhaustion ensued a few months after its removal.

Sections are preserved in **Series lv., No. 57c.** See also No. 1174b.

Carcinomata.

1174.—Sections of a rectus femoris muscle, in which are several large lobulated and circumscribed masses of a soft flocculent

medullary substance. The muscular fasciculi are separated by the morbid growths, but appear of healthy texture.

A large medullary tumour from the axilla of the same patient is preserved in **No. 3334.**

ENTOZOA IN MUSCLES.

Cysticercus cellulosæ.

1175.—Portions of a longissimus dorsi muscle, in which are specimens of the *Cysticercus cellulosæ*, the immature form of the *tænia solium*. The cysts are placed in the cellular tissue connecting the muscular fasciculi. In the upper portion of the muscle are two cysts, from which the cysticerci lying loose in the bottle were removed; in the lower portion the cysticercus is attached to the interior of its cyst.

These specimens were taken from the body of an old man, in many of whose voluntary muscles similar entozoa existed.

1176.—Portions of muscle and liver, from a pig, in which are numerous cysts, like those in the preceding specimen, and probably, like them, containing cysticerci.

Trichina spiralis.

1176a and 1176b.—Muscles infested with *trichina spiralis*.

The specimens were obtained from a man who had recently returned from America. All the muscles of the body contained an abundance of *trichinæ*, but none were noticed in the connective-tissues. Sections of the muscles are preserved in **Series lv., No. 189.**

INJURIES AND DISEASES OF TENDONS.

EVULSION OF TENDONS.

Evulsion, or tearing out, of a tendon with part of its muscle is not an uncommon injury. Several specimens follow:

1180.—The end of the tail of a rat, with numerous long slender tendons attached to it.

1182.—The tendon, with part of the muscular fibres, of the flexor longus pollicis, which were torn out from a man's arm.

The patient was a butcher, whose thumb was caught by a meat-

hook, on which he remained suspended till the muscle gave way. He recovered quickly from the injury. These specimens appear to be of unusually frequent occurrence in St. Bartholomew's Hospital, no doubt in consequence of its proximity to the central meat market.

1184.—This forefinger, with the accompanying tendons, was torn off from the hand of a man by a blow from a ramrod, which had been forcibly ejected from a gun. See also Nos. 1181, 1181a, 1183, 1185, and 1185a.

It will be noticed that in the preceding specimens it is nearly always the flexor tendon which is torn out of its sheath with the phalanx. This is due to the fact that the flexor tendons are inserted into the bone itself, whilst the extensor tendons are inserted into the periosteum.

THE PROCESS OF REPAIR AFTER SUBCUTANEOUS DIVISION OF TENDONS.

The process of repair after subcutaneous division of tendons has been much less completely studied in man than in the lower animals, yet "the few instances," says Sir James Paget, "in which examination has been made of human tendons, divided by subcutaneous section, have shown that the process in man and in animals is not materially different. The chief differences are, we may believe, that, as in the repair of bones, the production of reparative material is more abundant, and its organization more speedy, in animals than in man."

Immediately after division the upper end of the divided tendon is drawn to some distance from the lower by the contraction of its muscular fibres. The sheath and surrounding cellular tissue become inflamed, and inflammatory material is produced around and between the ends of the divided tendon. The ends themselves become swollen and infiltrated with new material, which combines with that already formed between them. The material thus uniting the ends is converted into fibrous tissue, which undergoes shrinking and contraction, and finally assumes the characters

of the original tendon, so that in some instances no trace of the division is left.

The inflammatory products, according to Sir James Paget, take little or no share in the healing of the injury, but are replaced by proper reparative material, which, by undergoing fibrous changes, leads to the restoration of the tendon.

The process of union is occasionally delayed by extensive extravasation of blood between the divided ends. Such extravasations, however, are rare.

The different stages in the process of repair, as it occurs in the lower animals (rabbits), are well illustrated in the following specimens, prepared by Sir James Paget and Mr. Savory.

I. Repair in animals (rabbits).

1187.—*Twenty hours.*—Leg of a rabbit, killed twenty hours after the division of the tendo Achillis. The upper end of the tendon has retracted above three-quarters of an inch, and is slightly connected to the lower portion by a soft, gelatinous, blood-speckled material effused between them within the sheath.

1188.—*Sixty-eight hours.*—Leg of a rabbit, killed sixty-eight hours after the division of the tendo Achillis. The ends of the divided tendon are about three-quarters of an inch apart, and the interval between them is filled by a firm clot of blood.

1189.—*Six days.*—Leg of a rabbit, killed six days after division of the tendo Achillis. The skin above has been removed; it was more firmly adherent than usual to the parts beneath, and here and there, beneath it, were small dots, the remains of minute extravasations of blood. There is a general enlargement of the tendon within the sheath where divided, the swelling tapering gradually into the natural size and shape of the tendon. The wound of the sheath is soundly and completely closed.

1191.—*Ten days.*—Leg of a rabbit, ten days after division of the tendon. The ends of the tendon are connected by firm, new material, in the centre of which are one or two small distinct spots.

II. Repair in man.

1197.—*One month.*—A portion of the tendo Achillis of a man

aged thirty-two, which was divided one month before the leg was amputated.

1198a.—*Two years*.—Longitudinal section of a tendo Achillis. The specimen was taken from the leg of a girl in whom a portion of the tendon had been resected more than two years previously on account of talipes calcaneus complicating infantile paralysis. The seat of this operation is marked by a considerable scar on the cutaneous surface, but the tendon itself has been entirely repaired. The operation did not materially benefit the patient, and the foot was amputated on account of its uselessness. Microscopical sections of the repaired tendon are preserved (No. 57b).

1196.—*Exact time not stated*.—Parts of the tibialis posticus and flexor longus digitorum of a child in whom the tendons of these muscles were divided a short time before death. The ends of the divided tendons, retracted about two lines asunder, are united by a slender bond of newly-formed substance.

1198.—Two portions of a tendo Achillis, which had been probably torn apart a short time before death. From a subject brought into the dissecting rooms.

DEPOSIT OF URATE OF SODA IN TENDONS.

1177.—A mass of urate of soda removed from around the tendons of the extensor communis digitorum. The crystals have the ordinary acicular character of urate of soda. From the body of an old woman who had long suffered from gout. See also No. 1055a.

TUMOURS IN TENDONS.

Tumours in connection with tendons are not often met with; the following are the only specimens in the Museum:

Fibromata.

1178.—A fibrous tumour, involving and blended with the tendons of the flexor carpi radialis, palmaris longus, and flexor sublimis digitorum. It had existed, slowly enlarging, for five years, but had never occasioned the slightest inconvenience.

It was removed after death from the right forearm of a man who died from acute pneumonia.

Carcinomata.

1179.—A medullary cancerous tumour growing in the substance

of the tendon of the rectus femoris muscle, immediately above the patella. The patella, divided at its centre, is seen beneath the tumour. A woman, thirty-one years old, presented herself at the hospital with a tumour larger than a hen's egg, and growing either upon or, as it seemed more probable, in the substance of the patella, and expanding its walls. She stated that she first observed it seven years before ; it had increased for five years slowly, but latterly its growth had been rapid. On operating, and when an incision was made into it, it appeared to be a fibrous tumour of the rectus tendon, separated from the knee-joint only by a thin layer of synovial membrane closely adherent to its surface. As it could not be extirpated without opening the joint, it and the patella were removed together. For a time the patient did well, but the disease returning in the scar, amputation was performed through the middle of the thigh, but she died of exhaustion. The microscopic appearance of the growth is distinctly medullary, and the secondary formation was soft, mottled, pink, and like brain-matter.

DISPLACEMENT OF TENDONS FROM THEIR GROOVES.

1186.—The upper portion of a humerus, with part of the long tendon of the biceps muscle. The tendon has passed out of its groove, and is confined to the adjacent part of the humerus by a tough membranous sheath formed by condensed fibro-cellular tissue. The tendon was attached to the margin of the glenoid cavity in the usual manner.

DISEASES OF SHEATHS OF TENDONS.

INFLAMMATION.

A slight degree of inflammation of the synovial lining of the sheath of a tendon, accompanied by effusion into the synovial cavity (*tenosynovitis*), occasionally occurs, especially in the forearm, as the result of over-exertion.

A much more severe form, however, of inflammation in the sheaths of tendons, constituting one form of whitlow (*paronychia tendinosa*), is frequently met with. The inflammation, which is generally the result of a punctured or poisoned wound, although it may arise spontaneously, runs a very acute course. The sheath of the tendon becomes rapidly distended with pus, and if the tension is

not relieved by a timely incision the tendon dies from the destruction of its bloodvessels. In severe cases the supuration may spread along the sheath of the tendon into the palm of the hand, or even under the annular ligament into the forearm, whilst at the same time the periosteum covering one or more of the phalanges may be destroyed, and the denuded bones suffer necrosis. In some cases the neighbouring joint becomes destroyed and ankylosed.

160.—The last phalanx of a thumb, which exfoliated almost entire, in a case of whitlow.

161.—The second phalanx of a thumb, separated after necrosis, which was connected with a whitlow.

GANGLION.

A ganglion is a cyst-like enlargement of the sheath of a tendon filled by serous fluid. Two forms are described—the simple and compound. The *simple* occurs generally in connection with the extensor tendons at the back of the wrist, and it is regarded by Sir James Paget as a “cystic transformation of the cells enclosed in the fringe-like processes of the synovial membranes of the sheath.”

The *compound*, which may be associated with tubercular disease of the joints, consists of the dilatation of the sheaths of several of the tendons. It commonly occurs in connection with the tendons that pass under the anterior annular ligament of the wrist, and is generally spoken of as a compound palmar ganglion (**Cast No. 68**). It most frequently extends along the flexor tendons of the thumb and little finger, causing them to become slightly flexed.

The walls of ganglia frequently become thickened and villous-like on their internal surface, and tubercle bacilli have been found in them. Melon-seed-like bodies, resembling those in bursæ, are found both free in the interior and attached by slender pedicles to the walls.

1178a.—A finger on whose deep flexor tendon are two small gelatinous cysts the size of split peas, apparently connected with the synovial sheath, but not separable from the tendon itself.

1199.—A collection of numerous round and oval cysts, with soft pale walls, which were found in the diseased sheaths of tendons. They floated in an opaque yellow and moderately thick fluid.

1200.—A collection of cysts like those last described, but rather larger and with thinner walls, which were removed from the bursa beneath the annular ligament of the forearm of a young woman.

1201.—A collection of soft solid bodies, removed from the sheaths of tendons. Most of them are thin, oval, flat, sharp-edged, and smooth, like melon-seeds; some are of irregular shape or branched.

1202.—Part of a hand and forearm, in which the sheaths of the extensor tendons of the finger and thumb have been greatly enlarged by the accumulation of fluid containing small cysts. The diseased sheaths are laid open, and one of them is shown extending half way up the forearm. The walls of the sheaths are thickened, their internal surfaces in many parts granular or like mucous membrane. The partitions between some of them appear to have been absorbed, so that several form one cavity. See also No. 3359.

DISEASES OF BURSAE.

Bursæ, from the constant irritation to which they are exposed by pressure or friction, are liable to undergo various changes, both in their walls and their contents. The following are the conditions most frequently met with:

Simple enlargement with collection of serous fluid in the interior.

1205.—Part of the left knee-joint of a child, with the muscles and tendons forming the inner boundary of the popliteal space. The bursa between the tendon of the semi-membranosus and the inner head of the gastrocnemius is enlarged, so as to form an elongated oval, lobed cyst, about two inches in length, and an inch and a half in width.

1205h.—A similar specimen to the preceding. It shows the relations of the ganglion to the surrounding muscles better than No. 1205. See also No. 3358.

Enlargement of the bursa in this situation is common. From the fact that the bursa communicates with the joint in about one in every five cases, it is unwise to inject with

tincture of iodine or other stimulant, as such treatment has sometimes set up destructive inflammation of the joint.

Simple enlargement, with collection of melon-seed-like bodies in the interior.

Thin, flat, oval, sharp-edged, smooth bodies, of a yellowish-white colour, resembling melon-seeds, are frequently found in enlarged bursæ (No. 1201). They vary from a somewhat soft to a moderately firm consistency. They are of various sizes, usually solid, occasionally hollow, and sometimes attached to the walls of the bursa by slender stalks or pedicles.

Among these bodies are sometimes found others, irregular in shape and branched, but otherwise resembling them in structure.

They appear to be formed by the coagulation of portions of fibrin contained in the fluid of the distended bursæ; in other instances, by small detachments of the fringe-like growths which sometimes project from the bursal walls, and in some cases by the necrosis of the inner wall of the sheath. The bodies are sometimes found attached by slender stalks that are probably in process of formation.

1204.—A shoulder-joint, exhibiting an enlargement of the bursa between the deltoid muscle and the capsule. The lining of the bursa is smooth, like the surface of a serous membrane. At the bottom of the bottle are numerous melon-seed-like bodies. See also No. 1201.

Enlargement with fibrous bands stretching across the interior.

These bands or cords are probably produced in part by the stretching and elongation of inflammatory adhesions, and in part (in the case of adventitious bursæ) by portions of fibrous tissue, which were left stretching across the cavity as the bursa was developed.

1206.—Two enlarged bursæ, removed with the integuments from over the patellæ of the same person. The walls of both the bursæ are thick, tough, and laminated, whilst fibrous cords are attached by one or both extremities to their internal surfaces.

1207.—A similar specimen, except that the bursa was distended by a honey-like fluid.

1208.—A similar specimen, removed after death, with the patella and other parts. The enlarged bursa is laid open from the front, showing its interior traversed by numerous slender fibrous cords, from some of which lobulated growths are suspended.

1209.—Part of a patella, with its bursa lying on its anterior surface. The bursa is enlarged, the walls thickened, and tough fibrous cords pass across its anterior, running almost horizontally from side to side, attached at either extremity, but free in the rest of their extent. See also No. 1209a.

Enlargement with thickening of the walls.

The thickening of the walls is due either to the concentric deposit of fibrin in the interior of the bursa, or to inflammatory infiltration of the walls themselves.

The thickening may proceed to such an extent as to completely fill the cavity of the bursa, which is thus converted into a solid tumour.

Bursæ are, moreover, liable to acute attacks of inflammation, which frequently terminate in suppuration. Syphilitic gummata in their interior are also not uncommon.

There are no specimens of acute or syphilitic inflammation of bursæ in the Museum.

1210.—An enlarged bursa, removed with the integuments from the front of the patella. The walls of the bursa are between two and three lines in thickness, tough, fibrous, and laminated, and its cavity was nearly filled by a substance like fibrin or imperfect false membrane, some of which is still attached to its internal surface.

1213.—An enlarged bursa, removed from over the patella. Its walls are greatly thickened, and its interior is about half filled with tendinous cords and lobulated growths. Many of the latter are attached by slender pedicles, and are loosely suspended from the walls.

1216a.—A bursa, with thickened walls, which was removed from the gluteal region of a man aged 53. The bursa was situated over the tuber ischii.

For an account of synovial cysts, see page 155.

INJURIES AND DISEASES OF FASCIÆ.

CONTRACTION OF THE PALMAR FASCIA—DUPUYTREN'S.

Dupuytren's contraction is variously attributed to such predisposing causes as gout and rheumatism, or to habits and occupations necessitating pressure in the palm and flexion of the fingers. It usually begins in that portion of the fascia which is continued on to the sheath of the flexor tendon of the little finger, afterwards attacking the portion extending to the ring-finger, and sometimes the remaining fingers. The characteristic way in which the fingers become flexed, drawn down towards, and even fixed in contact with, the palm, is well seen in **Cast No. 68b**. Contraction of the fascia may be distinguished from a contracted tendon by the puckering of the skin, in consequence of its adhesion to the fascia (**Cast No. 68b**), and by the contracting band bifurcating to be inserted upon either side of the flexor tendon, whilst the contracted tendon is centrally placed (**Cast No. 66**), and can be traced under the annular ligament.

1203.—Part of a hand, in which the middle and ring fingers were permanently flexed, in consequence of the thickening and contraction of the portions of the palmar fascia connected with them. See also **Nos. 1203a, 1203b, and 1203c**.

SECTION VI.

DISEASES AND INJURIES OF THE SPINE.

ANGULAR CURVATURE.

ANGULAR curvature (**Case C. 1109**), also called Pott's curvature, because it was first accurately described by Percival Pott, is produced by the destruction of one or more of the bodies of the vertebræ and intervertebral cartilages, and the consequent falling forwards of the upper portion of the spine so as to form an angle with the lower. It must be distinguished from lateral curvature (**Case C. 1122**), which is produced by the unequal compression of the intervertebral cartilages, and is unaccompanied by ulceration of the bodies of the vertebræ.

Angular curvature is generally met with in strumous children; its usual situation is in the dorsal region, but it may occur in any part of the spine.

It is generally held that the destruction of the vertebræ and intervertebral cartilages is the result of tubercular caries beginning in the bodies of the vertebræ; but there are some, among whom is the author, who maintain that the intervertebral cartilages are more often the first to suffer than is generally allowed. For in many specimens (**No. 1072**), as pointed out by Drs. Wilks and Moxon, "a vertebra is often found apparently destroyed in its middle by disease, but on closer examination the two portions, which appear to be the remains of one, are found to belong to two separate bones, the disease having commenced between them." Again, the occasional occurrence of angular curvature of the spine in

otherwise healthy adults, where there is some authentic history of a blow or fall upon the back, renders it probable that the affection sometimes begins in a slight laceration of the intervertebral cartilages, followed by destructive inflammation of the intervertebral joint, and afterwards by ulceration of the contiguous vertebræ. Moreover, in such specimens, the healthy condition of the vertebræ above and below those actually breaking down lends further support to this view, for in tubercular caries the vertebræ above and below are softened and infiltrated with caseous material. The appearances presented by the disease as it begins in one or other of these ways may be studied in the following specimens.

I. BEGINNING IN THE BODIES—TUBERCULAR CARIES.

In the bodies the disease begins either as strumous osteitis or as a "deposit" of miliary tubercle. As described under tubercle in bone (page 52), the inflammatory material, or miliary tubercle, as the case may be, rapidly undergoes caseous change, and, together with the osseous trabeculæ, breaks down and disintegrates, leading to the destruction of the affected vertebræ and subsequent ulceration and destruction of the neighbouring intervertebral cartilages. The characteristic yellow, cheesy appearance of the caseous material infiltrating the affected vertebræ, and the ulceration of those vertebræ in which the disease is more advanced, are seen in the following specimens :

1097.—Section of a spine, with angular curvature. The disease is situated in the middle of the dorsal region of the spine; a large portion of the bodies of two vertebræ are destroyed by ulceration. The bodies above and below the seat of disease are filled with caseous-looking material. The patient died of phthisis. See also Nos. 1064, 1065, 1067, and 1100.

II. BEGINNING IN THE INTERVERTEBRAL CARTILAGES — DESTRUCTIVE INFLAMMATION OF THE INTERVERTEBRAL JOINTS.

When the intervertebral cartilages are first affected, it is probably either as the result of a slight laceration or other injury of the intervertebral cartilage, such as may occur from sprains or blows upon the back, or of a low form of inflammation (strumous) of the intervertebral joint. In whichever way it begins, the inflammation terminates in ulceration of the cartilage, with subsequent ulceration and destruction of the contiguous vertebral bodies.

1072.—Section of a spine, exhibiting disease in the dorsal and lumbar vertebræ. Between two of the lower dorsal vertebræ the intervertebral cartilage is completely destroyed, and the adjacent surfaces of the bodies of those vertebræ are slightly ulcerated. See also No. 1071.

Production of the angular deformity.

No matter how the disease originates, the affected bodies and intervertebral cartilages, as we have seen, finally break down and disintegrate, and so leave a gap between the vertebra above and that below. Partly by its own weight, and partly by the dragging of the abdominal muscles, the upper portion of the spinal column, thus undermined, falls forwards, and at the seat of the disease forms an angle with the lower portion. When the disease occurs in the dorsal region, the normal lumbar and cervical curves will be greatly increased by the efforts made to maintain the body in an upright position; the angular projection is consequently thrown backwards, and the well-known hump-back produced. When the disease occurs at the lower end of the spinal column, there is no means of restoring the balance; the body therefore always remains tilted forwards, and walking or standing in an upright position is rendered impossible.

Case C. 1107.—The dorsal portion of a spine, with acute angular curvature, in consequence of the destruction of the bodies of three

vertebræ. The aorta, upon the altered part of the spine, forms a very acute angle, which is directed backwards in correspondence with the angle of the spine itself.

Case C. 1112.—A spine and pelvis. The spine presents an acute angular curvature in its dorsal region, the consequence of the destruction by ulceration of the bodies of the last nine dorsal and the first lumbar vertebræ. Two of the ribs are united by bone to the spine. The pelvis is well formed.

Case C. 1109.—A spine, with very acute angular curvature.

Case C. 1113.—A spine, thorax, and pelvis. There has been ulceration of the bodies of the lumbar vertebræ, and of the sacrum in its whole extent. Four of the bodies of the lumbar vertebræ are destroyed, and an angle is formed by the approximation of the vertebræ above and below the situation of the disease ; but their union by bone is incomplete. The thorax is depressed anteriorly, so that a space of only two inches and a half intervenes between the ensiform cartilage and the ossa pubis, whilst the false ribs nearly touch the crests of the ilia. All the ribs arch upwards, and the sternum arches forwards.

Nos. 1062, 1067, 1097, 1100, 1102, and 1103 show the progress of the disease from the initial caseous degeneration occurring in the cancellous tissue of the bodies of the vertebræ, through the formation of the curvature to the final ankylosis of the vertebral bodies with angular deformity.

Spinal Abscess.

In some instances it would appear that the disease may terminate favourably without the formation of an abscess. It more commonly happens, however, that the caseous material and partly destroyed vertebræ break down into pus, which collects in front of the diseased vertebræ in the angle formed by the falling down of the upper portion of the spine upon the lower. The periosteum and anterior common ligament, being naturally relaxed by the bending forward of the spine, readily yield, along with the pleura or peritoneum, as the case may be, to the pressure of the pus, and, becoming thickened and consolidated, form the abscess wall. The pus, which is prevented from going upwards by the overhanging of the spine, downwards over

the front of the spine by the attachment of the common ligament, and backwards in consequence of the bodies being generally less diseased posteriorly, makes its way downwards by the side of the spine, and finally points somewhere at the surface. When the disease occurs in the cervical region the abscess will point at the side of the neck or back of the pharynx (*cervical or post-pharyngeal abscess*). When in the dorsal or lumbar region, the pus will make its way either downwards, or backwards, by the side of the spine, giving rise to a psoas or lumbar abscess respectively.

Psoas abscess.—As already stated, this may result from disease in either the dorsal or upper lumbar region. When it is due to disease in the dorsal region, the pus makes its way downwards by the side of the spine, being prevented from passing backwards by the resistance of the ribs. On reaching the diaphragm it passes under the ligamentum arcuatum internum, and entering the sheath of the psoas, descends in the substance of that muscle, and finally points either above (*iliac abscess*) or beneath (*psoas abscess*) Poupart's ligament, at first external to the femoral vessels.

Lumbar abscess.—This may also be due to disease in either the lumbar or dorsal region. The pus, meeting with some resistance, does not enter the sheath of the psoas, but makes its way backwards through the quadratus lumborum and protrudes in the lumbar region, external to the erector spinæ.

1097.—Section of a spine with angular curvature. The disease is situated in the middle of the dorsal region of the spine, and large portions of the bodies of two vertebræ are destroyed by ulceration. A soft caseous matter is deposited around the diseased bone, and is so abundant in front and at the side of the spine that it elevates the periosteum of the vertebræ and the pleura costalis in the form of an abscess within the chest. A small piece of bone is separated from the rest by ulceration, and is embedded in the caseous matter behind the ulcerated vertebræ.

1101.—The last nine dorsal and the first lumbar vertebræ of a

child. The body of the eleventh dorsal vertebra is nearly destroyed, and those of the eighth, ninth, and tenth are completely destroyed by ulceration. The space left by their removal is diminished by the approximation of the vertebræ above and below, producing an acute angular curvature of the spine, and is bounded in front by the periosteum and ligaments of the vertebræ detached and raised up over a collection of purulent fluid. The detachment of the periosteum is also continued over the front of the bodies of the seventh, sixth, and fifth dorsal vertebræ, and these are hollowed out, except at their borders, by ulceration. The intervertebral cartilages, from the eleventh vertebra to the eighth, are destroyed, but those above appear scarcely diseased. The posterior common ligament is raised and made to project into the spinal canal by purulent, and probably tuberculous, matter collected behind the remains of the ulcerated vertebræ.

564.—A hip-joint, from a young woman in which the articular cartilages of the femur and acetabulum have been removed by ulceration, and the exposed surfaces of the bones are covered by soft granulations and flakes of lymph. The capsular ligament is thickened, and the head of the femur and the acetabulum appear enlarged. At the anterior and inner part of the capsule there is a large oval opening with smooth defined margins. This opening was immediately beneath the tendon of the psoas and iliacus muscles in the situation at which the bursa naturally existing beneath that tendon sometimes communicates with the cavity of the hip-joint.

A large psoas abscess had long existed in this patient, and it seemed probable that the pus, having passed under the tendon of the psoas and iliacus muscles, and through the aperture of communication between the bursa and the joint, had excited acute inflammation of the latter.

In the following specimen the disease is beginning simultaneously in many of the vertebræ—an occurrence which is not uncommon.

1064.—Section of a spine from the fifth dorsal to the second lumbar vertebra, exhibiting the effects of tubercular disease in the bodies of the vertebræ. In the body of nearly every vertebra there are one or more small, spherical, and exactly circumscribed cavities, which were filled with pus, or with a mixture of pus and tubercular matter. The cavities measure from one-eighth to one-half of an inch in diameter, and are nearly all lined with a thin layer of false

membrane; the bone around them is healthy, or in some parts slightly consolidated. The ligament between the bodies of the tenth and eleventh dorsal vertebræ is softened and in great part removed, as if by ulceration. The adjoining parts of the bodies of the same vertebræ are also ulcerated, and by the approximation of their anterior borders have produced a slight angular curvature of the spine: the parts of the vertebræ adjacent to the ulceration are solid, hard, and yellow. Most of the vertebræ also are ulcerated on their anterior surfaces, and their periosteum is raised from these parts by the collection of purulent matter beneath it.

Progress of cure.

As already stated, when the vertebræ and intervertebral cartilages are destroyed, the upper portion of the spine falls forwards upon the lower. If the subject of the disease now be kept at rest, union of the approximated vertebræ takes place. This union is greatly expedited by the changes which occur in the posterior segments of the spinal column. Thus, the ligaments uniting the arches and processes become much thickened, binding these parts firmly together, whilst at the same time the articular joints generally become inflamed and afterwards ankylosed, and so act as a kind of splint, which keeps the approximated bodies firmly in position. If the bodies are well in contact before the consolidation of the posterior segment takes place, true bony ankylosis of the bodies will occur. But if the loss of substance is very great, and the parts become fixed by the changes which occur in the posterior segment before the bodies come completely into contact, bony ankylosis will not occur, and the gap thus left will be filled up by the remains of the abscess and a certain amount of fibrous tissue, which, however, may subsequently ossify.

1096.—Section of a spine, exhibiting the process of reparation after extensive disease. Twelve spinous processes are shown in the preparation, but the bodies of only four vertebræ; eight bodies, therefore, have been destroyed. The vertebræ above and below these eight have been approximated, and are firmly united by bone with their remains and with one another.

1099.—Portion of the spine of a child. The bodies of four of the lower dorsal vertebræ are destroyed, and the anterior parts of the bodies of the vertebræ which were immediately above and below the situation of the disease are approximated and firmly united by bone.

1100.—Section of a spine, exhibiting disease in three of the bodies of the lower dorsal vertebræ, which was in progress towards its cure.

1102.—Section of the lower dorsal and the first lumbar vertebræ. The former, the seat of old disease, have their bodies broken down and crushed together. In this condition they have become consolidated. See also No. 1103.

Condition of the spinal canal and cord.

The spinal canal, constituting as it does a part of the posterior segment of the column, with the exception of being bent, is seldom materially interfered with; its calibre at the angle is not, as a rule, diminished; sometimes it is even enlarged. Occasionally, however, it is encroached upon by portions of bone separated from the vertebræ, and occasionally it is perforated by pus from an abscess. In some cases, too, pressure upon the cord is due to the extension of the inflammation to the spinal dura mater, leading to pachymeningitis. Pressure on the cord is more common in caries of the upper vertebræ, probably in consequence of the inflammatory products being less able to escape, whereas, in caries of the lower portion of the spine, the abscess is more likely to make its way to the surface, and the cord thus escapes pressure.

1061.—Section of a child's spine, from the second cervical to the third dorsal vertebra. A collection of purulent fluid existed between the diseased vertebræ and their periosteum, both in front of the bodies and behind them, and part of it was discharged by ulceration into the spinal canal.

1095.—The upper half of a spine, in which the bodies of the fifth and sixth cervical vertebræ are completely, and those of the fourth and seventh are partially, destroyed by ulceration. There is angular curvature in the lower part of the cervical region, and

the remains of one of the bodies of the vertebræ projects far into the spinal canal.

From a child ten years old. There was a large collection of matter in front of the spine pressing in the pleuræ.

1098.—Part of the dorsal portion of a spine. The anterior half of the body of the seventh dorsal vertebra is almost entirely destroyed by ulceration, and the body of the sixth is deeply ulcerated on its anterior surface. By the approximation and union of the sixth and eighth vertebræ an angular curvature of the spine has been produced. A small rough process of bone has grown from the most prominent part of the angle into the spinal canal. Opposite to this projection the spinal cord was softened and reduced in size. See No. 2544.

1102.—Section of the lower dorsal and first two lumbar vertebræ. The spinal canal at and above the curve is slightly narrowed. The cord is compressed in this situation. See also No. 1103.

Case C. 1110.—Section of a spine, in which there has been destruction by ulceration of the bodies of six of the dorsal and lumbar vertebræ. The vertebræ above and below the seat of the disease have been approximated and firmly united by bone. There is an acute angular curvature of the spine, but the diameter of the canal which contained the spinal cord is not lessened; rather, by the extensive destruction of the bodies of the vertebræ, it is increased where the angle is most prominent.

See also Case C., No. 1107, and several similar specimens in this Case.

DISEASE OF THE TWO UPPER VERTEBRÆ AND OF THE ARTICULATIONS BETWEEN THE ATLAS AND OCCIPITAL BONES.—CERVICAL CARIES.

Disease of the two upper vertebræ and of the articulations between the atlas and occipital bone, from the fact that the atlas has no body, and that there are no intervertebral cartilages between the axis and atlas, and between the atlas and occipital bone, differs from the disease of the other vertebræ, which, as we have seen, chiefly attacks the bodies and intervertebral cartilages. It is known as *Cervical Caries*, and requires a separate description.

The articulations between the axis and atlas, and

between the atlas and occipital bone, resemble other synovial joints, and are subject to similar diseases. The affection, however, to which they are most liable is that which is commonly designated "strumous disease." The articulations between the atlas and axis are those most frequently attacked, the disease beginning either as a tubercular inflammation of the synovial membranes or as caries of the odontoid or articular processes. The pathological changes which ensue are the same as those already described under tubercular disease of the joints. The cartilages, and subsequently the bones, become ulcerated, and the ligaments softened, elongated, or destroyed. The disease may terminate in sudden death from the giving way of the transverse ligament or the separation of the odontoid process, and the consequent compression of the upper part of the spinal cord through the sliding forward of the atlas upon the axis. As the ligaments, however, retaining the atlas in contact with the axis generally yield but slowly, and as the thickening of the parts around the affected joints further tends to keep the bones in apposition, the displacement of the atlas is usually very gradual; the cord, under these circumstances, escapes sudden compression, and neither death nor paralysis occurs.

If the parts are kept properly at rest the disease may terminate in ankylosis, and the patient escape with permanent deformity and a stiff neck.

Tubercular inflammation of the interarticular joints.

1092.—Section of the upper part of the spine, of the occipital bone, and of the spinal cord. The connections of the second cervical vertebra, with the first, and with the occipital bone, had been destroyed, apparently by ulceration. The anterior portion of the first vertebra and the basilar portion of the occipital bone have sunk down, so that the lower margin of the first vertebra is within a tenth of an inch of the upper margin of the intervertebral substance between the second and the third; and the whole of the odontoid process of the second projects straight upwards into the cavity of the skull. The medulla oblongata is thus lifted up and

stretched over the apex of the odontoid process, and as the pons retains its connection with the basilar portion of the occipital bone the axis of the medulla oblongata forms a right angle with the axis of the spinal cord. The displaced bones are held together by the thickened and consolidated adjacent tissues. Their texture appears indurated, but not otherwise diseased.

The patient was a woman thirty-two years old. The most prominent sign of the disease, which was of four years' duration, was a constant acute pain at the base of the neck, just below the occiput. She had some difficulty in swallowing, and used to sit with her chin on her hand, or resting on her sternum; but she suffered no loss of sensibility, and was able to walk the day before her death.

Caries of the odontoid process.

1137.—First and second cervical vertebræ, with part of an occipital bone. The odontoid process of the axis, softened and ulcerated, is fractured across its base, just below the level of the transverse ligament. The latter, as well as the other adjacent structures, retains a natural appearance.

From a woman, aged thirty-six years, who had enjoyed good health until four months prior to her death. She then began to complain of obscure pains about the back of the neck, which persisted. In moving about she carried her head stiffly, and always expressed a dread of moving it suddenly. One morning, while stooping over a tub, her head fell forward and she was seen to drop. When picked up a few seconds later she was dead.

1094.—Portion of a spine, in which the bodies of the second and third cervical vertebræ are partially ulcerated. The remaining bone is softened, and yellow. The odontoid process has been completely separated at its base from the body of the second vertebra.

Dislocation of the atlas.

1094a.—An atlas and an axis. The odontoid process has been dislocated in such a manner as to leave only a very narrow space for the spinal cord, and the bones have subsequently become ankylosed.

They were found in a graveyard at Aberdeen.

Case H. 1073.—Portion of an occipital bone with the atlas. The atlas is displaced towards the left side. Its right half, projecting

into the foramen magnum, considerably diminishes the size of the aperture. See also **Nos. 1093 and 1153.**

Anchylosis of the interarticular joints.

1075.—Portion of an occipital bone, with the three uppermost cervical vertebræ. The occipital bone and the anterior half of the atlas are firmly and completely united by bone. The second and third vertebræ are similarly anchylosed at their articular processes. These changes seem to have followed ulcerative disease, by which the odontoid process and the body of the second vertebra were changed in structure, and in part removed. See also **Nos. 1077 and 1080.**

LATERAL CURVATURE.

Lateral, unlike angular curvature, is due, not to ulceration of the bodies of the vertebræ or intervertebral cartilages, but to an unequal compression of the intervertebral cartilages from the habit of sitting or standing in one-sided positions. Hence it is common in young debilitated girls, whose muscles and ligaments are relaxed, or in subjects in whom a one-sided position of body is induced by the shortening of a limb, the result of disease or injury. It is also a common accompaniment of rickets.

The primary curve is almost always convex towards the right; it generally occurs in the dorsal region, and is accompanied above and below by compensatory curves, *i.e.*, curves whose direction is opposite, and sweep equal to that of the primary curve; the lower or lumbar curve is generally more marked than the upper or cervical.

The vertebræ and intervertebral cartilages are healthy, the former but little, if at all, altered in shape, the latter compressed wedge-wise, the base of the wedge looking towards the convexity of the curve, so that the transverse processes on the convex side are widely separated, while those on the concave side are approximated. In addition to the lateral deviation, the vertebræ are rotated on their own axes, so that the front of the bodies is directed towards the convexity of the curve, and the spinous processes to-

wards the concavity, while the transverse processes on the convex side project backwards, and those on the concave side forwards. The ribs on the convex side of the curve, like the transverse processes, are abnormally separated, and with them are carried backwards by the rotation of the spine. They are at first directed downwards, lying nearly in contact with the bodies of the vertebræ, and then, bending abruptly round the bodies of the vertebræ, are directed forwards and inwards towards the sternum, so that the cavity of the thorax on the side corresponding to the convexity of the curve is increased in its antero-posterior and diminished in its lateral diameter. The ribs on the concave side are crowded together in the concavity of the curve, are carried forwards with the transverse processes, and are directed almost horizontally first outwards and then straight forwards, only their extreme ends and their cartilages being directed inwards to the sternum (**Case C., No. 1114**). The cavity of the thorax on the side corresponding to the concavity of the curve, therefore, is increased in its lateral but diminished in its antero-posterior diameter. The sternum retains its position in the middle line, and the scapula on the convex side is more prominent and placed at a greater distance than is natural from the spinous processes.

The projection backwards of the posterior part of the ribs on the convex side of the curve is in some cases greatly marked, so that a deep longitudinal furrow is formed, limited mesially by the spinous processes, and laterally by the posterior parts of the ribs.

The hump is formed by the angles of the ribs and the transverse processes on the convex side of the primary curve.

Case A. 1116.—A skeleton, showing the changes consequent upon long-standing lateral curvature of the spine. All the dorsal and lumbar vertebræ are comprised in a lateral curve, the convexity of which is directed to the right in the dorsal region, whilst there is a compensatory curve to the left in the lumbar region. The bodies of the vertebræ and intervertebral spaces are much deeper

in the convexity than in the concavity of the curve ; they are also twisted round, so that what were their anterior surfaces are directed outwards towards the convexity of the curve, this outward direction being chiefly observed in those vertebræ which are in the middle of the curve, while those at each end of it gradually approach nearer to their natural direction. Connected with this twisting of the bodies of the vertebræ is a narrowing of the space between the spinous processes and the right transverse processes of the vertebræ, *i.e.*, the vertebral groove, although the spinous processes are directed rather towards the left side, that is, towards the concavity of the curve. The space between the spinous and left transverse processes is somewhat increased in width and in depth. The thorax presents the characteristic appearance usual in lateral curvature.

The cavity of the pelvis is of ordinary size, but its antero-posterior axis, in correspondence with the obliquity of the lumbar vertebræ, is directed obliquely, from before backwards, and from right to left. See also **Case C.**, Nos. 1114, 1119, 1120, and 1123.

Case C. 1121.—A spine with two lateral curves in its dorsal region and one in the lumbar. The principal curve is in the superior dorsal region and is directed to the right side. The bodies are thinner on the concave than on the convex side of each curve, and there are thin growths of bone from their edges overlapping the thinner intervertebral cartilages in each of the concavities of the curves.

Case C. 1115 and 1122.—Spines and pelvis, from cases of lateral curvature. They are interesting because the curves in the dorsal and lumbar regions respectively are in the opposite direction to that which is of most common occurrence, for the dorsal curve is convex to the left, whilst the lumbar curve is convex to the right, as in the specimen preserved in **Case C.**, No. 1114. There is considerable deposit of bone enlarging and surrounding the articular processes of those vertebræ which are comprised in the concavity of the curve ; a change which may also be observed, in various degrees, in many of the other specimens of lateral curvature.

POSTERIOR CURVATURE—KYPHOSIS.

In posterior curvature or kyphosis the spine is curved with its convexity backwards, but, unlike angular curvature, it is not dependent upon destruction of the bodies of the vertebræ and intervertebral cartilages. It generally

occurs in the dorsal region, and is then merely an exaggeration of the normal curve of the back. Like lateral curvature, it is commonly the result of muscular debility and relaxation of the spinal ligaments, and of unequal compression of the intervertebral cartilages. It also occurs in rickets, and to a slight extent in most persons who are accustomed to much stooping.

In consequence of the deformity of the spine the thorax is generally increased in its antero-posterior diameter, but diminished in its lateral.

Case C. 1125.—Bones of the trunk of an old woman. The dorsal portion of the spine is deeply curved backwards. The dorsal vertebræ are reduced in size anteriorly, but their texture is not distinctly altered. Between the ninth and tenth there is a deposit of new bone. The antero-posterior diameter of the chest is augmented, and the sternum is much curved forwards, but the height and width of the chest are diminished, the ribs anterior to the angles being nearly straight, and some of the lower intercostal spaces being almost obliterated.

Case C. 1126.—A spine, thorax, and pelvis. The spine in its dorsal region is curved with its convexity backwards and a little to the right. The thorax, projecting very far forwards, is flattened at its sides; its transverse diameter is only five inches; its antero-posterior diameter is eight inches and a half.

Case C. 1127.—The spine of an aged person, which, in its whole extent, is curved with the convexity backwards, and a little to the right. The bones are all healthy, but light.

ANTERIOR CURVATURE—LORDOSIS.

Anterior curvature or lordosis nearly always occurs in the lumbar region; it consists in an increase of the normal lumbar curve. Like lateral and posterior curvature it is the result of the unequal compression of the intervertebral cartilages, and not of the destruction of the bodies of the vertebræ or intervertebral cartilages.

Lordosis in a slight degree is a frequent accompaniment of rickets and disease of the hip-joint.

RARER FORMS OF DISEASE OF THE SPINE.

OSTEO-ARTHRITIS.

Case C. 1089b, and Case H. 1089a.—Lumbar vertebræ with osteo-arthritis, more especially of their articular processes.

TUMOURS OF THE SPINE.

The vertebræ may be the seat of any of the tumours which ordinarily affect bone.

Enchondroma.

409.—A cartilaginous tumour invading the spinal canal through the intervertebral foramina. The growth appears to originate in the heads of the ribs.

Spindle-celled sarcoma.

1130.—The lower cervical vertebræ with a growth involving the body of the sixth. Everywhere the outer wall of this bone is pushed irregularly before it, forming in front a considerable nodulated prominence, and behind, a less marked and smooth projection. On either side the tumour has made way through its bony envelope, involving the sixth transverse process, and projecting laterally through the fifth and sixth intervertebral foramina. At the last-named points it involves, chiefly on the right side, the nerves which principally form the brachial plexus. The vertebral arteries pass through the lower end of the tumour, and the canal of the right is somewhat narrowed.

The spinal cord is compressed by the expansion of the posterior wall of the body of the sixth cervical vertebra, the antero-posterior diameter being lessened chiefly upon the right side. A portion of bone is separated from the remainder of the body to show the extent of encroachment upon the canal. The woman from whom this preparation was obtained died with spindle-celled sarcomata, originating in the uterus, produced as a secondary formation in the pericardium, lungs, and in the body of the sixth cervical vertebra. Before death she suffered from paralysis, more especially of the right arm and leg. See also Nos. 438a and 517a.

Secondary melanotic sarcomata.

483.—Melanotic growths in the cancellous texture of the lumbar vertebræ.

Secondary scirrhus carcinoma.

1131.—Sections of seven dorsal vertebræ, from a man who died with scirrhus cancer of the breast and other organs. Five of these vertebræ are affected with scirrhus cancer. In the first and last two the cancellous tissue is filled, and in great measure displaced, by firm grayish substance, which had exactly the same characters as the cancer of the breast. Of the two middle vertebræ nothing remains but fragments, infiltrated with cancerous substance, and enclosed in a cavity which was filled with other detached fragments and softened cancer. The intervertebral substance between these two vertebræ is disorganised, and its remains lie in the cavity with their fragments; the corresponding substances between the vertebræ above and below are softened at their centres.

FRACTURE OF THE SPINE.

Fracture may occur in any part of the spine, but is most frequent in the cervical region. The character and extent of the injuries sustained by the vertebræ and their connecting ligaments vary considerably, according as the fracture is produced by direct or indirect violence. The condition of the parts can therefore be conveniently studied under the heads of fracture from direct and fracture from indirect violence.

FRACTURE FROM DIRECT VIOLENCE.

As direct violence can necessarily only be applied to the spinal column posteriorly, it falls primarily upon the spines and arches of the vertebræ. Hence, when the force is but moderately severe, the spines may be fractured or detached without implication of the spinal canal or vertebral bodies; or the fracture may extend to the arches on one or both sides, the bodies still escaping. When, however, the fracture is the result of a very severe blow, such as that from a crane, or of a fall from a great height upon the back across a wall or beam, the spine is, as it were, bent violently backwards, tearing asunder the structures constituting the anterior segment of the column and crushing those constituting the posterior. Hence the bodies of the

vertebræ are generally found uninjured, but wrenched apart, the intervertebral substance ruptured, and the anterior common ligaments torn; whilst the arches of the vertebræ, the articular processes and the spines, are fractured and crushed.

In injury from this form of violence the vertebræ above the seat of fracture are very frequently displaced forwards, as, the articular processes being fractured and the intervertebral substance torn, nothing remains to retain the vertebræ in position.

1135.—Portion of a spine, in which the right half of the posterior arch of the atlas has been completely detached by fracture.

1145.—Portion of a spine, in which there is an extensive comminuted fracture of the arches and bodies of the fifth, sixth, and seventh cervical and first dorsal vertebræ. See also **Nos. 1136 and 1136a.**

Case C. 1138.—Portion of a spine, with oblique fractures through the arches of the fourth and fifth cervical vertebræ, and a vertical fracture through the body of the fifth.

Case C. 1148.—Portion of a spine, in which a fracture extends obliquely through the body of the tenth dorsal vertebra, its superior articular processes, and the inferior articular and spinous processes of the ninth dorsal vertebra. See also **Case C., No. 1149.**

FRACTURE FROM INDIRECT VIOLENCE.

When the violence is indirect, such as that received in a fall from a great height upon the head, or from catching the head in travelling under a tunnel, or from a heavy weight falling upon the head and shoulders, the spine is bent violently forwards, crushing the structures forming the anterior segment of the column and tearing apart those forming the posterior. Hence one or more of the bodies, especially their anterior part, and intervertebral substances are fractured and crushed between the vertebræ above and below, the posterior part of one of the fractured bodies being frequently driven backwards into the vertebral canal. The spines, articular processes, and arches, on the other hand, are wrenched asunder, and their connecting ligaments torn.

Fracture of the sternum is occasionally combined with this form of fracture of the spine from the chin coming in violent contact with the sternum as the spine and head are doubled forwards; it may be said that in such cases the thorax is broken through.

1139.—Section of a spine, in which there is fracture of the body of the sixth cervical vertebra. The middle and fore part of the body is crushed between the two adjacent vertebræ; and its posterior part is pressed backwards into the spinal canal, so that the spinal cord must have been nearly divided. The spinous process of the vertebra retains its natural position.

1143.—Specimen of fracture of the last cervical vertebra. See also Nos. 1150 and 1165.

1146.—Section of a spine, in which there is a fracture of a dorsal vertebra, either the third or the fourth. The front of its body is crushed between the vertebræ above and below it, and the posterior part has been driven backwards into the spinal canal, and has completely divided the cord. The spinous and articular processes of the fractured vertebræ are torn away from those of the vertebra above it, leaving a wide gap at the posterior part of the spinal column.

CONDITION OF THE SPINAL CORD.

The spinal cord may altogether escape, as in those cases when the spines only are broken off, or the vertebræ little, if at all, displaced; or it may be completely divided or crushed; or, again, so bruised and injured that it rapidly softens and becomes diffuent. Sometimes, as in fractures from indirect violence, the anterior columns are alone injured, the posterior part entirely escaping. Under such circumstances motor paralysis only results, sensation being little, if at all impaired. When the fracture occurs below the second lumbar vertebra the cord necessarily escapes, as it terminates at this spot.

Complete destruction of the cord.

1141.—Cervical spine of a boy fifteen years old, showing fracture and dislocation of the fifth cervical vertebra. The spinal cord was destroyed at the seat of injury, so that there was complete paralysis

of motion and sensation of all parts below. In spite of this the patient survived the accident one year and seven months.

1146.—Section of a spine, in which there is a fracture of a dorsal vertebra. The front of its body is crushed between the vertebræ above and below it, and the posterior part has been driven backwards into the spinal canal, and has completely divided the cord.

Anterior columns injured. Posterior unaffected.

1154.—The cervical spine of a man, aged twenty-four, who fell out of the first-floor window of a house. The fourth cervical vertebra is dislocated forwards from the fifth; the intervertebral fibro-cartilage is ruptured, but there is no fracture of the bodies of the vertebræ. The superior articular processes of the fifth vertebra are placed posterior to the corresponding inferior processes of the fourth, and the tip of the right inferior articular process of the latter is broken off. The cord is compressed by the projecting upper part of the body of the fifth vertebra, but is not lacerated. The spines of the fourth and fifth vertebræ are widely separated, but there is no lateral displacement. There was at first complete paralysis of the trunk and legs, subsequently the arms became paralysed. The patient survived the accident eleven days.

1164.—Fracture of the spine, from a heavy man, aged sixty-three, who fell upon his head and shoulders. The intervertebral substance between the last cervical and first dorsal vertebra had been torn through. The head and cervical vertebra have been dislocated forward in such a manner that the first dorsal vertebra presses backwards upon the cord. At this point the cord is crushed, softened, and bloodstained. There was complete loss of motion below the nipple, but no loss of sensation. He died on the fifth day after the accident.

Compression of the cord.

1140.—A portion of the spinal column and cord, including part of the cervical and dorsal regions of a boy, aged fifteen. The column and cord are divided by a vertical section. The body of the fourth cervical vertebra is crushed and driven backwards, the intervertebral substance above and below coming into contact in front, while the spinal cord is much compressed by the angular projection thus produced.

REPLACEMENT OF THE FRACTURED VERTEBRÆ BY EXTENSION.

1150.—The lower dorsal and upper lumbar portions of a spine, from a man twenty-nine years of age, who, whilst wheeling a barrow filled with gravel, was knocked down by the sudden falling of a tree on his back. (He lived for more than a year after the injury.) When examined soon after the injury, an angular projection was discovered in the lumbar region, and extension was made by persons pulling at the superior and inferior extremities, with the desired effect of greatly lessening the projection.

The specimen shows that the first lumbar vertebra had been fractured in a transverse direction extending obliquely downwards and forwards through the upper third of its body ; the upper part of the vertebral column, together with the upper fragment of the fractured vertebra, had been thrown forwards, the superior fragment resting on the fore and upper part of the inferior fragment, to which it is connected by callus. The corresponding articular processes of the last dorsal and first lumbar vertebra had been dislocated, those of the former having been thrown upwards and forwards.

1166.—The right half of the specimen of which the left half is shown in 1165. It shows the almost complete repair that has taken place in the bones and soft textures of the spine, and the disintegration resulting from the injury of the cord. From a thin man, forty-eight years of age, who fell backwards upon his shoulders for a distance of six feet off a scaffold. A well-marked displacement between the seventh and eighth dorsal vertebra was observable on his admission into the hospital, the seventh with the bones above being carried forwards, and a depressed groove from the fourth to the broken seventh spinous process being manifest. The superior articular processes of the eighth could be felt. The ordinary symptoms of lesion of the corresponding part of the spinal cord were present. The patient under chloroform was subjected to extension by means of pulleys, with the result of replacing the bones in their normal position, the distorsion being entirely removed. He died, however, from exhaustion consequent on the paralysis at the end of nine weeks from the receipt of the injury.

COMPRESSION OF THE CORD RELIEVED BY OPERATION.

1147.—The lower cervical and upper dorsal vertebræ of a man who fell down a ship's hold and fractured his spine. The fracture

extended obliquely through the fourth dorsal vertebra and the intervertebral cartilage above. The spines of the injured and adjoining vertebræ were removed by operation, with relief of the symptoms of compression of the cord. On the fifteenth day after the operation, while the man was being moved from one bed to another, the spine not being supported, he became suddenly and completely paraplegic, and died three or four days afterwards. Opposite the fracture the cord was diffuent.

DISLOCATION OF THE SPINE.

Dislocation of the spine is nearly always associated with fracture of the articular processes. It occasionally occurs, however, in the cervical region entirely unaccompanied by fracture, and is said to have occurred in the dorsal and lumbar, but from the manner in which the articular processes are interlocked in these regions it is difficult to conceive how dislocation without some amount of fracture is possible.

Dislocation is nearly always incomplete. One vertebra is never displaced singly, the vertebræ above being always carried along with it. The interarticular cartilages and connecting ligaments are more or less torn. The spinal cord may be uninjured, or it may be completely crushed or torn across at the seat of injury. The spinal nerves may be compressed or torn as they pass through the intervertebral notches.

I. DISLOCATION IN THE CERVICAL REGION.

Of the atlas from the axis.

Dislocation of the atlas from the axis is rare. It is accompanied either by fracture of the odontoid process or by rupture of the transverse ligament, and is generally immediately fatal, the atlas with the occipital bone slipping forward upon the axis, and crushing the upper part of the spinal cord. This is not invariably the result, however, as in the following model the cord is said to have been uninjured.

Dislocation of the occipital bone from the atlas is so rare that it may be left out of consideration.

1153.—Model of an atlas and axis. The atlas is dislocated, and the odontoid process fractured. The spinal cord was not injured.

Of the five lower cervical vertebræ.

Unaccompanied by fracture of the articular processes. 1158.—Portion of a spine in which there is complete dislocation of the bodies and articular processes of the fifth and sixth cervical vertebræ, without any fracture.

1162.—Portion of a spine, in which there is a complete dislocation of the articular processes of the sixth and seventh cervical vertebræ, and a partial dislocation of their bodies, without any fracture. The right half of the intervertebral cartilage is torn through; the left half is nearly entire. The articular processes of the sixth vertebra were raised up above those of the seventh, but had not passed to the front of them.

The patient fell, from a height of about sixteen feet, on his head, and his neck was bent by the weight of his body. He lost all sensibility and power of voluntary motion in the trunk and limbs, and died on the third day after the fall. See also No. 1155.

Accompanied by fracture of the articular processes. 1156.—Portion of a spine, in which there is dislocation of the articular processes of the fourth and fifth cervical vertebræ, with fracture of the lower edge of the left inferior articular process of the fourth, and a separation of the intervertebral cartilages uniting the bodies of the fourth and fifth, and of the fifth and sixth.

1157.—Portion of a spine, in which there is dislocation of the bodies and articular processes of the fourth and fifth cervical vertebræ, with fracture of the upper margin of the body, and of the arch of the fifth. The body of the fourth vertebra projects in front of the fifth, and the membranes of the spinal cord appear tense and compressed beneath it.

It should be observed that the fissures upon the arches of the vertebræ, on each side of the spinous processes, were made by the saw in opening the spinal canal.

1160.—Portion of a spine, in which the articular processes of the fifth and sixth cervical vertebræ are dislocated, and the right articular process and body of the sixth are broken. The intervertebral cartilage between the fifth and sixth vertebræ is also

completely torn across. The spinal cord has been divided along its middle for the purpose of showing the softening and laceration of its substance opposite the injured vertebræ, and especially in the line opposite the division of the intervertebral cartilage.

1163.—Portion of a spine, in which there is dislocation, with fracture of the edges of the articular processes, of the sixth and seventh cervical vertebræ. The body of the sixth cervical vertebra is separated from the intervertebral cartilage below it, and projects in front of the seventh. See also Nos. 1159 and 1161.

II. DISLOCATION IN DORSO-LUMBAR REGION.

Accompanied by fracture of the articular processes. Case C. 1167.

—Sections of a spine, in which it is probable that there had been a fracture and dislocation of the first lumbar and the last dorsal vertebra. The first lumbar vertebra, unchanged in texture, but deprived of the fore part of the upper margin of its body, is thrown backwards, so that its fractured anterior margin is placed under the posterior margin of the body of the twelfth dorsal vertebra. They appear as if the last dorsal vertebra, with the superior portion of the spine, had been pushed forwards and downwards, breaking off and sliding over the upper and anterior margin of the first lumbar. In this position the two vertebræ are firmly fixed by bone deposited in front of the angle formed by their bodies. At the angle thus formed the body of the first lumbar vertebra projects into the spinal canal, reducing it to a fourth of its natural diameter. A distance of an inch intervenes between the spinous processes of the last dorsal and the first lumbar vertebræ. On the right side their corresponding articular surfaces appear to have been separated and reunited by bone; on the left side the inferior articular process of the last dorsal vertebra is wanting, but there are appearances as if it had been united to the posterior part of the body of the displaced first lumbar vertebra; it was probably detached in the dissection.

INCISED WOUNDS OF SPINAL CORD.

Incised wounds of the spinal cord and its membranes are usually the results of stabs in the back or of falls on sharp bodies. When the membranes alone are wounded there may at first be no signs whatever, except perhaps some escape of cerebro-spinal fluid, but later, should inflammation be

set up, there will be the usual signs of spinal meningitis. A wound of the spinal nerves may be known by the paralysis of the parts which they supply; a division of the cord by the complete paralysis of the parts below the seat of injury.

2548a.—Sections of the upper part of a spinal column with the spinal cord. A glass rod is passed between the laminae of the third and fourth cervical vertebrae on their left side, through the intervertebral cartilage, and into a hole in the membranes. Opposite this spot the cord has been externally injured. The antero-lateral columns on both sides, the whole of the gray matter, and the anterior part of the left posterior column, have been cut through below the origin of the fourth nerve. A strand of fibres from the fifth nerve passes over the line of incision, and has escaped injury. On the right half of the spine the intervertebral cartilage has been partially divided.

From a woman, aged twenty-one, who was stabbed with a knife. On admission to the hospital she had paralysis of motion in the trunk, legs, and arms, but she could shrug her shoulders. Her breathing was diaphragmatic. She could localize sensations on her legs, trunk, and arms, but sensation generally was impaired. Her temperature rose, before her death, to 107° F.

MALFORMATIONS OF THE SPINE.

SPINA BIFIDA.

Under the term “*spina bifida*” are included various congenital malformations of the vertebral canal, with protrusion of some of its contents in the form of a fluid tumour. In the majority of cases the malformation is due to a defective development of the neural arches or laminae (**Nos. 3473, 3474, 3475, 3476**) of the vertebrae, and the tumour projects posteriorly. In a few very rare cases the malformation involves the bodies of the vertebrae, and the tumour protrudes anteriorly into the thorax, abdomen, or pelvis between the lateral halves of the bodies affected. These cases are so rare, however, that no further notice need be taken of them.

Spina bifida may occur at any part of the spine (Nos. 3474, 3479a, 3480, 3481), but is most common in the lumbo-sacral region; by Humphry it is said to occur with the greatest frequency at the first sacral vertebra, whose neural arches, as he remarks, are the latest to unite. It is frequently associated with other malformations of the neural canal, especially with cerebral meningocele, with hydrocephalus (No. 3473), and with congenital talipes varus (No. 3480a).

The tumour is oval or globular in shape, with its long axis parallel to that of the spine. It is commonly covered by skin and adipose tissue, but in some instances the skin only covers the sides of the tumour, the central portion consisting of a thin translucent membrane derived from the epiblast.

The larger number of examples of spina bifida may be grouped under three great headings:

(1) *Spinal meningocele*, in which only the membranes of the cord form the tumour. This is a comparatively rare variety of spina bifida as it occurs in museum specimens, though it is not infrequently met with in practice. It may remain *in statu quo*, or it may undergo spontaneous cure by shrinking. The sac consists of dura mater and both layers of the arachnoid, and consequently contains cerebro-spinal fluid. A good example is found in

3486.—The sac of a spina bifida removed by excision from the upper dorsal region. The sac is of uniform thickness except at its summit, where there is a smooth and unpigmented longitudinal depression. There is no corresponding eminence in the inner wall of the sac, so that the depression affects the proper substance of the sac wall. The sac contained no nerves.

3485.—The parts concerned in a sacro-coccygeal meningocele after loss of the sac-wall. From a child about six years old. The extremity of the cord and the cauda equina, occupying the lower portion of the neural canal, are completely exposed: the conus medullaris terminates in a filament, which presents a gangliform enlargement measuring a twelfth of an inch in its shorter diameter near its lower end. The lowest nerve-roots are furnished with

"ganglia aberrantia." The aperture is bounded by an irregular ulcerated margin of skin.

(2) *Meningo-myelocoele* is the commonest variety of spina bifida. There is a protrusion of the spinal cord with its nerves, as well as of the spinal membranes. The sac, composed of the protruded membranes intimately blended together, is distended by a collection of fluid, and generally contains either the spinal cord or some large nerve-roots. The membranes protruded are either the dura mater and visceral and parietal layers of the arachnoid, or the dura mater and parietal layer of the arachnoid only. In the former case, which is by far the more common, the cavity of the sac communicates with the subarachnoid space, and contains cerebro-spinal fluid; in the latter case it communicates with the cavity of the arachnoid, and contains a fluid similar to that normally found in the arachnoid cavity. The cord usually crosses the sac a little above its centre, though it may become intimately connected with the roof of the sac directly it leaves the vertebral canal. In many specimens the cord is attached to the upper wall of the sac by a falciform fold of membrane (No. 3484). The cord may be of its normal size (No. 3479a), or it may be attenuated, owing to the traction made upon it by the distending sac. It cannot be traced by dissection further than the point where it becomes attached to the sac-wall. In some cases, after spreading out upon the sac-wall, the cord re-enters the spinal canal (No. 3479b). The nerves given off from the cord as it crosses the sac vary in their disposition like the cord itself. They are often directed forwards upon the sac-wall to reach their proper inter-vertebral foramina, whilst those apparently arising from the sac-wall are attached in a double series, the anterior and posterior roots being often distinct and separated by a well-defined falciform ligament which corresponds in position to the ligamentum denticulatum. When the nerves perforate the dura mater to reach the intervertebral foramina, they present the normal anatomy. Occasionally the lowest nerves in the sac may

present some small additional ganglia (*ganglia aberrantia*) (No. 3483).

3478.—A spina bifida, with defective formation of the laminæ, or arches, of the lower lumbar and the sacral vertebræ. A sac is formed by the protrusion of the membranes of the spinal cord. The cavities of the sac and of the spinal canal are shown by lateral section, and their continuity is marked by bristles passed through their narrow aperture of communication. Two large nerve-roots appear to have protruded with the sac of dura mater, and are adherent to its posterior walls.

3482.—A similar specimen, with the sac open from behind. Several nerve-roots pass out from the spinal canal, and are adherent to the inner surface of the sac.

3483.—A similar specimen of sacral spina bifida, from a child about six years old. The spinal canal and sac are laid open from behind, showing the passage of some of the sacral nerve-roots from the cord into the sac. The spinal cord reaches to the last lumbar vertebra.

As unusual conditions in connection with spina bifida, it may be noticed that the sac is sometimes multilocular, or that bony outgrowths from the spinal canal may divide the spinal cord (No. 3485).

(3) *Syringo-myelocoele* is that form of spina bifida in which there is a protrusion of the membranes with the spinal cord, the central canal of which is dilated to form the cavity of the sac, the inner lining being constituted by the expanded and atrophied substance of the cord. There are no nerve roots in the interval of the sac, a fact which serves to distinguish this variety from the meningo-myelocoele. These cases are very rare, but an almost typical specimen occurs in

3481.—A spina bifida; the sac, which is very thin, is of about the size of an orange, and is situated over the sacrum. At the anterior part are two minute apertures, through which bristles have been passed into the substance of the cord. The bodies of the vertebræ have been removed, and the central canal of the cord is seen to be much dilated; no nerves traverse the sac. On removing

the innermost lining of the sac, a series of nerves is exposed, lying in a loose areolar tissue, which is probably the subarachnoid.

Either from accident or other causes, the sac of a spina bifida may slough (Nos. 3480 and 3480a), or its contents may undergo changes in the direction of cure. As a very rare complication, a sacral cyst may co-exist with a spina bifida (No. 3488).

SECTION VII.

INJURIES AND DISEASES OF THE SKULL AND BRAIN.

FRACTURES OF THE SKULL.

THESE may be divided into fractures of the vault and fractures of the base.

FRACTURES OF THE VAULT.

Fractures of the vault are commonly the result of direct violence, such as a severe blow or fall upon the head. The fracture may take the form of a *simple fissure*, uncomplicated by any displacement of bone, extending for a variable distance over the vault, even to the base, or of several fissures radiating from a central depressed portion of bone (*starred or punctured fracture*: **Case H. 892a**). Again, the skull at the seat of injury may be broken into several pieces (*comminuted fracture*: **No. 888**), or a portion of bone may be pressed inwards (*depressed fracture*: **No. 879a**), or in rare instances raised above the level of the skull (*elevated fracture*).

The fracture may be limited either to the outer or to the inner table; but it more often involves the whole thickness of the skull, in which case the injury of the inner table is generally more extensive than that of the outer. Any of the above varieties may be accompanied by a wound of the integuments leading to the seat of fracture (*compound fracture*), or by laceration or other injury of the brain and its membranes. Injury of the brain is especially common in punctured fractures.

It occasionally happens after simple fissured fractures of the vault of the skull occurring in children and young adults that a large fluctuating tumour containing cerebro-spinal fluid forms at the seat of injury. As a result of the pressure produced by the swelling, the bone becomes thinned or even absorbed. Such a tumour is called a *traumatic cephal-hydrocele*. A good example of the destruction which the bone undergoes in such cases is seen in No. 881a.

Simple fissured fracture.

886.—Section of a skull-cap, exhibiting a fracture extending in several directions through the anterior part of the parietal bones. In one situation there is a fracture of the outer, without any corresponding fracture of the inner, table.

Case H. 741.—Fissured fractures of the skull, from a child, aged four years, who fell from a window in the first floor of a house. The right parietal bone is traversed by two converging fissures united by a transverse fissure. There is no depression of the fragments. At the base of the skull two fissures extended from either side of the foramen magnum into the corresponding temporal fossæ. These fissures did not unite with those seen on the vertex, and were probably produced by the weight of the body being suddenly thrown on the occipital condyles, through the cervical spine, when the vertex struck the ground.

The child died comatose about three hours after the accident.

Punctured fracture.

880.—Portion of the parietal bone of a child, on which a sharp piece of a chimney-pot fell from a house-roof. It made a circular aperture in the skull, half an inch in diameter, and forced the bone which was included within this circle into the brain and dura mater. Portions of the bone thus driven in remain attached to the margins of the aperture.

The child remained for three weeks with scarcely any of the usual symptoms of injury of the brain. Inflammation of the brain then ensued, and soon ended fatally.

Depressed fracture.

885.—Section of a skull-cap, exhibiting a comminuted circumscribed fracture of the outer and inner tables of one of the parietal bones. Many pieces of the inner table are depressed.

During life the outer table was raised by the elevator, and it was supposed that the instrument was acting upon the whole thickness of the skull, whereas the fragments of the inner table remained unmoved.

Compound depressed fracture.

879.—Posterior portion of a right parietal bone of a boy, aged three years, showing a compound depressed fracture of the skull. Death ensued from meningitis.

Depressed fracture with comminution.

Case H. 744.—Vertex of a skull, showing an extensive comminuted fracture of the parietal bones, and, to a less extent, of the frontal. The displaced portion of the parietal, pressing downwards and acting like a wedge, has caused separation of the sutures in the immediate vicinity.

The fracture occurred three weeks before death, and scanty new bone may be seen deposited about the edges of the displaced portions, chiefly on the cerebral surface.

In depressed fractures of the skull, when the fragments are firmly locked together, they often form round or oval depressions, which may be either shallow or deep, and are called *pond* or *gutter* fractures.

Pond fracture.

Case H. 883.—A skull-cap, in which a fracture with depression of the left parietal bone occurred many years before death. The fracture comprised a circle of bone, an inch in diameter, which was starred at its centre and surrounded by a nearly-circular fissure. The fracture is united, but the depression still remains; the centre of the depressed portion is nearly half an inch below the level of the contiguous internal surface of the skull.

Gutter fracture.

Case H. 788.—The upper part of a skull, with depression of a small oval portion of the right side of the parietal bone, from a fracture received a long time before death. Both the surfaces and the margin of the depressed part are smoothly and completely united; but on the inner surface are traces of a starred fracture of the internal table.

FRACTURE OF THE BASE.

Fracture of the base of the skull is commonly caused by indirect violence, such as a severe blow, a fall from a height upon the head, or, more rarely, from a fall upon the feet or nates, in which case the fracture is produced by the shock transmitted to the occipital bone through the spine.

Fracture of the base may also be caused by direct violence, such as a sword-thrust through the roof of the orbit, etc.

When produced by a blow or fall upon the vault, the fracture through the base is generally but the extension of a fissure starting from the part struck. Hence, as a rule, the anterior, middle, or posterior fossa is found fractured, according as the blow falls upon the anterior, middle, or posterior part of the vault. Should the force, however, be very severe, fissures may radiate from the seat of injury to two, or even to all three, fossæ.

Fractures through the middle fossa generally involve the petrous portion of the temporal bone on one or both sides of the skull. They frequently extend through the internal and external auditory meatus and walls of the tympanum, lacerating the prolongation of dura mater contained in the internal auditory meatus, the reflection of the arachnoid around the seventh pair of nerves, and the membrana tympani, and so allowing of the escape of the cerebro-spinal fluid from the external auditory meatus.

The fracture may also involve the lateral sinus or middle meningeal artery (**No. 2446a**), in which case blood may be found mixed with the cerebro-spinal fluid that escapes from the ear.

Fracture of the anterior fossa generally extends through the roof of the orbit and nose, allowing the escape of cerebro-spinal fluid and blood from the nostrils.

Fracture through the posterior fossa extends through the occipital bone, and frequently through the petrous portion of the temporal bones.

One or more of the nerves which escape through the bony foramina in the base of the skull, the lateral sinus, the middle meningeal artery, or one of the smaller blood channels, are frequently torn or otherwise injured in fracture of the base.

Case H. 892.—Portion of the right side of the base of the skull, with a fracture extending across the mastoid and petrous portions of the temporal bone. The inner portion of the petrous bone is almost separated from the outer by the fracture. Colourless fluid had escaped from the ear during life. From a boy, aged eleven, who died five days after being run over by a heavy van.

882.—The right occipital portion of the posterior fossa of the base of the skull, from a girl, aged nine years, showing a circular depressed fracture the size of a shilling. The outer table, though depressed, is apparently entire, except for a fissure which extends along one-third of the margin of the depression. The inner table is crushed in three or four directions.

890.—The petrous portion of a temporal bone, removed from the base of a skull which was fractured. See also **Nos. 890a** and **Case H. 891.**

PROCESS OF REPAIR AFTER FRACTURE OF THE SKULL.

In fracture of the vault, unaccompanied by displacement or loss of substance, repair is accomplished by intermediate callus, either entirely without or with a very slight production of provisional callus. In fractures where portions of the whole thickness of the bone have been removed the aperture remains, the bones around become smooth and rounded off, the exposed diploë being covered in by compact bone, whilst the dura mater adheres to the scalp, forming a fibrous cicatrix for the protection of the brain. Sometimes, however, as is the case in two of the following specimens, the hole is partially closed by the formation of new bone, the bone being produced from the margin of the aperture, and in part from the dura mater or from the pericranium.

In fractures through the base union may be effected by fibrous tissue or by bone, with or without the production of provisional callus; in some cases no union has occurred.

809.—Portions of a skull, in which a trephine hole, made thirty-four years before death, has been nearly filled up by new bone. The greater part of the new bone has been produced from the border of the aperture in the inner table. The aperture still remaining is of an irregularly oval form, about half an inch long and a fifth of an inch wide. Plates of porous new bone have been formed in the dura mater around part of the margin elevated by the effused blood, as well as in distinct patches nearer to the centre of the part thus elevated. A small quantity of new bone is also formed on the inner surface of the skull near the margin of the effused blood, but there is no appearance of any being formed beneath the blood. The margins of the hole are sharp, and its borders shelve obliquely inwards and downwards from the surrounding healthy bone. It was filled up by a tough fibrous membrane.

The patient, a sergeant of marines, was struck on the head with a tomahawk, at the taking of the Danish fleet in 1807, and was trephined in Haslar Hospital shortly afterwards by Sir Stephen Hammick. See also **No. 808.**

888.—Portion of a skull, in which an extensive fracture of the adjacent parts of the occipital and parietal bones occurred four years before death. Some portions of bone, detached by the fracture, were removed at the time of the accident; other portions were left, and have been reunited by bone. There is also a close union by bone of two lines of fracture extending outwards through the parietal bones. The margins of all the broken portions of bone have been smoothly rounded off, and their exposed diploë is covered in by compact bone. See also **Nos. 887 and Case H. 878.**

EFFUSION OF BLOOD.

Effusion of blood following injuries to the head may occur either inside the skull, or outside, in the substance of the soft tissues forming the scalp. There are no specimens in the Museum of effusions of blood outside the skull.

EFFUSIONS OF BLOOD INSIDE THE SKULL.

The effusion may be situated—(1) between the bone and dura mater—*subcranial*; (2) between the dura mater and arachnoid—*subdural*; (3) between the arachnoid and pia

mater—*subarachnoid* ; or (4) in the substance of the brain itself—*intracerebral*.

1. *Between the skull and dura mater—subcranial.*

Effusions of blood in this situation generally proceed from the middle meningeal artery or from the lateral sinus; occasionally from the small vessels running between the dura mater and bone. These effusions are generally considerable, widely separating the dura mater from the bone, and producing a deep depression upon the surface of the brain. The blood generally coagulates into a very firm clot, which may either be absorbed, or undergo organization and become adherent to both the bone and the dura mater. It may even undergo ossification, but, unlike clots beneath the arachnoid, never becomes encysted.

2446b.—A large clot of blood between the dura mater and the lateral part of a skull. The blood was effused from the middle meningeal artery, which was ruptured by external violence. See also No. 879a.

881.—Part of a parietal bone of an infant, with an effusion of blood between the skull and dura mater. The blood forms a circumscribed oval layer, about half an inch thick, and is coagulated.

2. *Between the dura mater and the arachnoid—subdural.*

Effusions of blood into the cavity of the arachnoid (*the subdural space*), especially in that part which covers the cerebrum, are very frequent; they are the result of capillary rupture, and follow upon most cases of severe injuries of the head.

The effused blood, which from the first is evenly spread in a thin layer over the surface of the cerebrum, rapidly clots, loses its colouring matter, undergoes organization, and assumes the form of a false membrane or of a membranous cyst. The false membrane may be delicate and film-like, or thick and leathery, according to the quantity of blood effused; it has a smooth, polished internal surface, and is nearly always adherent to the parietal layer of the

arachnoid, from which it receives its blood-supply. The cysts are formed by the organization of the outer part of the clot, whilst the central portion remains as fluid or clotted blood; like the membranes, they are, for the most part, firmly adherent to the parietal arachnoid, but they have been found free in the arachnoid cavity. After they have existed some time the blood in their interior becomes absorbed, and they take on a secreting action like other cysts. They have occasionally been found to contain a serous fluid.

Blood-clot in the subdural space.

2448.—A large clot of blood in the cavity of the arachnoid (*subdural space*) adhering to what was called by the older surgeons the parietal layer of the arachnoid. It was consequent upon external injury.

Blood membranes in the subdural space.

2450.—Portion of dura mater, exhibiting a newly formed membrane upon its internal surface, *i.e.* upon what was long described as the parietal layer of the arachnoid. This membrane lines the whole of the dura mater, covering the right hemisphere of the cerebrum; its thickness is about equal to that of the peritoneum, and it is very vascular throughout; it has been completely separated from the dura mater, except along one edge, where it is still adherent; and it will be observed that this edge is insensibly lost upon the dura mater, so that the internal surface of the new membrane, and that of the dura mater, appear to be continuous. The outer surface of the membrane is rust-coloured, like partially decolorized blood. Towards its lower part the new membrane is thicker than above, and it is here divisible into two distinct layers. The arachnoid lying beneath this layer of membrane is thickened. See also Nos. 2451, 2452.

It was formerly believed that specimens like the above were examples of the effusion of blood between the dura mater and what has hitherto been called the parietal layer of the arachnoid. "The blood glued to the parietal layer of the arachnoid, and covered over by a thin polished serous-like membrane (the blood membrane), looks," says Sir Prescott Hewett, "exactly as if the extravasation had taken place

between the dura mater and its arachnoid, widely separating these membranes from each other."

Blood cysts in the subdural space.

2449. Portion of dura mater, exhibiting a newly-formed, thin, and nearly transparent membrane, closely adherent to its internal surface, and consisting of two layers, which form a large cyst, containing coagulated blood.

3. *Between the arachnoid and pia mater—subarachnoid space.*

Effusions of blood in the pia mater—that is, between the so-called visceral layer of the arachnoid and pia mater (*subarachnoid space*)—are far less common than those in the *subdural space*. They are generally associated with some injury to the brain itself, and are very extensive, spreading far and wide in the spaces normally occupied by the cerebrospinal fluid. The blood does not become organized as in other situations.

2470.—Portion of a cerebrum with an extensive effusion of blood upon its surface between the arachnoid and pia mater.

4. *In the brain substance—intracerebral.*

Traumatic effusions of blood into the brain-substance may occur in any situation; they are generally associated with extensive laceration of, or other severe injury to, the brain, and are, for the most part, fatal. Should recovery, however, take place, the blood clot undergoes similar changes to those observed in the organization of a clot, such as occurs after an ordinary attack of cerebral hæmorrhage.

2523.—Portions of a brain, exhibiting deep laceration of its substance, with effusion of blood in the interior and in one of the middle lobes of the cerebrum, and in both lobes of the cerebellum. From a woman who fell downstairs upon her occiput.

CONTUSIONS AND LACERATIONS OF THE BRAIN.

Contusions and lacerations may occur in any part of the brain, but are most frequent at the base. As these injuries

are but poorly illustrated in the Museum, they will not receive further notice.

2522.—Portions of a cerebrum, exhibiting circumscribed bruising with loss of substance and effusion of small quantities of blood in its convolutions, the consequence of external injury.

2523.—Portions of a brain, exhibiting deep lacerations of its substance, with effusions of blood in the anterior and in one of the middle lobes of the cerebrum, and in both hemispheres of the cerebellum. From a woman who fell downstairs upon her occiput. She was immediately rendered insensible, and died on the fifth day, with signs of acute inflammation of the brain. A fracture was found extending from the transverse ridge of the occipital bone through several portions of the petrous part of the temporal bone. See also No. 2523a.

INFLAMMATION OF THE BRAIN AND ITS MEMBRANES.

Traumatic inflammation of the brain and its membranes may occur after almost any injury to the head, but more especially after injuries to the cranial bones and lacerations and contusions of the brain-substance itself.

The inflammation may begin in the membranes of the brain (*meningitis*), or in the substance of the brain itself (*encephalitis*). It seldom, however, remains long limited to either of these structures, but sooner or later involves both.

MENINGITIS.

Traumatic inflammation of the membranes of the brain may begin either in the dura mater, when it is commonly the result of some injury to the bone or scalp, or in the pia mater, when it is generally consequent upon inflammation of the brain itself. When inflammation begins in the dura mater it generally spreads inwards, involving membrane after membrane, and finally the cerebral substance. When it begins in the pia mater it seldom, except in severe cases,

spreads beyond this membrane and the arachnoid (*leptomeningitis*).

The various appearances presented by the dura mater, arachnoid, and pia mater, as they are successively attacked by inflammation spreading inwards, may next be studied in detail.

The dura mater.

The inflammation is at first confined to the outer surface of the dura mater (*pachymeningitis*), and to that portion only which lies immediately under the injured bone. The affected part appears red, injected, and covered by inflammatory products. The inflammation afterwards involves the whole thickness of the dura mater, and consequently the so-called parietal layer of the arachnoid, which constitutes its inner surface, and spreads far and wide in the subdural space. In very severe cases the dura mater may slough. In chronic cases the dura mater becomes infiltrated, thickened, and very adherent to the bone.

Inflammation limited to the external surface of the dura mater.

2455.—Portions of the dura mater and pia mater. Blood and inflammatory products are copiously effused upon the external surface of the dura mater. These changes were consequent upon an external injury.

Inflammation of the whole thickness of the dura mater.

2453.—Portions of dura mater. Both surfaces are covered with inflammatory material.

Sloughing of the dura mater.

2457.—A Portion of dura mater. About its centre is a considerable tract, which is soft and flocculent on the surface next to the bone. When recent it was of a brownish colour. The whole of the discoloured part seemed to be in a sloughing condition.

Thickening of the dura mater.

2454.—The dura mater in this specimen is thickened and indurated, measuring from a line to a line and a half in thickness. It has a tough, laminated texture. See also Nos. 2456 and 2457a.

The arachnoid and pia mater.

The inflammation, having reached the inner surface of the dura mater, now spreads to the arachnoid, and thence to the pia mater, while the subdural space generally becomes filled with greenish-yellow inflammatory material, and often with pus, although in some instances the effusion is limited by adhesions occurring between the dura mater and the arachnoid. Similar inflammatory material is produced on the surface of the pia mater, and extends with that membrane between the convolutions over the whole surface of the affected hemisphere, and sometimes even over that of the opposite side. The pia mater itself becomes opaque, thickened, infiltrated, and indurated, so that when it is removed its prolongations, which dip between the convolutions, can be pulled out without tearing, which cannot be done in the healthy brain.

2455.—The pia mater in this specimen is thickened, opaque, and indurated, both in that part which covers the convolution and in that which penetrates between them.

2457.—The visceral layer of the arachnoid in this specimen is slightly inflamed.

ENCEPHALITIS.

Inflammation of the brain may follow inflammation of its membranes, in which case usually the cortical substance only is affected; or it may be the result of contusion or laceration of the brain-substance itself, when both the cortical layer and the white matter around the seat of injury are equally involved. In the former case the cortical layer, which is very adherent to the inflamed pia mater, appears brownish-red, swelled, soft, and diffuent, so that it can be washed away by a gentle stream of water poured upon it. The white substance presents more puncta than usual; otherwise it is but little affected. The ventricles are frequently distended with serous fluid.

2522.—Portion of a cerebrum, exhibiting a circumscribed softening, following an external injury.

When the inflammation is consequent upon laceration or contusion of the brain-substance, both the cortical and white substance immediately around the seat of injury become intensely congested, dull red, soft, and diffuent, and finally break down into pus, giving rise to a cerebral abscess.

2487a.—The cerebellum, showing the site of a localized abscess in the left lobe, resulting from a fracture which extended transversely through the external auditory meatus and tympanum, as well as through the petrous and mastoid portions of the temporal bone. Pus was also diffused through the temporal bone, and the internal auditory meatus with the seventh pair of nerves was implicated in the suppuration. The membrana tympani was entirely destroyed.

From a man aged forty-three, who fell off a mail-cart on to his head, sustaining a fracture of the base of the skull. On admission he could answer questions; there was hæmorrhage from the left ear and left nostril. The pupils were equal, and he passed water naturally, but there was paralysis of the left side of the face. Three days after the accident the discharge from his ear became purulent and subsequently foetid, and the patient died a fortnight later. See also **No. 2486.**

2524a.—A skull with the brain *in situ*, prepared in such a way as to show the course of a bullet fired upwards from the mouth. The bullet has traversed the hard palate, the ethmoid and the frontal portion of the brain, leaving a track along which a black rod has been passed. The bullet was extracted from an abscess which formed twenty days after the injury behind the coronal suture; the remains of it are still visible. The lateral ventricle was not opened. The layers of arachnoid around the aperture are adherent, but there is no other evidence of meningitis. The portion of the brain corresponding with the left frontal lobes, which were disorganized, appears to be contracting by a process of cicatrization. From a man aged thirty-eight, who shot himself through the mouth with a revolver. He survived the injury one month, and during this time remained in a state of stupor unless he was roused, when he was cheerful and possessed some memory. See also **No. 2486a.**

HERNIA CEREBRI.

Hernia cerebri is a protrusion of brain-substance through a hole in the cranial bones and dura mater. It may occur

after any injury to the cranium, accompanied by loss of bone, and by a wound or slough of the dura mater. It is most common after compound fracture or the application of the trephine. The protrusion is the result of a swelling of the brain from inflammation, and generally occurs three or four days after the injury to the cranium. It must be distinguished from the mere escape of brain-substance which occasionally occurs at the time of injury.

Hernia cerebri appears as a reddish-brown, blood-stained, fungous-looking mass, overhanging the hole in the cranium through which it has escaped, and pulsating synchronously with the brain. On section it is seen to consist of brain-substance infiltrated with inflammatory products and covered by granulations and blood-stained pus.

The protrusion generally increases continuously, and may attain the size of an orange. Sometimes, however, it becomes constricted at its base and sloughs away, the parts cicatrize, and the patient recovers; or after its removal, either by sloughing or by other means, fresh protrusions of brain-substance take its place and the patient dies comatose. At other times the interior of the mass breaks down into an abscess, or its vessels give way and extensive hæmorrhage results.

Hernia cerebri is said to occur more frequently when the hole in the cranium is small than when it is large; to be more common after injuries of the anterior part of the skull than after injuries of the posterior; and to occur more often in the young than in the old.

Protrusions, similar in outward appearance to the above, composed either of granulation-tissue springing from the surface of the inflamed brain or of coagulated blood, sometimes occur, and are often described as varieties of hernia cerebri.

2525.—Portions of brain, skull, and cerebral membranes, exhibiting a hernia cerebri. The front of the preparation shows a vertical section of the protrusion and of the part of the brain from which it has arisen. In the centre of the protruded brain, which consists

of medullary substance, the vessels have given way and blood is effused in it. The portions of the skull and of the membranes of the brain surrounding the base of the protrusion were included in the section, for the purpose of showing how the protrusion has taken place through the openings formed by ulceration in the dura mater and pia mater, and through the aperture in the bone.

2526.—Section of the protruded brain last described. The deep groove which intervenes between the outer part of the protruded mass and the portion of brain from which it has arisen, was occupied by the bone and by the membranes of the brain.

The patient, a boy thirteen years old, had extensive fracture of the frontal bone, and several portions of bone were removed without injury of the dura mater. The protrusion of the brain began on the fifth day after the injury, and increased, without disturbance of the intellect or other remarkable symptoms, till the tenth day, when the protruded mass, consisting of healthy grey and white matter, was cut off. For the next ten days the protrusion was restrained by firm pressure; but, insensibility ensuing, the pressure was discontinued; the protrusion at once again made progress, and the patient died on the twenty-seventh day after receiving the injury, with softening of the brain.

2527.—Portion of a brain and its membranes and of the right frontal bone of a boy aged eight, who four months before his death sustained a compound fracture of the right frontal bone. A fortnight after the accident a portion of the brain began to protrude, the protrusion gradually increasing until his death. From time to time serum and pus were let out from the wound with considerable relief to the cerebral symptoms. A large portion of cerebral substance protrudes beyond the integuments, and the section shows its continuity with the rest of the brain. Beneath the adjacent portion of dura mater is a large cavity which was filled with pus. See also casts Nos. 143 and 143a.

CONGENITAL MALFORMATIONS OF THE CRANIUM.

MENINGOCELE AND ENCEPHALOCELE.

A meningocele is a tumour formed by the protrusion of the membranes of the brain through a congenital aperture in the skull, and containing cerebro-spinal fluid. An enceph-

alocele is a similar protrusion of the membranes of the brain, but accompanied by a portion of brain-substance itself. Both conditions are exceedingly rare, and are always the result of hydrocephalus. They may occur in any situation along the course of the sutures, but are most common at the internal angular process of the orbit, and just below the occipital protuberance of the occipital bone. In the former situation the protrusion takes place through an aperture left by the non-union of the sutures between the frontal and contiguous bones, and in the latter situation through an aperture at the point of union of the four centres, from which the posterior portion of the occipital bone is developed.

The protrusion, when occurring in the occipital region, generally appears as a tumour of large size, globular, translucent, and frequently pedunculated. When at the internal angular process of the frontal bone it is generally small and somewhat flattened, bearing a great resemblance to the dermoid cysts so common at the outer angle of the orbit. Unlike the latter, however, meningoceles and encephaloceles cannot be raised from the skull, and frequently pulsate.

3472a.—A section through the head of a newly-born child which had an occipital encephalocele. The sac of the tumour is formed by the scalp and pericranium externally, and by the cerebral membranes and a thin layer of brain substance internally. The swelling is situated in the middle line between the occipital protuberance and the foramen magnum. It is connected by a narrow neck, which passes above the transverse fissure in the brain, with the greatly expanded lateral ventricle.

Casts of congenital deformities, **No. 64.**—Cast of the head of a child who was born with a large meningocele situated in the occipital region.

HYDROCEPHALUS.

The following specimens exhibit some of the effects of hydrocephalus.

2514.—Part of the brain of a man, twenty-eight years old, who had

hydrocephalus in his infancy, and whose head was enlarged and somewhat deformed in consequence of that disease. The whole of the internal surface of the ventricles is finely granular, and appeared to be indurated. The inferior surface of the edges of the fornix is intimately adherent to the surface of the choroid plexus, and through its medium to the upper surface of the optic thalami. The mind of the patient appeared in no degree affected by this disease; he was a very skilful furniture painter, and died of a disease independent of the state of his brain. See also Nos. 2513a, 2516, 2517, and 2518.

Case D. 2519.—Skull of a girl eleven years old. The enlargement of the skull in consequence of hydrocephalus is effected by its elongation, and by the depression and hollowing of its base. An increase of width appears to have been prevented by the premature and complete closure of the sagittal suture. The coronal suture, and that between the frontal bone and the lesser wings of the sphenoid, are wide open. The superior walls of the orbits are pressed downwards. The bones, generally, are thin and light, and in many parts of the inner table there are deep depressions and foramina. See also **Case D. 2520, 2521a** and **Case A. 3489.**

SECTION VIII.

COMPARISON OF THE VARIOUS DEFORMITIES OF THE SKULL, SPINE, THORAX, AND PELVIS.

HERE it may be well to compare the various distortions of the skull, spine, thorax, and pelvis, which have been described under Diseases of the Bones, Spine, and Cranium.

THE SKULL.

Compare the rickety skull (Case A. 1111) with the hydrocephalic skull (Case A. 3489).

In rickets the skull is slightly enlarged; the frontal bone is high, square, and projecting; the fontanelles are open; the bones are thickened, soft, and spongy.

In hydrocephalus the cranium is enormously enlarged; the frontal bones are very prominent, and the parietal bones bulge out on either side. The sutures are open; the bones are widely separated; the brain between the bones is covered by a thin membrane, in which separate centres of ossification, leading to the formation of Wormian bones, occur. The bones, generally, are thin and light. The superior walls of the orbits are pressed downwards, and appear almost vertical instead of horizontal.

THE SPINE.

Compare the distortions of the spine produced by angular curvature (Case C. 1112), by lateral curvature (Case C. 1118), and by posterior curvature (Case C. 1127).

In angular curvature one or more of the bodies of the vertebræ and intervertebral cartilages are destroyed, and

the upper portion of the spine is approximated to the lower, forming with it an angle projecting backwards.

In lateral curvature the spine is curved laterally, and generally rotated at the same time on its own axis. The intervertebral cartilages are laterally compressed, but neither the cartilages nor vertebral bodies are ulcerated.

In posterior curvature the spine is curved with its convexity backwards; the intervertebral cartilages are compressed anteriorly, but neither the intervertebral cartilages nor the bodies of the vertebræ are ulcerated.

THE THORAX.

Compare the distortion of the thorax in rickets (Case C. 1126) with that in lateral curvature (Case C. 1115), and with that in angular curvature (Case C. 1113).

In rickets the thorax is increased in its antero-posterior diameter, and diminished in its lateral, and a shallow longitudinal groove is formed on each side of the chest, lying parallel and a little external to the sternum.

In lateral curvature the thorax is unilaterally distorted; one side is increased in its antero-posterior diameter and diminished in its lateral, and the other side is increased in its lateral and diminished in its antero-posterior (see p. 236 for full description).

In angular curvature the thorax is symmetrical, but bends down towards the pelvis, so that the lower ribs may reach the ilium. "The vertical measurement is decreased, while the antero-posterior is considerably increased, and the sternum is carried forwards, so that it is in a vertical plane considerably anterior to that of the face" (Wilks and Moxon).

THE PELVIS.

Compare the distortions of the pelvis in rickets (Case E. 276, Case E. 277), in mollities ossium (Case E. 292), in lateral curvature (Case C. 1115), in angular curvature (Case C. 1113), and in the oblique distortion of Naegelé (Case E. 280).

In rickets the pelvis is generally flattened from before backwards. The symphysis pubis is driven in, giving the inlet an hour-glass shape. The sacrum is more horizontal than natural, its curves are diminished, its promontory is pressed forwards and downwards into the pelvic cavity, and its apex, with the coccyx, is curved acutely forwards and inwards. The iliac crests are everted and curved boldly forwards. The tuberosities are widely separated, and the pubic arch is increased in width.

In mollities ossium the pelvis is flattened from side to side. The symphysis pubis projects in the form of a beak, giving the pelvis a rostrated appearance. The curves of the sacrum are increased. The iliac crests are inverted and folded up. The tuberosities are approximated, and the pubic arch is diminished in width.

In lateral curvature the pelvis is often natural or but slightly affected; its obliquity may be lessened, its antero-posterior diameter diminished, and its transverse increased.

The antero-posterior axis, corresponding with the lumbar curve, may be directed obliquely from before backwards, and from right to left, or left to right, according to the direction of the curve. The tuberosity on the side of the curvature is higher than that on the opposite side.

In the oblique distortion of Naegelé the sacrum is ankylosed to one or other of the iliac bones, and the lateral half of the sacrum which is fused with the adjoining iliac bone is imperfectly developed. The whole sacrum is deflected towards the ankylosed side, and its anterior surface looks in the same direction. The symphysis pubis is displaced towards the side opposite to that on which the sacro-iliac

fusion has taken place. The oblique diameter, which extends from the anchylosis to the acetabulum of the other side, is increased, and the remaining oblique diameter is diminished. "The distance of the promontory of the sacrum from the acetabulum on the anchylosed side is much less than the same measurement on the opposite side" (Tyler Smith).

In angular curvature the pelvis is but little altered; it sometimes appears, like the thorax, a little deeper than natural.

SECTION IX.

INJURIES AND DISEASES OF NERVES.

WOUNDS OF NERVES.

WOUNDS of nerves may be incised, punctured, lacerated, or contused. Of these, incised wounds alone are illustrated in the Museum.

Incised wounds may be classed as complete or incomplete, according as the nerve is completely or only partially divided.

Process of repair after complete division.

When a nerve is divided in its continuity, both portions slightly retract in consequence of their elasticity; the proximal end becomes slightly swelled and hypervascular. The swelling increases for several weeks after section. The distal end atrophies from fatty degeneration, inflammatory material is produced between the divided ends, and the nerve is ultimately restored. The process by which this restoration is accomplished is doubtful. By some it is maintained that spindle-shaped cells are developed in the inflammatory material and become connected above and below in some unexplained manner with the divided nerve-fibres, and are ultimately developed into axis cylinders. Others affirm that the axis-cylinders in the proximal end grow out, as it were, into the material uniting the two portions, and become united either to the old axis-cylinders in the peripheral end (which appear, after having undergone considerable degenerative changes, to be restored to their

natural condition), or to newly formed axis-cylinders which have taken their place.

When the two portions are widely separated, as by the interposition of some tissue between them, the distal portion undergoes more or less complete atrophy, whilst the upper usually becomes bulbous. Microscopical examination of the bulbous end shows that it contains numerous recently formed nerve-fibres, lying in a stroma of fibrous tissue. The parts supplied by the wounded nerve generally undergo atrophy and degeneration.

In the peripheral end of the nerve the myelin or white substance first breaks up into fat-globules within its sheath, and then disappears, whilst the axis cylinders subsequently disintegrate and finally disappear. These changes constitute *the Wallerian degeneration*. The microscopical appearances are well seen in sections presented by Mr. Bowlby, and preserved in the Histological Cabinet (Nos. 109c—k).

2563.—The ulnar nerve and adjacent parts, from the forearm of a man who had received a severe wound fourteen years before death. At the junction of the middle and lower third the nerve had been completely divided. The upper end of the nerve appears a little less than its normal size, and about three-quarters of an inch above the point of division there is a well-marked bulbous enlargement, which under the microscope showed a condition very like atrophy. The lower end of the nerve is much atrophied, and under the microscope it was found to consist almost entirely of connective-tissue, with an occasional indication of axis-cylinders. The lower end of the nerve is attached to the under surface of the tendon of the flexor carpi ulnaris, its upper end to the upper and inner aspect of the same tendon. The two portions of the nerve are not on the same plane, and much scar tissue intervened between them.

There was complete atrophy of all the muscles of the hand supplied by the ulnar nerve, with contraction of the little and ring fingers. Sensation was, however, perfect in the skin supplied by the nerve.

When a nerve is divided and the peripheral portion removed, as in amputation, the divided end of the proximal

portion becomes bulbous and adherent to the tissues of the stump, the bulbous condition being due to the formation of connective-tissue about the sheath. There is usually but little atrophy of the nerve-trunk; in the case of the optic nerve, however, after the removal of the eye, the nerve becomes greatly atrophied and shrunken within its sheath, but no bulbous condition is seen. If the end becomes involved in the cicatrix, or in inflammation or ulceration of the stump, severe pain is experienced, often necessitating reamputation.

2565.—Nerves of a forearm, with the bones, from a stump. The extremities of the radial, lunar, and median nerves form very dense, bulb-like swellings, two of which are closely, and one more distantly, connected with the cicatrix in the skin. See also Nos. 2564 and 2566.

2575.—The eyelids, the remains of the optic nerve, and the other contents of the orbit, from which the eye (No. 2625) was removed. The optic nerve terminates by a blunt, but not bulbous, extremity, which is firmly adherent to the surrounding tissues. The eyelids, muscles, and all the other parts are atrophied and contracted.

3213.—A stump, reamputated on account of constant pain and ulceration. There was found marked thickening of the sheath of the musculo-cutaneous nerve, which was also in a state of tension. The nerve was traced down to the ulcer, where it is probable its free extremity lay exposed. There was the usual bulbous enlargement of the posterior tibial and other nerves.

Process of repair after partial division.

After partial division the portions divided will retract, so putting the undivided portion on the stretch, thereby causing serious local and constitutional disturbance. Union of the divided portions is accomplished in a manner similar to that described under complete division.

2567.—Portion of a radial nerve, with the tendons of the flexor carpi radialis and flexor longus pollicis muscles. Long before death the artery was completely, and the nerve partially, divided. The divided filaments of the nerve have become firmly adherent to the two contiguous tendons. The sensibility of the fingers was unimpaired.

ATROPHY.

The occasional atrophy of the proximal portion of a divided nerve and atrophy of the optic nerve after extirpation of the eyeball have already been referred to under "Wounds of Nerves." Atrophy may likewise occur after any severe injury to a nerve-trunk, after pressure upon a nerve by a tumour or an aneurysm, or after destruction or degeneration of the organs which the nerve supplies.

An atrophied nerve appears shrunken and contracted within its sheath, and on microscopic examination few, if any, nerve-fibres can be discovered, the greater number having undergone granular and fatty changes.

2551.—Portion of a cerebrum, with the optic nerves and the eyes. The optic nerves are considerably diminished in size, thin, and flat, in their whole course from the retina to the thalami. The optic thalami are also small. The eyes are reduced in size, from a deficiency of their humours, but are not otherwise altered.

From an aged woman, who had been totally blind for twelve years.

2553.—Portion of a cerebrum, with the optic nerves and remains of the left eye. The cornea is opaque, and the coats of the eye are collapsed. The left optic nerve is considerably diminished in size between the diseased eye and the optic commissure. Behind the commissure, the nerve on the right side is rather smaller than that on the left; but the thalami appear to be of equal size.

From compression by a tumour in the course of a nerve. 2562.—A right recurrent laryngeal nerve. The mass of the tissue which surrounds it consists of dense scirrhous material involving one of the cervical glands. The nerve-fibres are not merely surrounded and compressed, but are separated from one another by the penetration of the cancerous growth between them. The left recurrent nerve was equally involved.

The man from whom these nerves were removed had suffered for nine months from cancer of the thyroid body and secondarily from cancer of the glands of the neck. His voice became by degrees weak and indistinct, and before his death he suffered from complete aphonia.

RESULT OF NERVE SECTION.

As a result of section of nerves certain trophic changes take place in the parts which they supply. Thus in the case of the median, radial, and ulnar nerves, the muscles waste, and the fingers become spasmodically flexed, so as to resemble "claws." **Cast No. 144a.**—The skin becomes glossy, hairless, shiny (**Drawing 388a**), and loses its sensibility. The extremities may ulcerate. **Drawing 388d.**—The nails may either disappear or may become "craggy," like a limpet-shell. **Drawing 388c.**—Suture of the nerve resulting in a restoration of its function will, however, lead to the disappearance of all these trophic changes, even when they have been well marked. This is excellently seen in:

Cast 144c.—The left hand of a patient seven months after section of the ulnar nerve. The muscles are extremely atrophied, and the fingers are somewhat "clawed." Compare this with

Cast 144c.—The left hand of the same patient a year after the operation of secondary suture. The muscles are almost completely regenerated.

Cast 144d.—The right hand of a patient eighteen months after division of the ulnar nerve. The muscles are wasted, and the hand is typically "clawed."

Cast 144e.—The right hand four years after section of the ulnar nerve, from a case in which the median nerve was also wounded. The fingers are spasmodically flexed.

Cast 144f.—The left hand of patient nine months after division of the median nerve. The opponens and abductor pollicis are completely wasted, and the ball of the thumb is much flattened.

Cast 144a.—The right hand from a patient whose fingers were contracted after inflammation. An old wound of the median nerve had been followed by partial ankylosis of the phalangeal joints, with trophic changes in the skin of the nails and muscles.

Cast 144b.—The left hand from a patient whose ulnar nerve had been divided eight months previously. See also **Cast No. 66b.**

388a.—Drawing of a hand showing the results of division of the median nerve.

388b.—Photographs of a hand some months after an injury to the radial nerve.

388c.—Drawings of the hands of a patient whose left median nerve had been divided nine months previously. There are well-marked trophic changes in the left hand. The right is normal.

388d.—Drawing of a destructive ulceration of the distal phalanx of the left fore-finger, resulting from the division of the median nerve. The adjacent sides of the thumb and middle finger are also ulcerated, but to a less extent.

388e.—Drawings of the face and extremities of a young woman who had general neuritis, probably of peripheral origin. The skin shows the changes characteristic of chronic nerve lesions.

2566a.—A hand deformed, as the result of an injury to the median nerve. The fingers are doubled up and claw-like; the nails are curved longitudinally and transversely; they are fibrous, ridged, and furrowed. The phalangeal joints are stiffened in a position of flexion; their cartilages are thinned, and in the articulation between the second and third phalanges of the ring-finger there is true bony ankylosis. The muscles are not wasted, but during life the skin of the digits was smooth and glossy. About one inch above the wrist-joints the median nerve is enlarged, and embedded in its substance may be seen a small foreign body—a piece of metal. The patient was a soldier, aged thirty-two, who received a *gunshot* wound on the front of the wrist by a splintered ramrod, two years before he came under notice. The hand had slowly assumed its present condition, and sensation in the median distribution was everywhere impaired. The forearm was wasted and hyperæsthetic.

TUMOURS OF NERVES.

The term “neuroma” was formerly applied to any tumour growing upon a nerve, without reference to its structure. It should, however, be restricted to those rare forms of tumours which are composed of nerve-elements themselves, and other tumours connected with nerves should be called, as in other situations, fibromata, myxomata, etc., according to their structure.

Of nerve tumours the fibrous or fibromata are by far the most common. They spring from the neurilemma or connective-tissue surrounding and connecting the nerve-fibres. They may involve the whole of the nerve or only a part of

it, the rest being spread out over them. They resemble the fibromata in other situations, are encapsuled, and generally single; but more than one tumour may occur upon the same nerve, and instances have been recorded of many such on nearly all the nerves of the body.

Another form of fibrous tumour connected with nerves is the small "painful subcutaneous tubercle" of Paget.

The myxomata are the next most common form of nerve tumours. They resemble the myxomata in other situations.

Sarcomatous and carcinomatous tumours are also found.

Cysts are sometimes developed in connection with nerves.

True neuromata are rare, and are not represented in the Museum.

Fibromata.

2555.—A posterior tibial nerve, in which there is a circumscribed oval tumour, composed of a soft grumous substance. The component fasciculi of the nerve are separated and spread out around the tumour; the peroneal nerve is adherent to the surface of the neurilemma extended over the tumour.

2559.—Portion of an axillary artery, with the axillary plexus of nerves and a tumour connected with them. A section has been made of the tumour, to show its interior consisting of soft fleshy substance. A nerve, presumed to be the median, is connected with the tumour at its upper and lower extremities. At its upper end the filaments of the nerve are expanded over the tumour in such a manner as to indicate that it commenced within the nerve.

2560.—An ischiatic nerve, with a small, firm, white tumour within its sheath. The filaments of the nerve are separated by the tumour, and loosely connected with its surface. See also No. 2559a.

2556.—A median nerve, in which there is a fibrous tumour. The tumour was completely embedded in the substance of the nerve, the filaments of which are separated and extended around it.

2557.—Portions of the internal cutaneous and posterior interosseous nerves, from the forearm of a woman, aged seventy-five, to which large fibrous tumours are attached and included amongst the filaments. In other portions of the nerve smaller tumours of vary-

ing sizes are seen more or less completely invested by a capsule. The larger ones had existed for more than thirty years ; they occasioned considerable pain. See also Nos. 2555a and 2558.

Sarcomata.

2561.—A portion of one of the nerves of a brachial plexus, probably one of the roots of the median nerve, with a tumour in its sheath. The tumour is of an oval form, nearly an inch in length ; it lies completely within the sheath of the nerve, the bundles of nervous filaments being pressed to one side ; and it is composed of a pale, uniform, firm, elastic, glistening substance, which appears in one situation to be somewhat softened. The patient was a man about twenty-five years old, in whom the tumour had grown slowly, and with much pain in the arm.

Cysts.

2566b.—Hand showing a cyst on the deep branch of the ulnar nerve. The cyst contains a synovial fluid ; it is connected with one of the carpal joints by a narrow process which runs up over the carpus.

PERFORATING ULCER OF THE FOOT.

Perforating ulcer of the foot usually commences as a corn situated on the sole opposite the head of one of the metatarsal bones, usually the first. It inflames, suppurates and slowly extends until it causes destruction of the bones, when it may perforate the foot. The disease is painless, and it appears to be due to an impairment of nutrition owing to degenerative changes taking place either in the nerves leading to the affected parts, or in that portion of the sensory column of the spinal cord which is in communication with the foot.

2689a.—Portion of a foot, including the first and second toes, with a perforating ulcer upon the sole. The ulcer is surrounded by thickened epidermis. A glass rod is inserted into a fistulous track, extending into the metatarso-phalangeal joint of the second toe ; this joint, which was filled with pus, is completely destroyed. The great toe is deformed and retracted, owing to necrosis of the first phalanx. The bones of the fourth and fifth toes were also diseased. Two months before his admission to the hospital the patient noticed

a hard lump on the sole, which subsequently ulcerated and discharged. The foot was removed by Syme's amputation.

2689b.—Portion of a foot, with an oval ulcer one inch and a half in diameter, situated upon the sole over the heads of the metatarsal bones. The ulcer is surrounded by heaped-up, thickened epidermis; the edges are cleanly cut, and at its base, on the inner side, the carious heads of the third and fourth metatarsal bones are exposed. The great toe had been removed for a similar disease.

SECTION X.

INJURIES AND DISEASES OF THE ORGANS OF CIRCULATION.

INJURIES OF THE HEART.

RUPTURE.

RUPTURE of the heart is rare. When it occurs it is the result of great violence applied to the chest-walls, or of some sudden violent exertion; but in the latter case there is generally pre-existing disease of the heart-walls to account for it (No. 1248a). In severe injuries of the head or lower extremities the heart has occasionally been found ruptured, although no direct violence has apparently been applied to the chest. Rupture in such cases has been attributed to sudden spasmodic action of the heart from intense fear.

When it is the result of external violence, the rupture may take place through any part of the heart, but perhaps more often through the right side on account of the closer proximity of that part to the chest-walls; when the result of sudden over-action of the heart, it is nearly always confined, as might be expected, to the left ventricle. The pericardium may or may not be involved in the rupture.

Spontaneous Rupture.

1248a.—A heart which has ruptured spontaneously. The left ventricle is greatly dilated, and its muscular tissue is easily torn. At the upper part of the right ventricle, near the lower portion of the conus arteriosus, is a rent extending completely through the substance of the heart. In the recent state the laceration, through

which a glass rod has been passed, was occupied by a clot of blood. To the left of the rent is a rupture through the fat and muscular tissue, measuring about one and a half inches in length. It is situated just over the anterior part of the ventricular septum, but it does not penetrate any cavity. This laceration extended upwards under the visceral layer of the pericardium, and appears to open into a branch of the anterior coronary artery. A red rod has been passed along it for some distance. From a man aged fifty-four, who was admitted in a comatose condition; no further history was obtainable. At the autopsy the pericardium was found to be filled with blood. The internal coat of the aorta was swollen and atheromatous, and there was a large hæmorrhage into the right side of the brain.

1248b.—The heart from a case in which the right ventricle ruptured spontaneously. About half-way down the anterior surface of the right ventricle is a discoloured patch of muscular tissue perforated by two small apertures. In the recent condition one of these apertures was filled with a small piece of soft blood-clot. From a woman aged seventy-one, who was admitted into the hospital with diabetes. At the autopsy the pericardium was entire, but was filled with fluid blood. The aorta was highly atheromatous. The skull-cap was greatly thickened.

Traumatic Rupture.

1365.—Rupture of the right ventricle and auricle. A large ragged opening is seen in the wall of the right ventricle, near the attachment of the pulmonary artery. There is a second opening at the posterior surface of the heart, through the wall of the right auricle, just below the inferior vena cava. The specimen was taken from the body of a man aged forty-one years, who fell from a height of fifty feet. The muscular substance of the organ was healthy.

1366.—A heart, in which a partial rupture of the walls of the auricles has taken place. In the posterior part of the right auricle, between the fossa ovalis and inferior vena cava, a rent an inch and a half in length extends through the endocardium. In the posterior part of the left auricle, between and below the orifices of the pulmonary veins, a rent nearly two inches in length exists in both the pericardium and endocardium, and there is a small aperture between some of the muscular fibres thus exposed, through which a little blood escaped into the pericardial cavity.

The patient was thirty-eight years old. His leg was crushed by a heavy weight, and amputation was performed on the following day. He seemed to suffer but little from these shocks, and went on well till the fifth day, when extensive inflammation ensued in the tissues of the thigh. He was much depressed, but his case was not deemed hopeless till the twelfth day, when he suddenly became pale and more exhausted and quickly died. From the time of the injury the pulse was generally feeble and frequent. During the last few days of his life the breathing was oppressed. A clot of blood, about the size of a half-crown, was loose in the pericardial sac, and a smaller clot lay upon the auricles. Several small effusions of blood existed between the pericardium and the muscular substance of the auricles and ventricles, especially of the former. The texture of the heart appeared quite healthy. See also Nos. 1364 and 1365a.

WOUNDS.

Wounds of the heart are generally the result of bayonet-thrusts, gun-shot injuries, or knife-stabs. They have occasionally been produced by the penetration of a needle. (No. 1372.)

As a rule they are immediately fatal, especially when of large size or transverse to the muscular fibres of the ventricles, as under these circumstances the wound gapes and allows of sudden hæmorrhage into the pericardium. When the wound is parallel to the fibres of the ventricle, death may be delayed, as the spiral arrangement of the different layers of fibres has a tendency to occlude the wound.

Wounds of the auricles, on account of the thinness of their walls and the absence of a spiral arrangement of their muscular fibres, are more fatal than those of the ventricles; cases of recovery have, however, been reported. The right side of the heart, from its position, is necessarily more exposed to wounds than the left. The pericardium alone is sometimes injured. An interesting specimen of a hernia of omentum into the pericardium after a wound follows.

1370.—Part of the heart of a lunatic, who destroyed himself by thrusting a needle, about an inch and a quarter in length, through the anterior wall of the left ventricle four days before death. The needle, entering just to the left of the septum, passes obliquely upwards and to the left, and its point enters the cavity of the ventricle through the apex of the anterior fleshy column; its larger end is buried in the substance of the ventricle. The pericardium was thinly covered with inflammatory material, and the muscular substance of the heart was in a state of fatty degeneration, which was most advanced and attended with softening of texture in the neighbourhood of the needle.

1371.—Part of the left ventricle of a cow, through which an awl was driven at some time not less than two days before death. The whole thickness of the ventricular wall is pierced; one end of the awl projecting half an inch into the pericardial sac, the other into the cavity of the ventricle. No external wound was noticed in this case, nor any signs of severe suffering. The cow walked two miles to the slaughter-house, where, on immediately killing her, the injury of the heart was discovered.

1372a.—A heart wounded by two bullets. One appears to have taken the course indicated by the glass arrow, entering the anterior surface of the left ventricle about midway between the apex and base, and passing out through the upper part of the posterior wall. The other bullet has lacerated the left side of the surface of the ventricle without penetrating its wall. See also No. 1367a.

INJURIES AND DISEASES OF THE ARTERIES.

WOUNDS OF ARTERIES.

Specimens illustrating a few of the various ways in which the arteries may be wounded are here appended. As pathologists, our attention, however, will be chiefly confined to the consideration of the results of wounds of arteries.

1377.—A common carotid artery, into which the smaller end of a tobacco-pipe was driven a few days before death. At the upper part of the preparation is shown a portion of a sloughing cavity, in which the wounded part of the artery is involved, and from which the external and internal carotid arteries proceed.

The patient was a young man. The tobacco-pipe was accidentally

driven through the tonsil into the artery at the angle of its bifurcation. He supposed that he had completely withdrawn it; but a portion of the pipe, an inch long, remained in the wound, closing the orifice which it had made in the artery, and preventing hæmorrhage. Extensive suppuration followed, in the course of which hæmorrhage ensued. The trunk of the artery was tied seven days after the accident, but hæmorrhage recurred twice, and the patient died four days and a half after the application of the ligature. See also Nos. 1378, 1384a, and 1386.

1377c.—Portion of an aorta, the whole of whose coats have been cleanly divided by a transverse wound about one inch in length just below the origin of the left carotid artery. The artery is atheromatous, and the surrounding cellular tissue blood-stained.

1380.—Arteries of a leg, with portions of the surrounding muscles, from a man in whom the peroneal artery was penetrated by a knife which passed transversely into the back of the leg from the inner side. The track of the wound into the peroneal artery is shown by the piece of coloured glass. The peroneal artery is unusually large; the posterior tibial, into which a bristle has been introduced, is very small.

RESULTS FOLLOWING WOUNDS OF ARTERIES.

The results following a wound of an artery depend upon whether the interior of the vessel is laid open, or the walls merely notched but not penetrated; whether the vessel wounded is of large or small size; or whether it is completely or only partially divided.

I. WHEN THE INTERIOR OF THE VESSEL IS LAID OPEN. (PENETRATING WOUNDS.)

When the vessel is of large size.

Wounds of the large vessels, such as the aorta or pulmonary artery, are, in most cases, immediately fatal. When, however, the wound is very small death may be delayed for a few hours; such was the case with the patient from whom the following specimen was obtained.

1375.—The heart and the commencement of the great arteries of a woman, aged twenty-five, who died under the following circumstances: She received a blow on the chest, whereby a needle which

fastened her shawl was driven through the second intercostal space of the right side in its upper part, close to the border of the sternum, passing between the bone and the internal mammary artery. It penetrated to the extent of about two inches, and was broken off on a level with the skin. No immediate effect was apparent. She came to the hospital, and the portion of the needle, which appeared firmly fixed, was extracted. When the broken end was exposed by a small incision it was observed to move slightly with the heart's action. She was persuaded to remain with difficulty. In less than an hour she became very faint. The faintness rapidly increased, and she soon died.

In a post-mortem examination the pericardial sac was found distended with blood, which had separated into clot and serum, the former completely investing the heart. The blood effused amounted to nearly a pint. In the wall of the aorta is seen a minute aperture (through which the portion of the needle is passed), and near it are two other smaller wounds, only one of which appeared to have completely perforated the wall. They are just below the point where the pericardium is reflected, the opposite portion of which presented a corresponding aperture. No other injury could be detected.

When the vessel is of the second or third degree.

When an artery of the second or third degree, such as the femoral or brachial, is wounded, different results follow, according as it is completely or only partially divided.

Results following complete division.—When the edges of the wound are cleanly cut, repeated hæmorrhages rapidly terminating in death will ensue; but when the edges are uneven, ragged and torn, as in the evulsion of a limb by machinery or by a cannon-ball, the internal coat and sheath of the vessel become twisted coil-like, the middle and internal coats retract and contract, and clots form within the vessel and about the torn end. By these means the artery is securely closed, and hæmorrhage effectually prevented. A similar condition of the ends of the vessels prevents hæmorrhage from the umbilical cord after it has been gnawed through by animals in the separation of their

young. The further changes leading to permanent occlusion will be described later.

Results following partial division.—When the wound is at all large, and made transversely to the long axis of the vessel, hæmorrhage and death will rapidly ensue; but when the wound is small—a mere puncture—or parallel to the axis of the vessel, the wound may heal by adhesive inflammation. This adhesion may be permanent, or the cicatrix may yield to the pressure of the blood, so giving rise to one form of traumatic aneurysm.

Or, again, blood may be effused into the tissues around the artery, the wound in the integument and other soft tissues may heal, and the effused blood become encysted from condensation of the soft parts, so giving rise to a second form of traumatic aneurysm. The subsequent changes undergone by the effused blood and its containing cyst are similar to those which occur in spontaneous aneurysms.

A transverse wound of an artery assumes a lozenge-shape. This has been shown by Mr. Savory to depend upon the longitudinal tension in which an artery is normally placed, and not upon contraction of the muscular fibres, as he found that a transverse wound of an artery after death assumes the same shape.

When the vessel is of small size.

When a vessel of small size is completely divided it retracts and contracts within its sheath, and a clot forms within and also without on the roughened surface of the sheath. Thus the vessel is effectually but only temporarily closed; it becomes so permanently by the union of the internal and middle coats by adhesive inflammation and by the organization of the internal clot. The artery ultimately shrinks into a fibrous cord as far as the first collateral branch.

When the artery is completely divided in its continuity,

the distal as well as the proximal end is closed in this manner.

When a small artery is but partially divided, its ends are unable to retract and contract to their full extent, and repeated hæmorrhages ensue. Continued hæmorrhage from a partially divided vessel was common when bleeding was performed by puncturing the temporal artery; the hæmorrhage was generally stopped by completing the division of the artery.

II. WHEN THE VESSEL IS NOT LAID OPEN. (NON-PENETRATING WOUNDS.)

When the walls of a vessel are merely notched, but the interior of the vessel is not laid open, the wound may heal; or the uninjured coat or coats, may ulcerate and give way and hæmorrhage ensue; or, again, after healing has taken place the cicatrix may yield to the pressure of the blood, so giving rise to a traumatic aneurysm.

ARTERIO-VEINOUS ANEURYSM.

Under this head two forms of aneurysmal dilatation, resulting from a communication between an artery and a vein, are generally described—aneurysmal varix and varicose aneurysm. In both there is an aneurysmal dilatation of the vein produced by the entrance of arterial blood into it, but in the former the blood passes directly into the vein, in the latter indirectly into the vein through the sac of an aneurysm interposed between the artery and vein.

I. *Aneurysmal Varix.*

Aneurysmal varix may occur spontaneously, but it is usually the result of a penetrating wound implicating both artery and vein. It was common when venesection was practised. The external wound heals, the adjacent walls of the two vessels become adherent, and, the opening between them remaining patent, arterial blood is forcibly projected into the vein, causing its walls to become dilated

into a fusiform or sac-like swelling. The artery on the cardiac side becomes greatly dilated from the impediment to the circulation, whilst the distal portion generally becomes smaller in consequence of less blood passing through it.

1462.—Portion of a left petrous bone, with which are connected the left carotid arteries and other adjacent parts. The external carotid is large from its origin; and just after giving off its lingual branch it becomes thin-walled, much larger, and very tortuous. Its canal, from this point to its final division, is nearly half an inch in diameter and about two inches in length. At the upper part of this, its tortuous and dilated portion, there is an aperture of communication between the external carotid artery and the upper part of the internal jugular vein, the vessels being brought into unnatural proximity at one of the curves of the artery. The aperture (through which a bristle is passed) is oval and nearly two lines in its chief diameter.

On the wall of the vein, immediately opposite to this aperture, and about three-quarters of an inch below the jugular fossa, a brownish discoloration appears beneath the lining membrane; it is due to the rust of a wedge-shaped piece of iron there embedded. The piece of iron is exposed on the other side by laying open a cavity in which it lies, with all the surrounding tissues closely applied to it and blackened by its rust and little particles of soil.

The patient was a middle-aged man, and his death was independent of the injury here shown. The injury was received twelve years before death. The piece of iron, broken from the point of a pickaxe, penetrated through the side of the neck. Severe hæmorrhage ensued, but the wound healed without difficulty. A loud whizzing sound and strong vibration were always perceptible over the swelling produced by the dilated artery.

II. *Varicose Aneurysm.*

A varicose aneurysm may occur spontaneously from the opening of the sac of an ordinary aneurysm into a vein, or it may be the result of a penetrating wound implicating both artery and vein. In the latter case the external wound heals, whilst the soft parts between the artery and vein are converted into the sac of an aneurysm. The blood before reaching the vein has therefore to pass through the

aneurysm, and hence causes less dilatation of the vein than when the communication is direct. The artery is not necessarily dilated.

1463.—A spontaneous varicose aneurysm of the femoral artery and vein. The aneurysm is situated on the artery just before its passage through the adductor magnus. It is a small globular sac, formed by the dilatation of the whole circumference of the artery, and communicates directly with the femoral vein. The interior of the vein presents a rounded opening, with thin and smooth edges, about a quarter of an inch in diameter. Around this opening the vein is closely united to the aneurysm, and immediately below it the cavity of the vein is obliterated to the extent of half an inch. A ligature had been placed around the femoral artery about a week before death. The whole length of the artery is uniformly dilated to the size of an abdominal aorta, and its coats are very thin.

The patient was a man forty-seven years old. The most striking sign of the disease was a peculiar purring thrill, which was felt along the whole course of the femoral artery, both during its pulsations and in the intervals between them, but which could be stopped by pressure on the varicose aneurysm. Long-continued pressure on this part produced, it was believed, the obliteration of the vein about six months before the patient's death. (The specimen is on the bottom shelf.)

1490.—The arch of an aorta, exhibiting an aneurysm which has opened into the vena cava superior. The vein is adherent to the exterior of the sac, and there is an aperture of communication between them. The vein and the sides of the sac immediately around the aperture are so attenuated as to be transparent.

RUPTURE OF ARTERIES.

When an artery yields to pressure from within or to force from without, and there is no accompanying wound of the integuments, the artery is said to be ruptured.

Rupture due to force from within, *i.e.*, from increase of blood-pressure, occasionally happens as a consequence of over-exertion, palpitation, etc.; but in these cases there is generally some pre-existing disease of the arterial walls.

Rupture by force from without may be due to a blow or sprain, or to the over-exertion of a limb; it may occur in

cases of severe fracture, or during the process of reducing old dislocations, or the breaking down of adhesions in cases of stiff joints.

1377b.—Part of an aorta, showing the transverse rent one inch in length immediately below the origin of the innominate artery, and just below the reflexion of the pericardium. The vessel is atheromatous, and the surrounding tissues blood-stained. The pericardium and sheath have been stripped up by the blood along several inches of the vessel. From an old man who was dead when brought to the hospital. He had been run over by a heavy cart.

1382.—An external iliac artery torn completely across. The rupture is transverse, and occurred in an injury by which the lower part of the femur was fractured.

1387.—Portions of a popliteal artery and vein. The artery was completely torn across by a wheel passing over the limb.

The results of the rupture of an artery will depend upon whether the rupture is partial or complete.

When the rupture is partial, i.e., when the internal and middle coats alone are ruptured, the external may gradually yield to the pressure of the blood and become the sac of a false aneurysm, or the internal and middle coats may retract and fold into the interior of the vessel, obliterating its calibre and so possibly producing gangrene of the limb.

When the rupture is complete, i.e., when all the coats are torn through, blood is extravasated into the tissues of the limb. If the artery is of large size, the extravasation may occur to an enormous extent, tearing up the tissues and ultimately producing gangrene by pressure upon the collateral bloodvessels (*diffused traumatic aneurysm*).

1383.—Portion of a brachial artery, which was torn straight across by external violence.

The patient, a gentleman sixty-nine years old, fell with his arm stretched out. At first he seemed little injured, but pulsation was lost in the radial and ulnar arteries. In a few hours the arm became enormously swollen and livid, and amputation near the shoulder was performed. The brachial artery sloughed after being tied during the amputation.

When the artery is of smaller size, and the force of the

blood pressure consequently less, the extravasated blood may become encysted by inflammation and condensation of the tissues around (*circumscribed traumatic aneurysm*).

1461.—A popliteal artery, with a circumscribed traumatic aneurysm. There appears to have been a complete rupture of the whole circumference of the artery, so that the sac is formed entirely by the surrounding cellular tissues. Above and below the aneurysm the artery appears to be healthy; its coats terminate abruptly at the boundaries of the sac. The sac is almost filled by laminated coagulum. The popliteal vein is pervious, but flattened by the pressure of the sac.

Under some circumstances, however, the artery retracts and contracts within its sheath, but little hæmorrhage occurs, an internal and external clot form, and permanent occlusion is accomplished, as already described.

1382.—An external iliac artery, torn completely and straight across. The torn ends of the artery are an inch apart, and are connected by a coagulum of blood. The coats of the artery are not obviously diseased. The rupture was directly under Poupart's ligament.

1387.—Portions of a popliteal artery and vein. The artery was completely torn across by a wheel passing over the limb, and its divided extremities are separated to a distance of nearly half an inch. They are widely open. In the upper part of the artery a coagulum is formed, which almost fills its cavity; in the lower part there are only some irregularly shaped portions of fibrin.

EFFECTS OF THE APPLICATION OF A LIGATURE.

I. TO THE DIVIDED END OF AN ARTERY IN AN OPEN WOUND.

When a ligature is properly applied, the internal and middle coats are evenly and transversely cut through by its pressure, their cut edges retract and incurve within the canal of the vessel, and the external coat, crumpled up and tightly embraced by the ligature, retains the two inner coats in contact with each other. A clot of blood of conical shape forms in the vessel from the seat of ligature to the

first collateral branch above, and becomes adherent by its base to the walls of the vessel. The cut ends of the internal and middle coats unite by adhesive inflammation. If an aseptic ligature is used it becomes encysted or absorbed, or possibly organized, otherwise the external coat, where it is embraced by the ligature, ulcerates and sloughs, and the ligature comes away, generally bringing with it the end of the artery round which it was tied. Finally, the part of the artery between the seat of ligature and the first collateral branch above becomes converted, together with the clot in its interior, into a fibrous cord.

The above changes may now be studied in detail by the aid of specimens.

Division of the internal and middle coats.

1391.—A femoral artery, showing the effects of a ligature placed round it a few days before death. The ligature was applied at a little distance from the extremity of the artery, and it has divided the inner and middle coats. For two inches above the ligature the artery is filled by coagulum.

1392.—A femoral artery and vein. They were cut through in an amputation, and the artery was tied eleven hours before death. The preparation shows the division of the internal and middle coats of the artery by the ligature, and how their divided borders are retracted and incurved within the adjacent parts of the canal.

The even, smooth, and complete division of the internal and middle coats, so essential for successful union by adhesive inflammation, is best accomplished by a small round ligature. The effects of different kinds of ligature are seen in the following specimen.

1390.—Portion of an artery, exhibiting the division of its middle and internal coats by three different kinds of ligature, viz., the large round, the small round, and the flat ligature. The ligatures employed were composed of the same materials as those which are tied round the portion of artery by the side of that on which the experiment was made. The small round ligature, which is in the middle, made the cleanest and most complete division of the coats ;

the division by the flat ligature is uneven, incomplete, and attended by partial separation of the adjacent part of the divided coats.

The experiment was made on a dead artery.

Formation of clot.

A few hours after a vessel has been tied, a clot commonly forms at the seat of ligature, and gradually extends up the artery to the first collateral branch. When fully formed, it appears of a conical spiral shape, attached at its base to the walls of the vessel, but free and movable above. It is white below, but gradually assumes a red colour towards its apex.

Although the clot is generally ascribed to the coagulation of the blood, which is said to be stagnant in the portion of artery between the seat of ligature and the first collateral branch, it is by some attributed to the gradual deposition of fibrin from the blood, an explanation the more probable, as Mr. Callender has shown that the blood is not stagnant in the portion of an artery above the ligature, but, on the contrary, is agitated in an orderly manner, so that the fibrin is, as it were, churned out of the blood to form the coagulum. Upon this orderly movement of the blood is believed by Mr. Callender to depend the conical and spiral shape of the clot, its cessation at the first collateral branch where the churning movement ceases, and the white appearance which its base assumes from the first. The dark red colour of the upper portion of the clot is due to the coagulation of the blood upon the already deposited fibrin.

Although in the majority of cases a clot forms as just described, in some instances occlusion is accomplished without the formation of a clot.

1398.—The femoral artery from the body of a man, who died eleven days after amputation of the thigh. Its canal is much contracted and wrinkled transversely. By its side is suspended the clot which it contained. It was of a deep red colour above, but white below, and of an irregular and spiral shape.

1399.—Parts of a femoral artery and vein, from a stump. The

extremity of the artery is open ; but its canal is filled to some distance by a coagulum, which adhered firmly to its coats.

1402.—Parts of a femoral artery and vein, from a stump. The extremity of the artery is closed by a conical clot, which extends up the vessel to the origin of the nearest branch. The base of this clot is united to the extremity of the artery. The extremity of the vein is closed by a similar but smaller clot. The coats of the artery and vein are thickened and closely united to the surrounding parts.

Union of the internal and middle coats by adhesive inflammation.

1403.—Parts of a femoral artery and vein, from a stump. The extremity of the artery is closed by the adhesion of its sides, but there is no clot within it. The extremity of the vein is open.

1404.—Parts of a femoral artery and vein, from a stump. The extremities of both the artery and vein are closed, and intimately connected with the surrounding tissues. Both of them have coagula above their closed extremities.

Separation of the ligature.

The pressure of the ligature on the external coat gradually produces ulceration and sloughing of that coat, and the ligature cuts its way out, generally bringing with it the portion of artery around which it was applied. This description only refers to the arteries secured by silk ligatures, when the ends of the silk are left hanging out of the wound. When an aseptic ligature, such as catgut or kangaroo tendon, is applied, it becomes encysted, organized or absorbed, the external wound healing by first intention.

1417.—This silk ligature was used to tie the subclavian artery (in the third part of its course) of a man, aged fifty-four, for a large axillary aneurysm. It came away with the attached slough on the twentieth day after operation.

Conversion of the artery above the seat of ligature into a fibrous cord.

The process by which the artery and contained clot are converted into a fibrous cord is discussed in the section

“Adhesive Phlebitis,” under “Organization of the Clot” and “Changes in the Vessel Walls,”

There is no specimen in the Museum.

II. TO THE CONTINUITY OF AN ARTERY, AS IN THE HUNTERIAN OPERATION OF PROXIMAL LIGATURE FOR THE CURE OF ANEURYSM.

When a ligature is applied to an artery in its continuity, changes take place similar to those which occur when a ligature is applied to the cut end of a vessel; the external coat is embraced and crumpled by the ligature; the internal and middle coats are evenly divided, and retract and contract into the interior of the vessel; a conical clot is formed both above and below the seat of ligature, but the clot below the ligature is less firm than that above. The cut ends of the internal and middle coats unite by adhesive inflammation, and the clots filling the artery above and below the seat of ligature become organized. The ligature, if it is aseptic, becomes encysted, absorbed or organized, otherwise by its pressure it causes absorption of the external coat, and comes away. The vessel is, however, never completely divided, because as fast as its wall is absorbed on one side it is renewed by plastic inflammation on the other, so that after a time the spot where the ligature was formerly applied can no longer be recognised. The artery between the first collateral branch above and the first below the seat of ligature becomes converted, together with the clots, into a fibrous cord, the rest of the artery between the seat of ligature and the aneurysm remaining pervious. The aneurysm itself becomes ultimately converted into a small mass of condensed fibrous tissue.

Division of the internal and middle coats.

1389.—Part of the aorta of a dog, exhibiting the effects of a ligature applied twenty-four hours before death. The inner and middle coats are partially divided, and above the seat of the

ligature is a conical coagulum, which appears laminated, and is loosely attached to the walls of the artery.

Formation and organization of clots.

After the formation of the clot, and probably as a result of the injury inflicted upon the coats of the vessel by its division, a traumatic inflammation is set up. Leucocytes and serum escape from the vasa vasorum of the divided middle coat, and they gradually permeate the clot. The clot then gradually loses its red colour and undergoes absorption. New vessels grow out from the vasa vasorum, and invade the inflammatory exudation which has replaced the clot. As a result of these changes the clot becomes intimately blended with the arterial walls, forming a plug of vascular granulation tissue. The granulation tissue is next converted into fibrous tissue, which gradually contracts and obliterates the newly formed vessels, until the clot and the artery are converted into a firm fibrous cord.

1397.—The iliac arteries of a man whose external iliac was tied four days before his death. The ligature was applied just above the orifice of the epigastric branch of the artery. Above this place, where now a constriction appears, the whole canal of the artery, to the origin of the iliac, is filled with a firm cylindrical blood-clot. Beyond the place of ligature a smaller conical clot extends for nearly an inch along the continued trunk of the artery.

1395.—The right common carotid artery of a man tied five days before death. It shows a long conical clot, commencing from the ligature on the lower portion.

Conversion of the artery near the ligature, and of the aneurysm into fibrous cords.

1551a.—The iliac and femoral arteries, from a case in which the femoral artery had been ligatured in its continuity in Scarpa's triangle. The operation was performed six years and nine months before death, and effected the cure of a popliteal aneurysm. The site of the ligature is apparent just above the second black bristle, and from this point to the first bristle is a clot which is decolorized.

Immediately above the aneurysm is another clot which has not yet become decolorized. The aneurysm itself has become converted into dense fibrous tissue. The vessel is throughout calcareous. It is patent between the seat of ligature and the cured aneurysm. From a railway porter. Aneurysm of ten months' duration. It was very large, filling the whole popliteal space so as to bulge out upon the inner side of the thigh. The leg was cedematous, the veins being varicose. Esmarch's bandage and digital pressure having failed to effect a cure, the superficial femoral artery was tied with a carbolyzed silk ligature. Death resulted from pneumonia.

1551b.—The iliac, femoral, and popliteal arteries, from a patient whose superficial femoral was ligatured for the cure of popliteal aneurysm six years before his death. At the seat of the ligature the vessel has become converted for a short distance into a fibrous cord. Between the point of ligature and the origin of the anastomotica magna, however, the femoral artery is pervious and apparently healthy. It gives off several small branches. The aneurysm is converted into dense fibrous tissue. Below the aneurysm the popliteal is patent. From a labourer, aged forty-nine, who had syphilis eighteen years previously. The aneurysm was only noticed three weeks prior to admission, although he had suffered pain in his knee for two years. An Esmarch's bandage affording no relief, the artery was tied in two places with a catgut ligature, and divided. Pulsation returned five months later, but the aneurysm was eventually cured by flexion. Death resulted from rupture of an intra-pericardial aortic aneurysm.

1551c.—The iliac, common femoral, and popliteal arteries, from a case in which the femoral had been ligatured in Scarpa's triangle twenty years before the death of the patient, for the cure of a popliteal aneurysm. The operation was performed by Mr. Stanley, late surgeon to the hospital. The artery has unfortunately been divided close to the seat of ligature, but it has been sewn together again with silk. For an inch and three-quarters from this point it has become converted into a solid fibrous cord, which is slightly smaller than the rest of the vessel. Between the point of ligature and the remains of the aneurysm the artery is pervious and gives off several large vessels, but its lumen is partially occluded by a thin membranous blood-clot. The aneurysm itself is converted into a dense mass of fibrous tissue. From a man aged fifty, who died from the rupture of an aneurysm of the aorta. See also Nos. 1407 and 1408.

Establishment of the collateral circulation.

After the main artery is obliterated the blood finds its way to the parts below by means of the enlarging anastomoses between the branches given off from the artery above and below the seat of obstruction. Specimens of collateral circulation after ligature of the principal arteries follow.

Case D. 1409.—A thorax, with the principal arteries injected, from a man in whom the left subclavian artery was tied on the first rib, six years before death. The circulation was maintained chiefly through the enlargement of the supra-scapular and infra-scapular arteries.

Case D. 1410.—A fore-arm, exhibiting the anastomosis and enlargement of arteries consequent on division of the radial a little above the wrist. The principal anastomosis is effected by a large artery passing from the interosseous at the lower edge of the pronator quadratus muscle across the front of the radius, to the radial artery, about half an inch beyond the point of its division.

Case D. 1411.—A limb in which the femoral artery was tied in the middle of the thigh eleven years before death for the cure of a popliteal aneurysm. The portion of artery obliterated by the ligature is about two inches in length, and extends to the origin of the profunda. Below this obliteration the artery was found open, but contracted to its entrance into the ham, where the aneurysm was situated. The injection of the vessels displays the collateral branches by which the circulation was continued ; these are situated chiefly at the back of the thigh and close upon the femur.

FAILURE OF ONE OR MORE OF THE NORMAL PROCESSES THAT OCCUR AFTER THE APPLICATION OF A LIGATURE.

When, from some of the causes to be presently illustrated, one or more of the normal processes fail, secondary hæmorrhage or gangrene may ensue.

I. Failure of formation of the clot.

Under some circumstances, as we have seen, although no clot forms in the artery above the seat of ligature, the end of the vessel still becomes closed by adhesive inflammation.

Usually, however, when the formation of a clot fails, the force of the blood, unbroken by the presence of a clot, falls on the uniting end, and prevents the closure of the artery. The common cause of this non-formation of a clot is the too close proximity of the ligature to a collateral branch, springing from the artery above the seat of ligature, *i.e.*, nearer the heart.

1512.—The arch of an aorta, with the left subclavian and axillary arteries. The left axillary artery is the seat of an aneurysm, for the cure of which the subclavian artery has been tied. The upper part of the preparation consists of the left subclavian artery and the arch of the aorta. By tracing the subclavian artery downwards, the situation where it has been tied will be recognised. On the side of the ligature nearest to the heart, the artery is pervious and of its ordinary size to its extremity, which was closed by only a small coagulum. Between this coagulum and the sides of the vessel is an aperture into which a bristle is passed; through it blood had passed from the artery to the wound. At a short distance above the situation of the ligature several large branches arise. The portion of artery between the situation of the ligature and the aneurysmal sac is completely closed by coagulum. The aneurysmal sac also is in great part filled by laminated coagulum; its exterior is firmly attached to three of the ribs which have undergone partial absorption. Below the sac is the remaining part of the axillary, with the commencement of the brachial artery. The axillary artery from the point of its connection with the sac is quite pervious, and a large branch arises from it which divides into the sub-scapular and circumflex arteries. The axillary vein is connected with the sac, and is pervious. The coats of the subclavian artery above the situation of the ligature were so brittle that they yielded to the slightest force.

The patient was a man thirty-eight years old. The aneurysm appeared to have existed four months, and was first observed six months after an attack of acute rheumatism. He died after repeated hæmorrhages, on the thirteenth day from the application of the ligature.

II. *Failure of adhesion of the internal and middle coats.*

When the internal and middle coats fail to unite, the internal clot of itself is unable to resist the force of the

blood, and may consequently yield when the ligature, if it be of silk, separates. A common cause of this non-adhesion is a diseased condition of the coats of the artery, such as atheroma, calcareous degeneration, etc. Another cause is the uneven division of the coats from the faulty application of the ligature, or the use of an improper one.

1401.—The popliteal, tibial, and peroneal arteries of a man, aged sixty-five, a drunkard, who died after amputation through the lower third of the left leg for compound dislocation of the foot.

The arteries are throughout extensively diseased. The posterior tibial at the operation was cut through by the ligature, a second ligature including surrounding muscle being employed. The vessels were filled throughout with firm clots, that in the peroneal being less perfectly formed and lighter in colour than the others. See also No. 1400.

1413.—A femoral artery from a stump. Its coats are thickened, and earthy matter is abundantly deposited in them. In consequence of the occurrence of hæmorrhage after the amputation, a second ligature was placed around the artery, about two inches above its extremity. This ligature had separated before death, and a piece of whalebone is passed into the aperture through which it was withdrawn. The cavity of the artery, above and below the situation of this ligature, is filled by clots of blood, which extend to a considerable distance up the vessel. The cut end of the artery is open.

III. *Failure of establishment of the collateral circulation.*

When from some cause or other the collateral circulation after the application of a ligature to a main artery fails to become established, gangrene of the limb below the seat of obliteration will ensue.

There are no specimens in the Museum illustrating the failure of the establishment of the collateral circulation after the application of a ligature to an artery.

TUMOURS OF ARTERIES.

Arteries, like other tissues, may become infiltrated with new growths. Under such conditions they soften, and may ulcerate.

1445a.—Portions of an artery infiltrated by sarcoma. The upper specimen is a part of the axillary artery free from the infiltration; its lower extremity is discoloured and jagged from the action of the pressure-forceps applied to arrest hæmorrhage. The two lower specimens are portions of the acromio-thoracic axis surrounded by and infiltrated with sarcomatous growth. The vessels, with the exception of the one into which the bristle is passed, are plugged with a firm clot.

From a man aged thirty-three, who was admitted into the hospital with a large tumour beneath the pectoral muscles. The mass was soft, and manifestly increased in size during the fortnight the patient was under observation. An attempt was made to remove the growth by a free incision along the lower margin of the pectoralis major, where it presented through the fat of the axilla a well-defined outline. That part of the tumour which lay below the vessels was easily removed, but no attempt was made to detach the portion which was found, during the operation, to have grown round those structures. Whilst securing some insignificant arteries, which had been divided in the lower part of the axilla, the hæmorrhage, which up to that stage had been but slight, began to be exceedingly copious. In searching for the seat of the bleeding, it became evident that it proceeded from where the axillary artery should have been, though that vessel could nowhere be found. The hæmorrhage was afterwards arrested by means of pressure-forceps. The patient lived a week after the operation, when there was suddenly a violent gush of blood, and before it could be arrested he died. Post-mortem examination showed that the part of the axillary artery involved in the tumour was completely destroyed.

Sections are preserved in **Series lv., No. 64b.**

ARTERITIS.

Arteritis or inflammation of the arteries may be acute or chronic.

ACUTE ARTERITIS.

Two forms of acute arteritis are recognised ; *Acute traumatic arteritis* and *suppurative arteritis*. The former variety occurs as a simple or plastic inflammation whenever an artery has been divided. It is, therefore, found in all stumps of amputated limbs (Nos. 1402, 1403, and 1404) which are healing by first intention, or by granulation. It also results from the presence in an artery of a non-infective thrombus. Septic, infective, or suppurative arteritis is the result of the extension of suppurative or infective inflammation to an artery, or of the presence of a septic or infective embolus lodged in it by the blood-stream, the embolus being brought from a distant organ, such as the heart, in cases of ulcerative endocarditis.

In the aorta acute simple arteritis sometimes seems to occur spontaneously, whilst the suppurative forms may spread from the endocardium in cases of ulcerative endocarditis.

1442.—A femoral artery and vein, which were exposed and partly destroyed in the progress of a phagedænic ulcer. The coats of the artery, to the extent of about an inch, are completely disorganized, and two small ragged openings are visible in this portion of the vessel. Above this part of the artery, a circular indentation may be perceived in its walls, which was occasioned by a ligature placed around it in consequence of hæmorrhage from the openings just mentioned. A portion of the vein is obliterated, and its cavity below the obliterated part is filled by a clot of blood.

The disease extended from the labia of a woman, and had destroyed a large portion of the perineum before it reached the groin. See also Nos. 1443, 1444 and 1460b (details of the latter specimen are given on p. 310).

1467.—Parts of a heart and aorta, exhibiting a transverse rent extending round the whole circumference of the inner and middle coats of the aorta, about half an inch above the valves. The torn coats are soft, but in other respects they appear healthy.

The patient was a man about twenty-five years old. He had delicate health, but was not supposed to have any disease of the

heart. He was suddenly seized, while walking, with pain in the chest and faintness, and quickly died.

CHRONIC ARTERITIS OR ATHEROMA.

The condition of the arteries, long known as atheroma or atheromatous degeneration, is here called chronic arteritis, as microscopical research has shown that it primarily depends upon a chronic inflammation of the deeper layers of the intima. The disease in its early stages is characterized by grayish white, slightly elevated patches upon the inner surface of the vessel ; these were formerly thought to be exudations of lymph from the vasa vasorum upon the free surface of the lining membrane, and more recently to be deposits of fibrin from the blood itself. That neither of these theories is correct, but that the patches are due to an infiltration of round cells into the deeper layers of the intima, is clearly demonstrated by sections, when the internal layers of the intima (those next the blood) are seen to pass uninterruptedly over the patches, from which they can be readily stripped off. A similar exudation of cells, but to a smaller extent, also takes place into the middle and external coats of the artery.

[1547.—The arch of an aorta, with the subclavian and carotid arteries. The deeper layers of the internal coat of the aorta are infiltrated with inflammatory products ; the innermost layers are slightly elevated, but appear otherwise unaffected.

SECONDARY CHANGES IN CHRONIC ARTERITIS.

The inflammatory material in the deeper layers of the intima may undergo fatty, calcareous, or fibroid degeneration.

Fatty degeneration.

This is a common change in chronic arteritis. The inflammatory material in the deeper layers of the intima softens into a fatty caseating mass, so that the atheromatous

patches, which were formerly gray, now appear yellowish-white. These collections, which consist of cholesterin and fat in a fine state of subdivision, are sometimes spoken of as *atheromatous abscesses*. When the superficial layers, which separate the fatty material from the blood, have given way, and the contents of the abscesses have passed into the blood stream, the depressions left behind are known as *atheromatous ulcers*.

1425.—An aorta, exhibiting atheromatous abscesses graduating into atheromatous ulcers. There are deposits of a soft and earthy substance in the thickened tissue of the vessel. See also No. 1426.

Calcareous degeneration.

Calcareous, like fatty degeneration, is a common change in chronic arteritis. The inflammatory material becomes infiltrated with earthy salts at once, or after first undergoing the fatty change already described. In either case calcareous plates of various sizes and shapes are produced, often converting the artery into a rigid tube. This secondary calcification is readily distinguished from the primary calcareous degeneration to which arteries are liable by the irregular distribution of the plates, and by the fact that they are situated in the internal coat of the artery, and do not therefore conform to that circular arrangement of the muscle in the middle coat which is so conspicuous a feature in the primary form.

1420.—Portion of an abdominal aorta, with large nodular and granular masses of calcareous matter apparently attached to its internal surface. Around these deposits the internal coat is thickened and opaque, and the bases of some of them are fixed on thin circular plates of earthy matter.

1447.—The arch of an aorta, with the carotid and subclavian arteries. Earthy and soft matter is seen in their coats.

1486.—The arch of an aorta, with a very large aneurysm projecting through the front of the chest walls. There are thin scattered plates of fatty and calcareous matter in many parts of its coats.

Fibroid degeneration.

This degeneration is less common than the two preceding varieties. It consists in the conversion of the inflammatory material into fibrous tissue, and is characterized by a general thickening and induration of the arterial walls. According to some authors this change is the result of syphilis.

SYPHILITIC ENDARTERITIS.

Syphilitic arteritis is a form of chronic inflammation in which there is very great thickening of the internal coat. It is most common in the cerebral vessels and in the neighbourhood of gummata, but there is reason to suppose that it is frequently a predisposing cause of aneurysm. The thickening of the internal coat is due to an extensive infiltration of small round cells, which develop into spindle cells, and subsequently into an imperfect form of fibrous tissue. The outer coat of the artery is often affected in the same way as the tunica intima, whilst the middle coat escapes. The disease is very chronic, and may terminate in thrombosis. The microscopical appearances presented by an artery in syphilitic endarteritis are well seen in the following preparation :

Histological series. 64c.—A transverse section through a cerebral artery. The internal coat has been thickened to three or four times its normal size, owing to the formation of new fibrous tissue in its deeper layers. As a result of this thickening the lumen of the vessel is very greatly narrowed, and has become occluded by a thrombus. The unstained fenestrated coat of Henle marks the limit of the internal coat. The middle coat is normal, but the outer coat is infiltrated by an exudation of leucocytes.

RESULTS OF CHRONIC ARTERITIS.

Among the results of chronic arteritis may be enumerated rupture, general or aneurysmal dilatation, thrombosis, embolism, and gangrene of parts supplied by the vessel.

Rupture.

1464 is probably a specimen of rupture from chronic arteritis.

Dilatation.

1. *General dilatation.* — 1421. — Portion of an abdominal aorta dilated, and exhibiting large masses of earthy matter on its internal surface.

1449. — A subclavian and axillary artery. The coats of the artery, especially the inner coat, are atheromatous; and its cavity is uniformly dilated.

1446. — The arch and thoracic portion of an aorta uniformly dilated. The coats of the artery are generally thickened and indurated.

2. *Partial dilatation (aneurysms).* — For specimens of partial dilatation, see "Aneurysm," p. 313.

Thrombosis.

Thrombosis, after chronic arteritis, is induced by the inequality and roughness of the internal surface of the artery, caused by the presence of the atheromatous ulcer or calcareous plates.

1561. — A portion of the right femoral artery of the patient from whom No. 1332 was taken. A few days before death he complained of acute pain and numbness in the right thigh. The temperature of the limb was at the same time considerably reduced. The artery is laid open to show a firm fibrinous plug filling up and obstructing the canal. The clot presented in different parts some slight variations in consistence and colour. The wall of the artery exhibited in some spots traces of atheromatous degeneration.

1571. — A femoral artery and vein. The femoral artery in its whole extent is rigid from calcareous degeneration of its coats. Its cavity is filled with a solid, firm, and partially laminated coagulum. The man from whom it was taken died of gangrene of the leg.

This plugging of the vessels of the lower extremities is a frequent cause of gangrene.

Embolism.

Embolism is another result of chronic arteritis. The emboli are composed of small portions of the broken-down

fatty material which, after the internal coat covering the atheromatous patch has given way, become exposed to the current of blood, and are carried away and impacted in smaller vessels. The impaction of an embolus in an artery is a frequent cause of gangrene of the part which the vessel supplies. It is also a cause of aneurysm, especially of the smaller arteries, the artery becoming dilated and, if the embolus be septic, ulcerated, immediately behind the obstruction.

1460b.—The arteries of the lower extremities of a girl who had multiple emboli followed by the formation of aneurysms. The right common iliac artery near its seat of bifurcation contains a calcareous embolus, which is kept in place by a loop of white silk. The arterial wall immediately round the embolus is ulcerated, thinned, and expanded. The greater part of the external iliac and the upper part of the femoral is occluded by recent clot, which resulted from the ligature of the common femoral artery in Scarpa's triangle shortly before death. The right femoral and popliteal arteries are patent and apparently healthy, but the posterior tibial opens by a small ulcerated aperture, through which a blue glass rod has been passed, into a large false aneurysm of the calf, which is formed by the condensation of the soft tissues of the organized blood-clot.

The left external iliac artery presents an aneurysmal dilatation, which is apparently of recent date. Lower down, both this artery and the common femoral are entirely occluded by calcareous matter and by old decolorized clot.

From a girl, aged twenty, who was admitted into St. Bartholomew's Hospital suffering from aneurysmal swellings at the bend of the right elbow and in the right popliteal space, respectively of three and four weeks' duration. The heart was diseased and the aneurysms were considered to be of embolic origin. After treatment by rest and pressure, which at first appeared to be beneficial, the swelling in the arm rapidly increased, in such a manner as to render it probable that the aneurysm was becoming diffused. On this account the brachial artery was tied above the bend of the elbow, the vessel being secured by two ligatures and divided between them. The operation was followed by cessation of pulsation and slight diminution in the size of the aneurysm. Within a few days the popliteal swelling also began to extend; the super-

ficial femoral artery was therefore tied in Scarpa's triangle in the same way as the brachial, and with equally good results.

Six weeks after admission the patient had a sudden attack of left hemiplegia, with pain in the right thigh and leg, followed by complete loss of pulsation in all the arteries of the right lower extremity. The aneurysmal swellings gave no further trouble, and slowly decreased in size. The patient became weaker, and died eight weeks after admission. A post-mortem examination showed that the aorta at one spot was almost completely ulcerated through. The spleen and kidneys were scarred by the lodgment of emboli. [The specimen is on the bottom shelf.]

Gangrene.

Gangrene is a frequent result of atheroma. How gangrene may be induced by thrombosis or embolism, has already been described. Gangrene may, however, occur without any clotting, simply from the rigidity of the walls of the vessels, which renders them unable to adapt themselves to the varying demands of the part they supply.

1571d.—The heart and arteries of the right upper extremity, from a case of dry gangrene following upon embolism of the subclavian and brachial vessels. The heart is greatly enlarged, and is very fatty. Its mitral orifice is so dilated as to admit of the passage of four fingers through it, and the valves are rigid, calcareous, and fringed with lymph. The aortic valves are slightly atheromatous, and the aorta is somewhat larger than normal. The innominate and right subclavian vessels are patent, but at the spot where the subscapular branch is given off from the axillary artery to the origin of the circumflex vessels the main vessel is completely occluded by an embolus. The clot is decolorized; it is very firm, and is adherent to the walls of the artery. The brachial artery appears to be normal as far as its bifurcation, but it is then occluded by an embolus, and by a firm adherent clot which extends for about half an inch into the radial and ulnar arteries. The hand had undergone dry gangrene, and was mummified for about three inches above the wrist.

From a man aged sixty-three. Whilst rubbing some butter into his shoe with his right hand, six weeks before his death, he suddenly felt a pain in the situation of the carpo-metacarpal joint

of the thumb. A small black spot appeared in this situation, and his hand soon became blue and numb.

The hand is preserved in **Series 1, No. 3235d.** See also **No. 1571 e.** and **1571 f.**

PRIMARY CALCAREOUS DEGENERATION.

Primary calcareous degeneration must be carefully distinguished from the secondary calcareous change, which, as we have already seen, may occur in atheroma. The primary disease begins in the muscular layer of the middle coat; the secondary in the deeper layers of the intima. The primary chiefly affects the smaller vessels, where muscular tissue is most abundant; the secondary the larger arteries, especially the aorta, where the elastic tissue predominates. In the primary the earthy matter is deposited in the muscular fibres of the middle coat in the form of a number of small rings; in the secondary it is deposited in the inflammatory new material, and assumes the form of irregular bony plates. The primary is essentially a disease of old age; the secondary of the middle periods of life, as well as of old age.

In the disease now under consideration the earthy matter is first deposited around the nuclei of the muscular fibres, but sooner or later it involves the greater part of the muscular coat. It is most common in the arteries of the lower extremities, especially in the tibials. It is a frequent cause of senile gangrene.

1434.—A femoral artery, the coats of which are made completely rigid by deposits of earthy substance. The deposits form a nearly uniform tube, in which, however, traces of an annular arrangement may be observed.

1435.—The femoral, tibial, and peroneal arteries, in the coats of which there is an abundant deposit of earthy matter. In some positions the earthy matter occupies the whole circumference of the vessel. Its general arrangement is in narrow rings.

From an aged man, in whom mortification of the toes spontaneously occurred. See also **Nos. 1436, 1437, and 1438.**

PRIMARY FATTY DEGENERATION.

Fatty, like calcareous degeneration, occurs as a primary change as well as secondary to chronic arteritis. As a primary change, it begins in the endothelial lining of the arteries, to which it is usually confined, though in rare instances it may spread more deeply. It occurs in yellowish-white patches, slightly projecting into the interior of the vessel. These patches can be readily stripped off from the deeper layers, which, when thus exposed, are found to be healthy, whereas in chronic arteritis it is the deeper layers themselves which are the seat of the disease.

Although primary fatty degeneration generally affects the endothelial lining, it may occur in the case of the smaller arteries in the adventitia, or, in rare instances, in the middle coat.

1473.—The commencement of an aorta, exhibiting atheroma and fatty degeneration of the internal coat. See also No. 1466.

ANEURYSM.

An aneurysm has been defined as a tumour containing blood and communicating with the interior of an artery.

STRUCTURE OF AN ANEURYSM.

An aneurysm consists of a sac and its contents (No. 1486).

The sac.

The sac may be formed by the dilatation of the whole circumference of a portion of an artery, and may therefore consist of all three coats (*fusiform aneurysm* or *aneurysmal dilatation*: No. 1485). The sac may be formed by the dilatation of part only of the circumference of an artery (*sacculated aneurysm*), in which case it may consist of all the coats (*true sacculated aneurysm*: No. 1499), or of one coat only (*false sacculated aneurysm*: No. 1454). In the latter instance it is nearly always the external coat which

becomes dilated, the internal and middle having given way. A rare form, where the internal coat is protruded through a rupture of the external and middle coats (the so-called hernia of the internal coat), is said by some to occur. Again, the sac may be formed by the condensation of the surrounding soft parts, into which the blood has been extravasated in consequence of the rupture of all the coats of a vessel or of the sac of a previously-formed aneurysm (*consecutive or diffused sacculated aneurysm*: Nos. 1461 and 1484).

Or, again, the sac may be formed of the coats of the artery separated by blood which has been effused between them (*dissecting aneurysm*: No. 1456).

In the case of *aneurysmal varix* (a so-called form of aneurysm in which blood escapes from an artery into the cavity of a vein), the sac, if such can be said to exist, consists of a dilatation of a portion of a vein (No. 1462).

The walls of the sac are generally thickened, atheromatous, and more or less blended with the tissues around.

1454.—An aneurysm of the arch of the aorta. The sac is formed by the external coat alone.

1484.—An aneurysm of the aorta. The sac is formed in part by the dilated aorta, and in part by the condensed tissues around.

1485.—An aneurysm of the arch of the aorta. The sac is formed by the dilatation of the whole circumference of the aorta.

1499.—An aneurysm of the arch of the aorta. The sac is formed by a partial dilatation of the artery, with integrity of all the coats.

1456.—Aneurysm of the abdominal aorta. The sac is formed by the separation of the walls of the aorta.

1532a.—The abdominal aorta, showing an aneurysm situated an inch above its bifurcation. The aneurysm is sacculated, and measures two and a half inches in length by one inch in breadth. It is filled to the level of the vessel with firm clot. The iliac vessels are very atheromatous and calcareous.

1461.—Aneurysm of the popliteal artery. The sac is formed entirely by the surrounding cellular tissue.

From a man aged eighty-seven, who was admitted for an injury to the left hip.

The contents of the sac.

When an aneurysm is first formed, the sac contains only fluid blood, or after death an ordinary blood clot; fibrin, however, is gradually deposited from the blood in concentric layers upon the internal surface of the sac, so that after an aneurysm has existed some time the contents are partly solid laminated fibrin and partly fluid blood. The laminated fibrin next the wall of the sac is firm, dry, and of a yellowish-white colour, but gradually becomes softer, moister, and reddish towards the centre of the sac, while that next the fluid blood which still remains near the mouth of the sac merely resembles ordinary blood clot, and is probably the result of post-mortem coagulation. As will be seen under the head of spontaneous cure, this deposition of fibrin may continue until the whole sac is filled. In those instances in which an aneurysm becomes solid in a few hours (the result of treatment or otherwise) it is probable that the greater part of the material filling the sac is merely blood coagulum, as in such instances the time would probably be too short for fibrin to be deposited. The subsequent stages in the organization of such a clot probably do not materially differ from those observed in the organization of clots in other situations. In fusiform aneurysms, in which there is but little retardation of the blood stream, deposits of laminated fibrin do not, as a rule, form, unless there be much roughening of the walls from atheroma, and even then the deposits are but scanty.

1450.—A fusiform aneurysm of the ascending aorta. Over some of the roughened atheromatous patches, seen on the internal surface of the sac, fibrin had been deposited and projected thread-like into the cavity of the sac. The fibrin was readily detached; it merely clung to the surface.

1455.—Portion of an aneurysmal sac, showing the laminated arrangement of the coagulum contained in it. See also Nos. 1454, 1486 and 1552a.

1485.—A fusiform aneurysm of the arch of the aorta.—The sac contains no clot.

THE PROCESS OF FORMATION OF AN ANEURYSM.

The process of formation of an aneurysm will be explained under the head of *Varieties of Aneurysm*.

METHODS OF SPONTANEOUS CURE OF AN ANEURYSM.

I. *By the deposit of laminated coagulum from the blood in the interior of the sac.*

Specimens showing the deposit of laminated fibrin have already been seen. After the whole sac has been filled with such deposit, condensation and shrinking of the sac and its contents take place, and a little fresh blood passes in between the successive layers of clot which have thus shrunk one from another. The aneurysm eventually becomes converted into a small nodular mass. Under such circumstances the artery may remain pervious, or it may be converted into a fibrous cord as far as the first collateral branches above and below the seat of the aneurysm.

Such a favourable termination may be brought about by retardation of the blood-current induced:—1, by the lowering of the heart's action; 2, by the pressure of the aneurysm on the artery above its opening into the sac; 3, by the partial blocking-up of the mouth of the sac by a portion of coagulum; 4, by the impaction of a clot in the artery below the mouth of the sac; 5, by the pressure of another aneurysm or of some other tumour upon the artery above the mouth of the sac; 6, by the aneurysm becoming diffused, the extravasated blood causing compression of the artery leading to the aneurysm.

1548.—Sections of an aneurysmal sac which was situated on the abdominal aorta, immediately below the superior mesenteric artery. The sac is completely filled by firm laminated clot. See also No. 1532a.

1454.—Sections of an aneurysm of the arch of the aorta. The sac is nearly filled with laminated clot.

1486.—An aneurysm which has been spontaneously cured. The sac is filled with laminated clot.

The cure was brought about by the simple lowering of the heart's action and consequently of the force of the circulation through the sac—the result of rest in bed and low diet (Tufnell's method). The patient died of pleurisy four years after the cessation of pulsation in the aneurysm. The heart was small and flabby, the walls of both ventricles were of scarcely half their normal thickness. See also Nos. 1508 and 1583.

1547.—The remains of an aneurysm of the right subclavian artery, which has been spontaneously cured.

On each side of the aneurysm the artery is contracted and completely closed.

II. *By the coagulation of blood in the sac.*

The coagulation of blood in the sac—the *passive clot*, as it is sometimes called, in contradistinction to the *active clot* (a name sometimes applied to the coagulum produced by the gradual deposition of laminated fibrin)—may be brought about by the total cessation of the blood-current through the sac, induced (1) by the complete blocking-up of the mouth of the sac by a portion of detached fibrin, or by (2) the complete plugging of the artery above or below the aneurysm. The clot under favourable circumstances becomes organized and converted, like clots in other situations, into fibrous tissue.

1510.—An aneurysm of the right common carotid and commencement of the internal and external carotid arteries. The sac is filled by a firm coagulum. This specimen well illustrates how an aneurysm may be cured by the clotting of the blood in the sac consequent upon the complete arrest of the circulation through the artery. In this case, however, the arrest of blood did not occur spontaneously, but in consequence of the application of a ligature to the artery.

1542.—An aneurysm of the popliteal artery. The artery below the aneurysm was filled by a moderately firm plug, which was continuous with a firm decolorized clot in the mouth of the sac. The centre of the sac was full of dark coagulum (which has been washed out), but the walls were lined by laminated fibrin, that in the upper part being firm and tough, but that in the lower portion was softer and almost diffuent. See also Nos. 1538a and 1551a.

III. *By inflammation and suppuration of the sac.*

The sac may become inflamed, and may afterwards suppurate and slough away, hæmorrhage being prevented by the formation of clots in the ends of the vessel, as in the separation of the slough in ordinary gangrene. Such a favourable termination is rare; more often fatal hæmorrhage supervenes on the separation of the slough.

No specimen.

FATAL TERMINATIONS.

An aneurysm may terminate fatally—from rupture of the sac; from pressure upon important parts; from inflammation and suppuration of the sac; from gangrene caused by the obstruction to the circulation in consequence of the large size of the aneurysm, or of the plugging of a large vessel by a portion of detached coagulum; or from general constitutional disturbance.

From rupture of the sac.

Rupture of the sac, although here enumerated as one of the fatal terminations, is not in every case fatal, for, as we have seen, it may sometimes lead to a spontaneous cure, and in accessible aneurysms death, after rupture of the sac, may sometimes be averted by operative proceedings.

The manner in which the rupture occurs, and the various ways in which it proves fatal, differ according as the aneurysm opens into a serous cavity, into a mucous canal, into the cavity of a joint, upon a cutaneous surface, or into the substance of the tissues.

(A.) *Into a serous cavity.*—The rupture in these cases is usually by a rent or fissure, and for the most part occurs suddenly.

Into the pericardium. 1478.—An aorta with an aneurysm of the first portion of the arch, which has burst into the pericardium. From a patient forty years old, who, while apparently in good health, died suddenly after a full meal. The pericardium was found distended with blood.

Death under such circumstances is caused by the impediment to the heart's action from the effused blood rather than by loss of blood.

Into the pleura. 1484.—A heart with an aneurysm extending from the commencement to the termination of the arch of the aorta. There is a small fissure on the side of the sac near its upper part, through which the blood escaped into the pleura.

In such a case death is usually the result of the actual loss of blood.

(B.) *Into a mucous canal.*—When an aneurysm opens into a mucous canal, it is generally by a small round ulcerated orifice. Death may occur at once, or only after repeated hæmorrhages.

Into the trachea. 1493.—The arch of an aorta, with an aneurysm at its upper and posterior part. The sac has first compressed and subsequently burst into the trachea.

Into the œsophagus. 1495.—The arch of an aorta from which an aneurysm of the posterior wall has burst by a large ulcerated aperture into the œsophagus. See also No. 1504.

Into the trachea and œsophagus. 1494.—The arch of an aorta with a large aneurysm. The sac has burst by two irregular apertures into the trachea and œsophagus.

Into a bronchus. 1499.—The arch of an aorta, with a small aneurysm rising from its termination, which has burst into the left bronchus.

Into the duodenum. 1531.—An aneurysm of the abdominal aorta, which has burst by a small, round, and ulcerated opening into the duodenum.

(C.) *Upon a cutaneous surface.*—Rupture upon a cutaneous surface is generally accomplished by sloughing of the integuments covering the sac. Death occurs only after repeated hæmorrhages, as the slough has at first a tendency to block up the aperture.

1539.—The iliac and femoral arteries, with an aneurysm at the commencement of the femoral. Upon its lower part a portion of the skin is left, with the aperture through which it burst externally.

1487a.—The heart and aorta, with a portion of the thoracic wall, showing the seat of an aneurysm and the manner in which it has ruptured through the chest wall. The heart is healthy, but the aorta is much dilated and is atheromatous. The aneurysm extends from the transverse part of the arch downwards and forwards to the thorax, where it opens by a large aperture through the sternum and right costal cartilages on a level with the fifth costal interspace. The skin for some distance round the actual point of rupture is thickened and discoloured. The aneurysmal sac is large and free from clot ; its walls are thickened to a considerable extent.

From a married woman, aged forty-two, who first noticed a swelling at the right side of the sternum eleven months before her death. On raising the right arm she had aphonia. The tumour, which measured during life two and a half inches in diameter, had a well-marked expansile pulsation. The patient suffered much from dyspnœa and cough. A cast of the case is preserved in **Series lvi., No. 98a**, and a drawing in **Series lvii. No. 105a**. See also **Nos. 1487 and 1487b**.

Into an artery.

(D.) 1485.—The arch of an aorta generally and almost uniformly dilated into a large aneurysmal sac, which burst into the pulmonary artery. See also **Nos. 1476, 1477**.

Into the substance of the tissues.

(E.) There is no specimen in the Museum.

Into a joint.

(F.) There is no specimen in the Museum.

EFFECTS OF PRESSURE.

As an aneurysm increases in size it gives rise to important symptoms, in consequence of the pressure which it exerts upon the tissues around ; these symptoms serve as a valuable guide to the diagnosis and prognosis of the disease.

These effects of pressure, as far as they are illustrated in the Museum, will be discussed under the following heads :

Upon the bones and cartilages.

The bones and cartilages become eroded, and in the case of the sternum and ribs frequently perforated.

Upon the vertebræ. 1504.—The arch of an aorta, with an aneurysm of the third part. The pressure of the aneurysm has caused absorption of the bodies of several of the vertebræ. It may be noted that the intervertebral cartilages are but little affected, as is usual in these cases. See also Nos. 15, 16, and Case E., No. 17.

Upon the sternum and costal cartilages. 1488.—An aneurysm which has caused absorption of part of the sternum and costal cartilages, and has projected through the aperture thus formed in the thoracic walls. See also Nos. 17a, 1486, 1496 and Case E., 17b.

1532.—Part of an abdominal aorta with a large aneurysm, which has extended from its posterior wall backwards through the vertebræ and ribs, and forms a large sac external to the chest by the side of the spine. See also Nos. 1487, 1487a and 1487b.

Upon blood-vessels.

Pressure upon the veins frequently leads to the formation of clots in their interior, and consequently to œdema of the parts from which they return the venous blood, to dilatation of the superficial veins, or, in the case of accessible aneurysms, where the arterial supply is also interfered with, to gangrene of the limb.

It has already been seen how the pressure of an aneurysm upon an artery, either above or below the mouth of the sac, may lead to the spontaneous cure of the aneurysm.

1459.—A femoral artery, the seat of aneurysm. The femoral vein to the extent of two inches is obliterated by the pressure of the aneurysm.

1478.—An aorta, with an aneurysm of the first part of the arch compressing the pulmonary artery. See also No. 1512a.

Upon nerves.

The pressure of an aneurysm upon nerves is often productive of severe pain, and frequently seriously interferes with the functions of the parts which the nerves supply. A good illustration of this is the alteration or loss of voice from paralysis of the muscles of the larynx, in consequence of the pressure of an aneurysm upon the recurrent laryngeal nerve.

1506.—The arch of an aorta with its branches, with an aneurysm of the arteria innominata. The pneumogastric trunk and its recurrent branch are closely adherent to the exterior of the aneurysmal sac; and the former was much compressed between it and the clavicle.

1510.—An aneurysm of the right common carotid artery. Portions of the pneumogastric and sympathetic nerves are flattened and compressed by the aneurysm.

Upon the trachea, bronchi, and lungs.

Pressure on these important structures may give rise to dyspnœa, cough, or other symptoms of pulmonary irritation.

1507.—An aneurysm of the arteria innominata, pressing upon the trachea. For a fortnight before death the patient was subject to paroxysms of dyspnœa, in one of which she died.

1483.—An aneurysm of the aorta and innominate artery pressing upon the trachea. The pressure upon the trachea gave rise to symptoms of asthma. The symptoms increased to such a degree that the trachea was opened to prevent suffocation, which seemed to be imminent.

1487.—Part of an aorta with an aneurysm at the commencement of the arch. The sac in its progress towards the sternum has extended on each side into the lungs.

Upon the œsophagus and thoracic duct.

Pressure upon the œsophagus or thoracic duct is occasionally fatal, in the one case from the inability to swallow food, and in the other from the obstruction to the passage of the chyle into the blood.

1504.—A large aneurysm of the thoracic aorta compressing the œsophagus.

EFFECTS OF TREATMENT.

By rest and low diet (Tufnell's method).

1486.—The arch of an aorta, with a very large aneurysm projecting through the front of the chest. With the exception of a small part immediately adjacent to its mouth, the whole cavity of the aneurysm appears filled with tough, and for the most part firmly compacted, layers of decolorized blood-clot.

The patient, a publican, aged forty-seven, had suffered for a year with well-marked symptoms of aneurysm of the aorta. He kept his bed and took only small quantities of light food, but the swelling, dyspnœa, venous congestion, and other distresses, still increased. At the end of a few months the disease apparently ceased to make progress; the external swelling did not enlarge, it slowly became firmer, and its pulsations diminished in force, until they were scarcely perceptible. The patient during this time became pale, emaciated, and very feeble, needing better diet and stimulants. He had kept his bed for six months, but now moved about in a chair. Improvement still continuing, the tumour became, at length, pulseless, hard, and incompressible. In this state he lived for more than two years, when, after exposure to excitement and less prudent living, he died of an empyema.

By ligature of the artery leading to the aneurysm.

1512.—An aneurysm of the axillary artery, for the cure of which the subclavian artery has been tied. The portion of artery between the situation of the ligature and the aneurysmal sac is completely closed by coagulum. The aneurysmal sac is also in great part filled by laminated clot. The axillary artery from the point of its connection with the sac is quite pervious. See also No. 1512a.

1539.—An aneurysm at the commencement of the femoral artery, for the cure of which the external iliac was tied fifty-five hours before death.

1406.—An aneurysm of the popliteal artery, for the cure of which the femoral was tied three weeks before death. See also No. 1551.

1407.—A popliteal aneurysm, for the cure of which the femoral artery was tied eighteen months before death. The aneurysm was diminishing at the time of the patient's death. The femoral artery is completely obliterated from the situation of the ligature to the origin of the profunda, and in part is converted into a fibrous cord. Below the obliterated part of the artery a rust-coloured clot of blood extends for half an inch, and is continued as a thin fibrinous layer lining the whole length of the rest of the artery down to the aneurysmal sac. The sac and its mouth are completely filled with dry laminated coagulum.

1551a.—The iliac and femoral arteries, from a case in which the femoral artery had been ligatured in its continuity in Scarpa's triangle. The operation was performed six years and nine months before death, and effected the cure of a popliteal aneurysm. The

site of the ligature is apparent just above the second black bristle, and from this point to the first bristle is a clot which is decolorized. Immediately above the aneurysm is another clot which has not yet become decolorized. The aneurysm itself has become converted into dense fibrous tissue. The vessel is throughout calcareous. It is patent between the seat of ligature and the cured aneurysm. From a railway porter in whom the aneurysm was of ten months' duration. It was very large, filling the whole popliteal space so as to bulge out upon the inner side of the thigh. The leg was oedematous, the veins being varicose. Esmarch's bandage and digital pressure having failed to effect a cure, the superficial femoral artery was tied with a carbolized silk ligature. Death resulted from pneumonia. See also 1551b.

By pressure upon the artery leading to the aneurysm.

1541.—Aneurysm of the left femoral artery, which was treated by the method of compression. On passing a stream of water, under slight pressure, into the artery from above, none appeared to escape from the lower end; and it was evident, on further examination of the clot contained in the aneurysm, that it was sufficiently firm to have prevented the current of blood flowing through it.

By flexion of the affected limb.

1552.—Aneurysm of the popliteal artery filled with recent laminated fibrin. The aneurysm had been treated by flexion of the patient's limb upon the trunk, and all pulsation in the sac ceased. Four hours after the limb had been returned to the horizontal posture, symptoms, supposed to be those of gangrene, made their appearance, and amputation through the thigh was performed. The patient made a good recovery.

VARIETIES OF ANEURYSMS.

The various aneurysms contained in the Museum may be classified as follows:

I. SPONTANEOUS ANEURYSMS.

A. Fusiform.

B. Sacculated.

(i.) True.

(ii.) False.

(iii.) Consecutive or Diffused.

- c. Dissecting.
- d. Cirroid.
- e. Arterio-venous.
 - (i.) Aneurysmal varix.
 - (ii.) Varicose aneurysm.
- f. Arterial varix.
- g. Aneurysm by anastomosis.

II. TRAUMATIC ANEURYSM.

- A. Traumatic, or circumscribed traumatic, aneurysm.
- B. Diffused traumatic aneurysm or ruptured artery.

These so-called traumatic aneurysms are described under "Injuries of the Arteries" (page 289).

(A) FUSIFORM ANEURYSM, OR ANEURYSMAL DILATATION.

A fusiform aneurysm is a dilatation of the whole circumference of a portion of an artery. The sac, therefore, consists of all three arterial coats, and its cavity is continuous with the lumen of the artery at each end. The dilated portion of the artery is also elongated, a fact well shown in fusiform aneurysm of the arch of the aorta, where the three primary branches given off from the convexity of the arch are much further apart than is natural.

Fusiform aneurysms are of an elongated, fusiform, or cylindrical shape; they often attain a large size, are usually chronic, and after they have existed some time frequently become sacculated from the unequal yielding of their walls. They seldom contain any laminated fibrin, as the circulation through them is not, as a rule, sufficiently retarded to allow of its deposition. The walls of the sac are sometimes thinned, but they are more often thickened and highly atheromatous.

The favourite seats of these aneurysms are on the arteries that contain much yellow elastic tissue, hence they are most

often met with on the aorta and its primary branches, and on the contiguous portions of the iliac and femoral arteries.

1485.—The arch of the aorta generally and almost uniformly dilated into a large aneurysmal sac. The interior of the sac is very unevenly tuberculated ; it contains no coagulum.

1507.—An aneurysm of the innominate artery. The sac appears to be formed by dilatation of the whole circumference of a part of the artery, and contains laminated coagulum.

1452a.—A fusiform aneurysm of the axillary artery. The subclavian had been tied in the third part of its course shortly before death. The axillary artery is not often dilated into an aneurysm of this variety. See also 1511a.

1453.—A fusiform aneurysm of the popliteal artery—an uncommon situation for this variety of aneurysm.

1539a.—A fusiform aneurysm of the common femoral artery.

(B) SACCULATED ANEURYSMS.

A sacculated aneurysm is one in which dilatation occurs in part of the circumference of an artery. It may consist of all three coats ; but much more frequently the internal and middle coats give way, and it is formed of only the external coat, or after it has existed for some time, chiefly of condensed cellular tissue which surrounds it. If all three coats are present, the aneurysm was formerly spoken of as *true*, whilst if one or more had given way, it was known as *false*. As, however, it is only the smallest aneurysms that can consist of all three coats (No. 1536), the true aneurysm could hardly ever be said to occur, and all sacculated aneurysms were then called false—the absurdity of which is self-evident. As these aneurysms increase in size, the sac comes to consist almost entirely of the tissues around. Whilst they are still enclosed by one of the coats of the artery, they are sometimes called *circumscribed* ; and after all the coats have given way, *consecutive* or “diffused.” As the term “diffused,” however, is sometimes applied to a leaking or ruptured aneurysm, it had better be discontinued. Nearly all aneurysms when they have

existed for some time are of the consecutive variety, and usually contain a considerable amount of laminated fibrin.

1. *True sacculated aneurysm.* *Of the arch of the aorta (common seat).* 1473.—The commencement of an aorta, with part of the pulmonary artery and of the right and left ventricles. A true aneurysm projects from the aorta into the right ventricle, and two others are seen in different stages of formation.

1476.—The arch of an aorta, with its great branches and the pulmonary artery. The whole of the arch is somewhat dilated. A small aneurysmal pouch involving all the coats extends from the aorta just above the right semilunar valve.

1499.—The arch of an aorta, with a small aneurysm arising from its termination.

Of the abdominal aorta. 1457.—A true aneurysm springing from the posterior wall of the abdominal aorta. The internal coat of the artery appears continuous throughout the aneurysm.

Of the renal artery. 1536.—True aneurysm of the renal artery.

2. *False sacculated aneurysm.* 1454.—A false aneurysm of the second portion of the arch of an aorta. The abrupt ending of the internal and middle coats at the mouth of the sac is well seen.

1548.—Sections of a false aneurysm of the upper part of the abdominal aorta. The abrupt ending of the internal and middle coats of the vessel at the mouth of the sac is well seen.

It was formerly taught that another variety of false aneurysm, the so-called hernia of the internal coat, might arise in consequence of rupture of the external and middle coats and the protrusion of the internal coat in the form of a pouch through the rent. The occurrence of such a variety is now doubted.

There is no specimen in the Museum.

3. *Consecutive or diffused aneurysm.* 1460b.—The arteries of the lower extremities of a girl who had multiple emboli followed by the formation of aneurysms. The right common iliac artery near its seat of bifurcation contains a calcareous embolus, which is kept in place by a loop of white silk. The arterial wall immediately round the embolus is ulcerated, thinned, and expanded. The greater part of the external iliac and the upper part of the femoral is occluded by recent clot, which resulted from the ligature of the common femoral artery in Scarpa's triangle shortly before death.

The right femoral and popliteal arteries are patent and apparently healthy, but the posterior tibial opens by a small ulcerated aperture, through which a blue glass rod has been passed, into a large false aneurysm of the calf, which is formed by the condensation of the soft tissues of the organized blood-clot.

1461.—A popliteal artery with consecutive aneurysm. There appears to have been a complete rupture of all the coats of the artery, so that the sac is formed of condensed cellular tissue. The coats of the artery terminate abruptly at the boundaries of the sac.

1484.—A consecutive aneurysm of the arch of the aorta. The sac is of immense size. The lower part is formed by the dilated aorta, but at its upper part its walls are formed by condensed cellular tissue, the original walls of the sac having given way in this situation. See also 1460c and 1539a.

(C) DISSECTING ANEURYSM.

A dissecting aneurysm is one in which the internal coat of the artery has given way, and blood has been forced between the layers of the middle coat for a variable distance parallel to the course of the artery. It is most frequent in the arch and thoracic portion of the aorta. Three forms are described :

1. That in which the blood, after travelling a variable distance between the layers of the middle coat in the course of the artery, escapes into the tissues around the vessel, in consequence of the giving way of the external coat and the outer layers of the middle coat.

1464.—Part of the heart with the aorta. A transverse rent extends through the inner coat and innermost layers of the middle coat. Blood has been forced through the rent, and has thence extended and separated the layers of the middle coat through a large portion of the arch and thoracic portion of the aorta. The external coat, at a spot not shown in the preparation, has given way, and the pericardium was found distended with about two pints of blood.

The patient was a woman, aged forty-five, who, as she was carrying two pails of water, suddenly fell down and almost instantly expired. See also No. 1467.

2. That in which the blood, after travelling some distance in the course of the artery between the layers of the middle coat, has again made its way into the interior of the artery in consequence of the yielding of the internal coat and the innermost layers of the middle coat.

No specimen.

3. That in which the blood has made its way a variable distance between the layers of the middle coat in the course of the vessel, but has escaped neither externally nor internally.

1465.—The base of a heart, with the arch and thoracic portion of the aorta. About half an inch above the valves there is a rent extending through the inner coat and innermost layers of the middle coat of the aorta. The blood passing through it has extended between the layers of the middle coat through the whole length and greater part of the circumference of the aorta, separating them and tearing across the intercostal and other small arteries. Some of the blood, coagulated, remains in the channel which it has formed for itself between the coats of the artery.

1466.—The abdominal aorta of the same patient, showing the further separation of its coats by the effused blood. See also No. 1466a.

(D) CIRROID ANEURYSM.

“Cirroid aneurysm” is the name given to a pulsatile tumour composed of several lengthened, dilated, and pouched arteries.

There is no specimen in the Museum.

(E) ARTERIO-VEINUS ANEURYSMS.

Aneurysmal varix and varicose aneurysm have been considered under the heading of “Wounds and Injuries of Arteries” (pages 290-292).

(F) ARTERIAL VARIX.

Arterial varix is a dilated, tortuous, and irregularly pouched condition of an artery, similar to that of a varicose vein.

There is no specimen in the Museum.

(G) ANEURYSM BY ANASTOMOSIS.

Aneurysm by anastomosis is a localized dilatation of arteries, veins, and capillaries. It occurs chiefly in connection with the vessels of the scalp, and is often congenital.

3345.—The pinna of an ear affected with aneurysm by anastomosis. The outline of the dilated and tortuous vessels is seen on the upper margin and posterior surface. Part of the external surface is rough from superficial ulceration. A microscopic section of the ear shows large tortuous vessels with thin walls giving off capillaries of nearly uniform size, which anastomose and form a close and more or less irregular network.

INJURIES AND DISEASES OF THE VEINS.

WOUNDS.

Extensive wounds of the large veins are fatal, but, owing to the decreased blood pressure in these channels, less immediately so than wounds of arteries. Indeed, cases are reported of patients surviving several hours after rupture of the subclavian vein, and even after rupture of the vena cava superior.

Punctured or incised wounds, when small and parallel to the long axis, even of large veins, readily heal; a clot of blood forms within the wound and projects slightly into the lumen of the vessel, while externally it overhangs the walls of the vein around the wound. The clot becomes organized and converted into fibrous tissue, leaving a distinct cicatrix in the walls of the vein. In the majority of cases healing thus takes place without obliteration of the lumen of the vein; in other instances, however, successive layers of fibrin are deposited upon the clot projecting into the interior of the vein, so as completely to fill the vessel. Under the latter circumstances the clot may become organized and converted, together with the vein in which it is contained, into a fibrous cord, or it may break down into pus (*sup-*

purative phlebitis). Occasionally the lips of the wound, when kept in apposition, unite by adhesive inflammation without the interposition of a clot. Such a result was often noticed after venesection, no trace of the wound being visible even on the smooth lining membrane.

When a vein is completely cut across, as in amputation, a clot forms, extending from the divided end to the next collateral branch above, and, becoming organized, leads to occlusion of the vein, as already described. When a vein is completely cut across in an incised or other wound, a clot forms in the lower as well as in the upper end, occluding the vein in a similar manner.

After the application of a ligature healing occurs in a vein in the same manner as in an artery. It is no longer believed that the application of a ligature induces suppurative phlebitis. When the edges of a small wound in the continuity of a vein are secured by a ligature (a method of arresting hæmorrhage frequently resorted to by surgeons in preference to tying the whole circumference of the vessel), healing takes place without obliteration of the lumen of the vein.

1379.—A posterior tibial artery and vein, which were wounded a few days before death. The wound is transverse, and extends through only one side of each vessel. The clot of blood seen in the preparation was found adhering to both vessels. The regularly circumscribed cavity in it was exactly over the division of their coats.

1404.—Parts of a femoral artery and vein from a stump. The extremities of the artery and vein are closed. Both of them have coagula above their closed extremities.

1607.—Portion of a vena cava inferior, in which there is a transverse lacerated aperture, about two inches above the iliac veins.

THROMBOSIS.

Thrombosis is the clotting of blood in a vein, the resulting clot being called a *thrombus*. It may be due to changes in the vein wall ; to changes in the blood ; to the presence of

micro-organisms ; to the retardation or arrest of the blood-stream, as a result of ligature or pressure on the vessel ; or to the presence of a foreign body in the vein. Thrombosis is not necessarily due, therefore, to inflammation of the vein-wall, although it is usually associated with it. When a thrombus has been formed, it generally extends in the direction of the blood current, though it is sometimes found to pass in the opposite direction. The appearance of a thrombus varies according to the conditions under which it is formed. If the blood was not circulating, as after ligature of a vein, the clot fills the entire lumen of the vessel, is of the same colour throughout, and is but loosely attached to the vein-wall. If, on the other hand, the blood be in motion, the thrombus is laminated and firmly adherent to the vein-wall. It is white if it has been formed very slowly, red if it has been produced more rapidly. A post-mortem clot in a vein does not adhere to the wall of the vessel, and does not as a rule fill its entire lumen. It is never laminated.

Specimens of thrombosis will be found under the head of "Adhesive Phlebitis" (page 334).

PHLEBITIS.

Two conditions of the veins, the one characterized by the formation of clots in their interior, the other by the presence of pus within and around them, have long been described and have received the names of adhesive and suppurative phlebitis respectively, on the supposition that both were dependent upon inflammation beginning in the walls of the veins themselves.

SIMPLE ADHESIVE OR PLASTIC PHLEBITIS.

This disease is a local inflammation beginning in the internal and middle coats of the veins. The walls become infiltrated with leucocytes, and a clot subsequently forms in the vein when it is said to occur idiopathically (No. 1596). The disease usually commences in the smaller veins, and

extends from them into the larger ones. Simple phlebitis may be the result of injury to the vein-walls ; of simple inflammation of the surrounding tissues ; of the formation of a non-infective thrombus in the vein ; of gout ; or of certain ill-understood constitutional conditions, in which clotting is very prone to occur. The latter class of cases are grouped together as "*idiopathic*." These various causes are considered in detail below.

1587.—Four specimens, showing certain changes in veins. The two upper represent (*a*) an external circumflex vein occupied by a pale, fawn-coloured coagulum, which shows a spiral arrangement of the fibrin which forms it ; (*b*) the femoral vein of a dog, part of which, included between two ligatures, had been punctured during life, the blood which it contained removed, and two small pieces of lead introduced. Twenty-four hours after the operation the vein was examined and was found to be surrounded by a quantity of lymph, a considerable amount of which had entered the vein through the puncture, distending the vessel as seen in the preparation.

The two lower represent : (*a*) part of the femoral vein of a dog upon which an experiment was performed resembling the preceding, but the upper ligature was shifted so as to cut off the portion of a vein in which the bits of lead were included from communication through the puncture in its walls with the outer wound. The portion of vein (thus isolated) is laid open, showing an unaltered condition of its lining membrane twenty-four hours after the operation. Its canal was free from exudation material, and the bits of lead lay in simple contact with the vein-wall.

(*b*) Part of the femoral vein of a dog, into which a small piece of lead had been introduced, suspended from a thread, as seen in the preparation. The blood was then allowed to flow through the vessel for twenty-four hours, at the end of which time the lining membrane of the vein retained its natural appearance.

Causes of the clotting.

A predisposition to clotting is induced by weakened cardiac power and slowing of the circulation, such as occur in exhaustion following upon acute and chronic diseases ; and possibly by excess of the fibrin-forming elements in the blood. Clotting is common in patients dying of phthisis or

cancer, and, as pointed out by Sir James Paget, in persons of marked gouty constitutions, or with gouty inheritance.

The exciting causes of the clotting may be enumerated as :

1. *Pressure*.—Pressure upon a vein is a frequent cause of thrombosis. When the pressure is sufficient to completely obliterate the vein-channel a clot forms above and below the seat of obstruction, as after the application of a ligature (No. 1608a) ; but when the pressure is slight and only partially obstructs the flow of blood the coagula are more extensive, and generally occur in the veins *below* the narrowed portion (where the blood stream is retarded).

1459.—A femoral artery, the seat of aneurysm. The femoral vein, to the extent of two inches, is obliterated by the pressure of the aneurysm. Below the obliterated part the vein is laid open to show the clots of fibrin filling its cavity. See also Nos. 1539 and 1544.

1556.—Parts of an abdominal aorta and of the vena cava inferior. Both vessels are embedded in a mass of enlarged lymphatic glands. The vena cava, to the extent of three inches above the iliac veins, is completely filled with concentric layers of fibrin, which are adherent to its inner surface.

1595.—A portion of the common iliac and of the external and internal iliac veins of a man aged thirty-five. Five weeks before his death he was admitted into the hospital with phlegmonous erysipelas of the right leg and thigh. Profuse suppuration occurred, and he appeared to be rapidly recovering, when pneumonia suddenly supervened, and he died ten days afterwards. Four days before his death the left leg and thigh became œdematous. The portions of the vein in the preparation are completely filled up by large clots, which extended to the level of Poupart's ligament. The clots were firm and partly decolorized. Similar clots filled up the neighbouring smaller veins. The clot in the femoral vein below Poupart's ligament was in great measure disintegrated.

1600.—Part of an external saphenous vein, obliterated by clots in consequence of slight pressure produced by a cancerous growth involving the lower part of the femur.

2. *Inflammatory changes of the tissues around the inflamed vein*.—Inflammation, ulceration, and gangrene of the tissues

surrounding a vein, in consequence of the alteration they produce in the vein-walls, are frequently causes of thrombosis.

1443.—A femoral artery and vein, which were exposed and partly destroyed in the progress of a phagedænic ulcer. A portion of the vein is obliterated, and its cavity below the obliterated part is filled by a clot of blood. The disease extended from the labia of a woman, and destroyed a large portion of the perineum before it reached the groin.

1571.—A femoral artery and vein, from a man in whom, in advanced life, gangrene of the leg spontaneously arose several months before death, and extended high up the leg. The coats of the femoral vein are thickened and portions of it are filled by a firm coagulum.

1594.—A right common iliac vein, with the termination of the left and of the right internal and external iliacs, containing coagula. From a man who died with chronic inflammation of the contents of the pelvis.

3. *Wounds of the veins.*—Thrombosis is a frequent result of wounds, lacerations, and bruises of veins. As illustrations may be mentioned the coagula found in the veins after amputation, or occasionally after venesection, in the veins about the seat of severe compound fracture, or, again, in the veins of the pelvis and lower extremities after parturition, where they occur in consequence of the laceration of the vessels in the separation of the placenta.

1402.—Parts of a femoral artery and vein from a stump. The extremity of the vein is closed by a conical clot, similar but smaller than that in the artery. The coats of the artery and vein are thickened and closely united to the surrounding parts.

1593.—The left common iliac, the external iliac, part of the femoral, and of the adjacent veins, irregularly distended, and their canal completely obliterated by firm clots, from a woman who suffered from much obscure pain about the pelvis and groin after a protracted labour.

1596.—A femoral vein, from the junction of the profunda to an inch above the canal of Hunter, occupied by a conical clot. The tissues around are extensively ecchymosed, and all the smaller veins

are filled by fibrinous clots, apparently of older date than that which fills the femoral.

From the body of a feeble old man, who died three weeks after sustaining a fracture of the neck of the left femur. The muscles and other tissues of the upper part of the thigh were the seat of extreme ecchymoses.

1597.—A preparation, in many respects similar to No. 1596. The clot which fills the femoral vein is tough, firm, and decolorized. The vessel is surrounded below by some ecchymosed tissues, and here the small venous branches are occluded by old clots, continuous with the large one seen in the femoral.

From a man, aged seventy-three, who died from bronchitis eleven days after sustaining a fracture of the left femur at its great trochanter. There was much ecchymosis of all the parts around, especially in the vicinity of the femoral vessels. The leg and foot were slightly œdematous.

1598.—Part of a femoral vein where it is joined by the profunda. The latter vessel is obstructed with firm clots, which extend up into the femoral, forming in its interior an irregular mass of a pale colour. The coagula in the profunda were traced to a considerable ecchymosis, which involved the structures about a fracture of the right femur, more especially in the inner and posterior aspect of the thigh. The entire extremity was œdematous. The fracture, which had occurred ten weeks prior to the patient's death, was still ununited.

The patient was a man, aged forty-two, who died from an attack of continued fever.

4. *Growths into veins.*—Growths invading the lumen of a vein, by destroying the smoothness of the lining membrane, induce coagulation, and may even occlude the vessel by their presence.

1555.—The base of a heart, with the large vessels, the trachea, and the bronchial glands. The whole of the bronchial glands are converted into one large mass of cancer, which surrounds and compresses the pulmonary arteries and veins and the vena cava superior. Both the venæ innominatæ are also pressed upon by the upper part of the diseased mass. The vena cava superior is so much compressed that its canal would scarcely admit more than the bristle which is passed through it. At the junction of the venæ innominatæ the cancerous structure appears to have made its way into

the cavity of the vein. Near the junction of the right subclavian and internal jugular veins, beneath the valve, there is a small growth from the interior of the vein, the structure of which appears to resemble that of the large tumour. See also No. 1592 and page 345.

5. *Inflammation of the walls of veins.*—In rare instances the clotting may be the result of inflammation in the deeper layers of the intima (*i.e.* those next the middle coat), though never of the lining membrane, as formerly taught. This inflammatory change has some resemblance to the inflammatory condition called atheroma, already described as occurring in the arteries.

There is no specimen in the Museum.

6. *The application of a ligature to a vein.*—After the application of a ligature, a clot forms in the vein as far as the next collateral branch, and, in the usual course of events, becomes organized, and is ultimately converted, together with the portion of vein in which it is contained, into a fibrous cord.

1585.—Part of the femoral vein of a dog, which was killed ninety-six hours after the injection of twenty drops of pus. The ligature has separated, and the vein is obliterated where it has been tied. Its internal coat presents a natural aspect.

1586 —A similar specimen, in which three ligatures were applied to the vein. They have separated, and the portion of vessel included between the ligatures is destroyed.

1608a.—The left kidney and a portion of the left lobe of the liver, from a case in which the right kidney had been removed. A ligature has been passed round the right renal vessels at the point where the right renal vein opens into the inferior vena cava. A portion of the inferior vena cava has been included in the ligature. A thrombus fills the entire vena cava.

7. *Without apparent exciting cause.* 1599.—A femoral vein from a man aged forty-two. It is filled with blood, which coagulated in it a few days before death. The same condition was presented by all the veins of both arms and legs. The patient's illness, which was ascribed to phlebitis, began three weeks before death.

Extension of the clot.

The clot, when it is once formed, may extend either with or against the blood stream; as a rule, it follows the former direction, extending from the smaller to the larger veins, till in extreme cases it may even reach the heart.

Against the stream. 1594.—A right common iliac vein, with the termination of the left and of the right internal and external iliacs. They are opened on their posterior surface so as to expose the coagula within. One of these occupies the external iliac, and was thence continued into the femoral. It is firm and contracted, being everywhere in contact with the shrunken vein-wall, the outer coat of which, and the surrounding tissues, are thickened. This coagulum ends at the junction of the internal iliac, above which is a larger clot. From a man who died with chronic inflammation of the contents of the pelvis.

With the stream. 1596.—A femoral vein, from the junction of the profunda to an inch above the canal of Hunter. Its lumen is occupied by a conical clot, which retains the colour and the appearance noticed in its recent state. The clot clung, but did not adhere, to the lining of the vein, and was further retained in its position by its connection with other clots, which filled all the communicating branches.

The tissues around were extensively ecchymosed, and all the smaller veins were filled by fibrinous clots, more or less decolorized, and apparently of older date than that which fills the femoral.

1593.—The left common iliac, the external iliac, part of the femoral, and of the adjacent veins, completely obliterated by firm clots, clinging, not adhering, to the inner coats of the vessels. Traced from below, these clots are arranged in successive layers fitting cup-like one upon the other, and terminating above in a pointed extremity. The veins opening into the main trunks are to some extent obliterated by coagula continuous with those already described. Both sides were equally affected. From a woman who suffered from much obscure pain about the pelvis and groins after a protracted labour.

Appearances of the thrombus.

The appearance of the clot depends upon its age, its situation, and the manner in which it has been formed.

When recent the clot is red and gelatinous, and but slightly adherent to the vein-walls, but after it has existed some time it loses its red colour, and becomes firmer and shrunken.

When suddenly formed it fills the whole vessel, and has a uniform consistence throughout ; when slowly formed it is laminated, and may or may not fill the vessel, according to the time it has been in process of formation ; this lamination is the result of the deposition of alternate layers of fibrin and white blood-corpuscles. When produced in a vessel round which a ligature has been applied near a collateral branch, the clot may be colourless from the first, and of a curious spiral shape—a result, according to Mr. Callender, of a churning movement of the blood, which he believes to take place in that portion of vein included between the ligature and the first collateral branch. The clot is usually of a conical shape, with either a pointed or a blunt extremity, according as it is formed within, or only projects into, a large vessel.

These appearances must be distinguished from those observed in clots which form after death. A post-mortem clot does not adhere to the walls of the vessel, nor does it, as a rule, entirely fill up the lumen ; it often consists of two layers, one white and one red, but is never laminated.

1590.—The primary branches of a portal vein. The one proceeding to the right lobe of the liver is occupied by a firm decolorized clot, which clings to the adjacent walls, but is not adherent to them. The wall is wrinkled transversely.

1593.—The clots in this preparation, traced upwards from below, are arranged in successive layers, fitting cup-like one upon the other, terminating above in a pointed extremity. This mode of termination is seen in the clot suspended separately, which was removed from the right common iliac vein.

1596.—A recent clot, of a conical shape, occupying the femoral vein. It terminates above where a large vein enters the femoral, and here its shape seems to have been influenced by the current of blood directed upon its surface.

1602.—Two coagula of blood, which were found attached to the

inside of one of the veins in **No. 1601**. The section of the left-hand coagulum shows that it consists of regularly arranged layers of fibrin. See also **No. 1556**.

Changes in the thrombus.

I. The thrombus or clot may become *organized* and converted, with that portion of vein in which it is contained, into a fibrous cord. It first loses its red colour, from the disappearance of the red corpuscles, becomes firmer and more adherent to the walls of the vessel, and finally appears like a cord of connective-tissue, indistinguishable from the walls of the vessel, which have undergone a similar change.

The minute changes occurring during this process are not thoroughly understood. It is certain, however, that at one period of its transformation the thrombus is abundantly permeated by bloodvessels, which communicate both with the interior of the vessel and with the vasa vasorum in its walls; the manner, however, in which they are formed is but imperfectly known. These vessels, after playing an important part in the organization of the clot, almost or entirely disappear, and the organized clot degenerates, as already stated, into fibrous tissue.

II. The thrombus may *soften* into a puriform fluid, disintegrate, and be in some cases carried away by the blood stream, leaving the vein natural or but little affected. Portions of the thrombus thus carried away by the blood may become impacted in the small bloodvessels of distant organs (*embolism*), giving rise, if septic, to metastatic abscesses (*pyæmia*), or other grave complications. If the emboli are aseptic, however, no such complications occur. In other cases the disintegrated clot, instead of being removed by the blood, may become, as it were, encysted, by the formation of fresh coagula above and below.

1594.—The interior of the clot in this specimen is softened and diffuent, forming a puriform mass, separated from the circulation by a thin shell of fibrin shown in the preparation.

1602.—Two coagula of blood. The lower coagulum is enclosed

in three distinct cysts, of which the outer two are membranous, and the inner consists chiefly of bone.

III. The thrombus may *shrink* to one side or be tunnelled through its centre by the blood.

1591.—Part of a superior mesenteric vein, the canal of which is occupied by a decolorized clot. By the side of this a narrow channel existed, and allowed of the passage of fluid blood. In the centre of the coagulum is a small cavity; its walls were stained of a pink colour. It contained some clear serum.

IV. *Calcareous changes* in the thrombus sometimes occur, leading to the formation of phleboliths, or vein stones. These are generally of concentric structure, and consist of albuminous material, impregnated with the salts of the blood, especially the phosphates and carbonate of lime. In some instances slender branching pieces of bone have been found in the veins; these are likewise in all probability examples of further organization of old clots.

Series liv., No. 300.—A collection of phleboliths, or calculi from veins. Most of them are spherical; some are oval; they vary from a tenth to half an inch in diameter; and some are laminated. They consist chiefly of phosphate of lime. See also **Series liv., No. 301.**

1603.—A portion of an external saphenous vein containing calcareous masses, which fill here and there the entire canal of the vessel, the wall being contracted around them.

1604.—A long and slender branching piece of bone, from the liver of a sheep. It was probably formed in obliterated branches of the portal vein.

Changes in the vein-walls, and in the tissues around.

I. There may be no apparent alteration in the vein-walls, or only some slight thickening of the internal and middle coats. This thickening, however, is in many cases due not to inflammation, but simply to the contraction and condensation of the vein-wall produced by the shrinking of the clot. This is well illustrated in the following specimen:

1593.—The internal coat of the obstructed vein in this specimen

is natural in appearance ; the tissues around were much thickened and indurated.

1596.—A femoral vein filled by a clot ; its walls present a natural appearance, but the tissues around were extensively ecchymosed.

1600.—Part of an external saphenous vein. In consequence of a cancer-growth involving, and extending from, the lower part of the femur, the principal veins of the leg became obstructed by clots. The veins shrank upon the clots as the latter contracted, so that their canals in the midst of oedematous tissues were much reduced in size, and their walls appeared thickened as from inflammation. By injecting water they were easily restored to their natural size and appearance, as shown in the preparation.

II. When organization of the thrombus occurs, the vein-walls and the parts around become infiltrated with inflammatory material, and blending with the clot, form with it at length, as already stated, a fibrous cord. The changes, however, which take place in the vein-walls, like those which occur in the organization of the clot, are very imperfectly understood. According to Cornil and Ranvier granulations grow out from the walls, and, penetrating the clot, unite with one another towards the centre. If this be a fact, it explains the vascularization of the clot already referred to, as the granulations are said to contain blood-vessels which communicate with the vasa vasorum.

Obstruction to the circulation.

When a vein of considerable size is plugged, the parts from which it conveys the blood become swelled, oedematous, and occasionally permanently indurated. The oedema of the lower extremity so common after parturition (*phlegmasia alba dolens*, as it is termed) is an example of this condition.

1593.—The left common iliac, the external iliac, part of the femoral and of the adjacent veins, irregularly distended and obliterated by clots. From a woman, who had suffered from much obscure pain about the pelvis and groins after a protracted labour. The lower extremities were oedematous.

1600.—The patient from whom this specimen was taken had marked œdema of the lower extremities.

SUPPURATIVE PHLEBITIS.

The condition of the veins known as suppurative phlebitis is either secondary to aseptic inflammation of the tissues outside the vein, or to suppuration of a clot already formed within the vein.

The inflammation usually commences in the surrounding tissues, and only secondarily extends to the vein-wall. The blood contained in the vein clots, owing to the structural alteration which the wall of the vessel has undergone as a result of inflammatory changes, and the vein may itself suppurate. In such cases micro-organisms are found both in the vein-wall and in the clot.

The exciting causes of suppurative phlebitis may be enumerated as wounds, lacerations, or bruises of veins occurring in debilitated subjects. Thus, it is frequently met with in compound fracture, in ill-conditioned stumps, in cases of acute necrosis and caries in bone, in malignant pustule, and in the umbilical vein after its division in unhealthy infants. Ligature of the veins was, moreover, formerly thought to be a common exciting cause. This belief, however, is now generally abandoned, for, in amputations, the *venæ comites* are constantly tied with the arteries which they accompany without ill results; and in those cases where suppurative phlebitis has occurred after the application of a ligature to a vein, there have always been other conditions present, sufficient in themselves to account for it.

1578a.—A right iliac vein filled with a thrombus, which, though firm in some parts, is breaking down in others. From a woman who had phlegmasia dolens, and died of pyæmia four weeks after delivery.

1581.—A femoral vein, exhibiting an abundant and nearly uniform deposit of inflammatory material upon its inner surface.

That part of the inner membrane of the vein which is exposed is of a dark-red colour. The branches of the vein are filled by firm coagula.

The vein was taken from the left lower extremity of a man who had compound fracture of the right thigh. He died a month after the injury with obscure signs of phlebitis. The remaining cavities of the vein were full of pus, but no other veins were diseased.

1579.—The right external iliac and femoral vein. The coats of the vein are much thickened, and are consolidated with the surrounding tissues. Its interior is rough with inflammatory material deposited on its lining membrane. The lower and upper parts of the vein, and all the branches proceeding from it, are filled by firm coagula composed of concentric layers of fibrin. The middle portion of the vein contained only soft fibrin and a fluid resembling pus. From a young man, who died after amputation of the right arm, which was performed in consequence of traumatic gangrene. See also No. 1582.

VARIX OR VARICOSE VEINS.

The veins most liable to become varicose are those of the lower extremities, the hæmorrhoidal, and the spermatic. Varix of the hæmorrhoidal and spermatic veins will be found treated of under diseases of the rectum and testicle respectively; our remarks will here be confined to the form of varix commonly known as varicose veins, so frequent in the lower extremities.

A varicose vein is lengthened, dilated, and frequently tortuous, the dilatation being especially marked where the intermuscular veins open into the superficial. The valves, from the dilatation of the veins, cease to be of service, and become atrophied and sometimes reduced to mere fibrous cords stretching across the lumen of the vein. The walls are generally thickened from hypertrophy of the muscular coat, sometimes, however, they are attenuated, and may even give way, producing severe hæmorrhage. The parts around become at first atrophied from the pressure of the dilated vein, but after a short time, œdematous, indurated

and thickened. The skin becomes congested, and especially liable to eczematous inflammation.

Ulceration of the congested tissues about the dilated veins (*the varicose ulcer*) is of frequent occurrence, and clots, as already described under adhesive phlebitis, often form in the affected veins.

Both the superficial and deep veins are generally involved in the varicose condition ; indeed, some surgeons say always, maintaining that the disease begins in the dilatation of the deep veins. In this opinion the author cannot agree, as sometimes the varix is undoubtedly confined to the superficial veins.

Of the superficial veins, the disease may affect one of the main trunks, as the internal saphenous, or the small subcutaneous venous radicles.

1575.—Portion of a saphenous vein and its branches in a varicose state. The veins are generally and uniformly dilated ; their coats are thickened and rigid, so that their canal remains open ; and they have a convoluted and very tortuous course.

1576.—Portion of a saphenous vein, the walls of which are in several places dilated in the form of pouches. Its coats are thickened, and there are thin cords, apparently the remains of valves, extending across its cavity. See also No. 1574.

TUMOURS IN VEINS.

New growths of various kinds may invade the lumen of a vein, and may either block it up entirely, or so alter the endothelial coat as to lead to thrombosis (see p. 336).

The following specimen shows a sarcomatous growth occupying almost the whole of the inferior vena cava.

1606a.—A vena cava inferior which is almost entirely occupied by a chondrifying sarcoma. The tumour, which also filled the right external and internal iliac veins, has so far infiltrated the vein-wall at its lower part that it cannot be separated. In the upper two-thirds of the specimen, however, the growth lies quite freely within the vein, and terminates in a tapering extremity at a point which corresponded to the entrance of the vena cava into the

liver. From an unmarried woman, aged twenty-two years, in whose right iliac bone a sarcoma had been growing for three months.

2785.—A branching cartilaginous growth, which projected from a lymphatic into the cavity of the vena cava inferior. The coats of the vein, which had undergone no change in their structure, were reflected on its narrow base, but, gradually thinning, were lost on many of its branches, which thus appeared bare and in direct contact with venous blood.

SECTION XI.

INJURIES AND DISEASES OF THE NOSE AND RESPIRATORY TRACT.

DISEASES OF THE NOSE.

LIPOMA NASI.

THE term "lipoma nasi" is applied to an hypertrophy of the skin, subcutaneous tissue and sebaceous follicles of the nose. It results from acne rosacea, and gives rise to a growth of irregular pendulous and lobe-like masses, situated at the end of the nose. The growth has a bluish-red tinge. It is frequently met with in middle-aged men who have long been drunkards. It should be noted that notwithstanding the name it contains no fatty tissue.

1760a.—A large lobulated growth removed from the nose of an old man in whom it had been growing for several years. The surface of the tumour is thickly studded with the orifices of enlarged sebaceous follicles. A cut section is firm and fibrous, but in places contains sebaceous material. A microscopical examination showed that the tumour consists of enlarged sebaceous glands held together by fibrous tissue.

DEVIATION OF THE SEPTUM NASI.

Deviation of the nasal septum is usually the result of an injury to the nose. It may be so greatly deflected as to bulge into the opposite nostril, where it may be mistaken for a polypus.

Cast No. 102d.—A cast of the face of a man showing a lateral deviation of the septum of the nose.

RHINOLITHS.

Nose-stones are occasionally formed by the deposition of phosphate of lime and mucus upon a foreign body which has become lodged in the meatus, or upon a portion of hardened secretion.

Series liv., 303a.—An irregularly square rhinolith, measuring nearly an inch across. Chemical examination shows that it consists of a mixture of calcium carbonate and phosphate. It weighs thirty-three grains, and appears to have been formed round a piece of rag, which has served as a nucleus.

The concretion was removed from the inferior nasal meatus of a woman aged twenty-four, who gave an indistinct history of having had a foreign body in her nose for twenty years.

ADENOID VEGETATIONS.

Adenoid vegetations are often found in the naso-pharynx of children. They are produced by an hypertrophy of the adenoid tissue, which is very abundant in this situation. They give rise to deafness, obstruction to nasal respiration, and a peculiar nasal tone of voice. They may be felt as a soft, pulpy and velvety mass when the finger is passed behind the pharynx.

CHRONIC INFLAMMATION OF THE MUCOUS MEMBRANE.

Chronic inflammation of the mucous membrane covering the turbinated bones occasionally occurs. The inflamed mucous membrane appears thick, soft, pulpy, and of a dull red colour. It somewhat resembles a vascular tumour or polypus projecting into the nasal cavity, from which it may, however, be readily distinguished by its colour, shape, and attachment to the outer wall of the nasal cavity.

1762.—Section of a nose, in which the mucous membrane covering the posterior portion of the inferior turbinated bone is inflamed and thickened.

POLYPI.

The term "polypus" has been applied generically to several varieties of tumour in the nasal fossæ. Thus mucous,

fibrous, and malignant polypi have been described, but it would be better to restrict the use of the term to the first-named variety.

Gelatinous or mucous polypi.

These occur as soft, gelatinous, semi-transparent growths springing from the mucous membrane covering the turbinated bones or the roof of the nasal cavity. They are generally multiple. They begin as flattened elevations of the mucous membrane, but soon become pedunculated. Though very vascular, they are not attended with hæmorrhage, as is the case with the fibrous variety. In structure they vary slightly, but more or less resemble the myxomata, and sometimes contain glandular elements. They are covered with ciliated epithelium.

1764.—Sections of a nose, exhibiting on each side large soft polypi, which are suspended from the mucous membrane covering the inferior and middle spongy bones. One polypus of smaller size is situated in the frontal sinus. They were probably of gelatinous aspect, though now, having collapsed, in consequence of fluid having escaped from them, they appear opaque.

1765.—Numerous polypi removed from the nose. They are of soft texture, semi-transparent or gelatinous in aspect, and several of them were attached to the mucous membrane of the nose by long narrow pedicles. See also Nos. 1766, 1767 and 1768b.

Fibrous polypi.

Fibrous polypi usually spring from the periosteum covering the roof of the naso-pharynx or lining the walls of the antrum. They are composed of dense fibrous tissue, sometimes intermixed with myxomatous tissue and with a few sarcomatous elements interspersed through their fibrous structure. Their blood-vessels are often thin-walled and very numerous, giving them at times a cavernous structure. They are sessile or pedunculated, and are apt to give rise to severe hæmorrhage; they may occasion much disfigurement by displacing surrounding parts.

1770.—The right side of a child's head, in which the nasal passages are completely filled by lobulated polypous growths from the mucous membrane. The section of one of the largest growths displays a pale pinkish and obscurely fibrous texture, firmer and less transparent than that of the common gelatinous polypi. They proved fatal by suffocating the child.

1770a.—A large naso-pharyngeal polypus, two inches in its long diameter by one and a half in breadth. Its cut surface is firm and fibrous, and its base of attachment is broad and very vascular. The tumour grew from the bones at the base of the skull, and was removed through an opening made in the roof of the mouth. The patient was a boy aged fourteen years, who made a good recovery after the operation. On microscopical examination the growth was found to consist of sarcomatous cells mixed with loose connective-tissue.

There is no specimen of a true fibrous polypus in the Museum.

Malignant polypi.

These commonly spring from the antrum, or some other of the sinuses connected with the nose. They are exceedingly rapid in their growth, and quickly infiltrate surrounding parts, causing great displacement and disfigurement. They protrude upwards into the orbit, forwards through the cheek, downwards into the mouth, and backwards into the fauces. They have an epitheliomatous, medullary, or sarcomatous structure. They frequently give rise to excessive hæmorrhage.

1772.—The left side of a face, with a soft medullary tumour filling the antrum, and thence extending into the nostrils, and into the cavities of the mouth and orbit. The parts of the tumour which are exposed are broken and flocculent, as if they were sloughing.

1772a.—Section of a skull with the brain *in situ*. The antrum is occupied by a large and tolerably firm growth, which has extended upwards into the orbit, and inwards so as to fill the nostril on the right side. The growth extends along the inferior meatus from the anterior nares, where it is ulcerating nearly as far as the choanæ. Microscopically the growth is a spheroidal-celled carcinoma.

The specimen was obtained from the body of a woman aged

sixty-four, who died from epistaxis. The tumour had only been observed for two months before her death. The patient had well-marked diplopia.

GLANDERS.

1763.—Portion of the septum nasi of a horse, exhibiting pustules and ulcers of the Schneiderian membrane. Each separate ulcer is small and circular, but on the posterior part of each surface of the septum there is a large extent of ulceration of an irregular form, probably the result of the coalescence of many small ulcers with each other.

The disease was produced by inoculation with matter taken from an abscess in the arm of a man who was believed to have been infected with glanders. Previous to the inoculation the horse was healthy.

NECROSIS OF THE TURBINATED BONES.

345.—Six portions of hard, closely cancellous bone removed from the cavities of a nose. They appear to be parts of diseased turbinated bones, which had suffered necrosis after being exceedingly enlarged, thickened, and indurated.

The patient was forty years old; he had had syphilitic disease of one testicle, and had been for twelve years liable to syphilitic pains in the limbs, when he received a severe injury of the nose in a fall. This disease of the bones followed the injury. It was very slow in its progress, and the portions of bone here shown were not more than half of what was removed. After their removal the patient remained well and without deformity of the nose.

SPECIMEN ILLUSTRATING THE RESULT OF THE RHINO-PLASTIC OPERATION.

1775.—The face of a man on whom a new nose was formed three months before death from a portion of the integuments of the forehead.

Some years before the operation the patient had cut his nose off in a fit of insanity. He died of fever shortly after the union of the transplanted part was completed.

DISEASES AND INJURIES OF THE LARYNX.

ACUTE LARYNGITIS.

The post-mortem appearances of acute laryngitis convey but a faint idea of the intense congestion which characterized the disease during life, as the excess of blood is squeezed out of the mucous membrane after death by reason of the recoil of the elastic tissue, which is very abundant in the submucous tissue.

In a recent specimen the mucous membrane appears slightly red and injected, swelled, œdematous, and covered with a semi-purulent discharge, in places superficially ulcerated, and here and there dotted with small ecchymoses. The submucous tissue is infiltrated with serum and inflammatory exudation. In Museum specimens, however, the redness of the mucous membrane is no longer seen.

1612.—The larynx, with a part of the trachea, of a man who died of acute laryngitis. The mucous membrane covering the epiglottis, and lining the whole interior of the larynx, is swollen by a copious effusion of serum and inflammatory products in its tissue. The ventricles of the larynx are nearly obliterated by the swelling of the membrane and the consequent approximation of their borders. A small quantity of inflammatory exudation is seen on a part of the mucous membrane over the right side of the epiglottis and thyroid cartilage.

The patient was about fifty years old, and was healthy till within thirty hours of his death, when signs of acute laryngitis ensued. When brought to the hospital suffocation was imminent. Tracheotomy was immediately commenced ; but he died before the operation was completed. See also No. 1614.

CHRONIC LARYNGITIS.

Chronic laryngitis is generally of syphilitic origin, or a sequel of the acute affection. Specimens show the mucous membrane to be thickened, indurated, and covered with a muco-purulent discharge, and the glottis narrowed and encroached upon by the thickened mucous membrane.

1635.—The larynx and trachea of a man on whom the operation of tracheotomy was performed twelve years before death. The orifice in the trachea is situated immediately below the cricoid cartilage. The rima glottidis is almost closed by the thickening and contraction of the mucous membrane lining the larynx. The chordæ vocales also are so much shortened that the arytenoid cartilages are within a quarter of an inch of the angle of the thyroid cartilage. The trachea is healthy.

The patient continued to the time of his death to breathe easily through a canula in the opening made in the operation.

FOLLICULAR LARYNGITIS.

Follicular laryngitis, or clergyman's sore throat, is a chronic inflammation of the larynx beginning in the mucous follicles. It is most frequently met with in persons accustomed to loud and prolonged speaking; hence it is common in clergymen and town hawkers; it also occurs in photographers and others exposed to chemical fumes.

The contract of irritating fumes, or of cold air in prolonged speaking, induces dryness of the throat, to relieve which an extra quantity of mucus is secreted by the follicles. This over-stimulation of the follicles leads to their congestion and enlargement, the congestion subsequently passing imperceptibly into a chronic inflammation.

The mucous membrane, besides being infiltrated, swelled, and thickened, presents a characteristic granular appearance from the enlargement of the mucous follicles, especially in the neighbourhood of the aryteno-epiglottidean folds where the follicles are most abundant. The mucous membrane is also superficially ulcerated in places. During life the follicles are surrounded by a red halo, and are frequently distended by a small quantity of glairy mucus.

TUBERCULAR LARYNGITIS.

The favourite seat of tubercle in the larynx is the mucous membrane forming the aryteno-epiglottidean folds, and covering the lower and back part of the epiglottis and the arytenoid cartilages. In the earlier stages the mucous

membrane, as a rule, is pale, and the aryteno-epiglottic folds are swollen and are of a characteristic pyriform shape (No. 1631a).

A small oval ulcer on the mucous membrane covering the arytenoid cartilages, immediately behind or over the posterior attachment of the true vocal cords, is very characteristic of tubercular ulceration (No. 1633d).

Miliary tubercles are formed in the submucous tissue, giving a characteristic granular appearance to the overlying mucous membrane (No. 1631d). The tubercles undergo the ordinary caseous change, and by breaking down lead to the formation of ulcers. The ulcers are at first distinct, small, round, with hard everted edges (No. 1633f), and surrounded with a characteristic induration of the mucous membrane, in part inflammatory, and in part due to more recent formation of tubercle. This later deposit of tubercle also breaks down into ulcers which become confluent with those already formed, thus producing much irregular destruction of the mucous membrane (No. 1633a). The ulceration may extend to the vocal cords or to the epiglottis; the natural contour of the latter structure is, however, rarely destroyed as it is in syphilis. Compare the tubercular larynx (No. 1631c) with the syphilitic larynx (No. 1627). At times the inflammation extends to the cartilages, which may then undergo caries or necrosis (No. 1636).

1623.—A larynx and trachea. The whole of the mucous membrane covering the inferior surface of the epiglottis and lining the larynx and trachea presents closely set, minute, and, for the most part, shallow ulcers, which have in some places coalesced so as to give the appearance of diffuse superficial ulceration. Near the posterior extremity of each chorda vocalis there is a small, oval, excavated ulcer, the result, probably, of tuberculous disease.

1624.—A larynx and trachea with the base of the tongue and the adjacent parts. The upper two-thirds of the epiglottis have been destroyed by tuberculous ulceration, and all the adjacent parts of the mucous membrane, as far down as the chordæ vocales, is deeply ulcerated. There is also a distinct oval ulcer on the mucous membrane covering each vocal chord, near its attachment to the

arytenoid cartilage. The ulceration is irregular on each side, but exactly symmetrical.

1632.—A larynx, with part of the trachea, from a man in whom tracheotomy was performed two days before death. Upon the epiglottis, the arytenoid cartilages, and the chordæ vocales, the mucous membrane is thickened, ulcerated, and granular. Within the trachea, and especially upon its posterior wall, there is an almost continuous ulceration, which in some parts is superficial, in others extends deeply, and which at one point has formed an irregular opening through the walls of the trachea.

The patient died of phthisis. Tracheotomy was rendered necessary.

1632a.—A larynx showing the effects of tuberculous disease. The mucous membrane is generally roughened and papillated, much increased in thickness, and completely hides the vocal cords, which appear to be buried in its folds. The epiglottis and the aryteno-epiglottidean folds share in the general thickening. There appears to be a very superficial ulceration in various parts, most marked at the upper end of the trachea.

The patient was a young man who died with general tuberculosis. He had suffered from aphasia for some time before his death.

1636a.—A larynx with a portion of the tongue and of the trachea, from a patient aged twenty, who died of tubercular phthisis. The whole of the supraglottic portion of the larynx has undergone ulceration, especially upon the left side. The left great cornu of the hyoid is necrosed, and the epiglottis is completely destroyed. See also Nos. 1633 and 1633a.

ŒDEMA OF THE GLOTTIS.

Œdema of the glottis is a serous transudation into the loose sub-mucous tissue covering the epiglottis, the aryteno-epiglottidean folds, and the adjacent portions of the cartilages of the larynx. It never extends below the true vocal cords, as the mucous membrane is tightly attached to those structures without the intervention of sub-mucous tissue.

It generally occurs suddenly, supervening upon some previous inflammatory condition of the larynx or neighbouring parts, and is probably caused by the increased lateral pressure in the capillaries due to the compression of the bloodvessels

at the focus of inflammation. It is a frequent termination of acute and chronic laryngitis, and is of common occurrence after scalds of the larynx. It sometimes appears to partake of an acute erysipelatous nature, and is then generally accompanied by acute cellular inflammation of the neck.

Œdema of the glottis of a passive character also occurs in dropsical affections in conjunction with œdema of other organs. Hence, it is a frequent termination of chronic Bright's disease. The anatomical appearances are well seen in the following specimens.

1612.—Œdema of the glottis, the result of acute laryngitis. The mucous membrane covering the epiglottis and lining the whole interior of the larynx is swollen by a copious effusion of serum into its submucous tissue. The ventricles of the larynx are nearly obliterated by the swelling of the membrane and the consequent approximation of their borders.

1613.—A larynx, with the neighbouring parts. The mucous membrane lining the epiglottis and upper part of the larynx, the tonsils, and uvula is swollen and œdematous, so that the entrance to the pharynx is almost obliterated, and that of the larynx reduced to a narrow chink.

1615.—A larynx, of which all the mucous membrane is upraised and the glottis is much narrowed by œdema. The epiglottis is thickened, and its edges turned backwards and downwards. The œdema extended also down to the pharynx and œsophagus, and was attended in the recent state with the characters of active inflammation.

These changes appear as the consequences of the lodgment of a fishbone across the fauces, immediately in front of the epiglottis. See also No. 1626.

CROUP OR CROUPOUS INFLAMMATION.

Croupous inflammation is characterized by the formation of a false membrane in the larynx and trachea. The membrane, which is sometimes tough and fibrous, at other times soft and crumbling, is produced by the coagulation of fibrinogenous material exuded upon the surface of the mucous membrane. It is composed of a delicate network of fibres enclosing white blood corpuscles in its meshes.

On removing the false membrane the mucous membrane of the larynx is found abraded and hypervascular, and the submucous tissue infiltrated with serum. The disease is generally confined to the larynx and trachea, but it may in severe cases spread into the bronchi.

Croup is essentially a disease of childhood, and it will be noted that whereas a large amount of submucous tissue exists in children, but little is found in adults.

1616.—The larynx and trachea of a child who died with croup. A false membrane extends from the under surface of the epiglottis down the trachea into the bronchi.

1617.—A similar specimen.

DIPHTHERITIC INFLAMMATION.

Many authorities maintain that no difference exists between the croupous and diphtheritic inflammations. It is generally taught, however, that whereas in croup the exuded material forming the false membrane exists only on the surface of the mucous lining, in diphtheria it is found also in the substance of the mucous and submucous tissue, where, from its interference with the circulation, it occasionally gives rise to gangrene and sloughing of the affected part. Diphtheria usually begins at the back of the fauces, and then spreads to the larynx and nares. By some authorities it is thought to be due to a fungus. With this short account, which only serves to illustrate the local appearances of the larynx, the subject of diphtheria will be dismissed, as it more often comes under the observation of the physician than of the surgeon.

1621.—A larynx and trachea, of which the mucous membrane is almost uniformly lined by a thin layer of inflammatory material, which is slightly adherent, and is granular on its inner surface.

The patient, a woman twenty-five years old, had had fever. During her recovery, but while she was very weak, symptoms of acute laryngitis ensued, for which laryngotomy was performed on the third day. She lived twelve hours; and after death all the bronchial tubes were found similarly lined by inflammatory material.

1622.—The larynx and trachea of a child who died of diphtheria. A membrane is seen covering a considerable portion of the mucous surface of the larynx.

TYPHOID ULCERATION OF THE LARYNX.

Ulceration of the larynx sometimes occurs during an attack of typhoid fever. The mucous membrane chiefly affected is that covering the arytenoid cartilages, immediately posterior to the attachment of the vocal cords. The ulceration is generally limited in extent, but sometimes penetrates deeply and causes perichondritis, which may terminate in necrosis of portions of the cartilages. At times, also, the ulceration destroys the whole of the free edge of the epiglottis.

1641.—The larynx and part of the trachea from a young woman who died after an attack of typhoid fever. On either side of the glottis, immediately posterior to the vocal cords, are seen the cavities of two small abscesses which surround the arytenoid cartilages. The cavity of the right one has been laid open to show the necrosed and bare arytenoid cartilage in its centre. The abscess on the left side is smaller. See also Nos. 1641a and 1641b.

VARIOLOUS ULCERATION OF THE LARYNX.

The larynx, in common with the mouth and throat, frequently participates in the eruption of small-pox, and on the bursting of the pustules presents a number of small round superficial ulcers scattered over its mucous membrane. The eruption and resulting ulceration are frequently accompanied by the formation of a false membrane lining the larynx and trachea. In some cases the false membrane is present without any accompanying ulceration.

1642.—The larynx and trachea of a patient who died with small-pox. Inflammatory material in the form of a false membrane is thinly deposited over the surface of the mucous membrane.

1644.—A larynx and trachea. Just above the chordæ vocales there is a fistulous ulcer beneath the mucous membrane of the back of the larynx, in front of the arytenoid cartilages. Part of its course is marked by a bristle. The mucous membrane covering

the whole of the larynx and trachea is thickened, and rough on its internal surface. Near the attachment of the epiglottis are several small superficial ulcers. The patient died of small-pox.

SYPHILITIC DISEASE OF THE LARYNX.

In the early stages of syphilis, inflammation, indistinguishable in its anatomical characters from other laryngeal inflammations, occurs in the larynx; later, condylomata and mucous tubercles make their appearance, especially on the vocal cords. In the so-called secondary stages, ulcers occur upon the epiglottis, true and false vocal cords, and other parts of the larynx, but are with difficulty distinguished from other forms of ulcers. Mucous tubercles are also common in this stage. In the later stages the characteristic tertiary ulcers, due to the breaking down of gummata, are common, and may be recognised by their irregular shape, sharp-cut excavated edges, and smooth base covered with yellow purulent discharge, by the surrounding induration, and by the deeply retracted cicatrices they leave on healing. The epiglottis is the part perhaps most frequently affected, and is often completely eaten away. As the ulcers increase in depth the perichondrium becomes involved, and necrosis of the cartilage may result, ossification of the cartilage sometimes preceding the necrosis. In other instances necrosis of the cartilage is the result of gummatous formations under the perichondrium.

The trachea is not uncommonly affected in a similar way.

1630.—The larynx of a man, aged fifty, who had had syphilis. It is laid open from behind, and the mucous membrane is seen to be thickened and indurated throughout. In different portions there is evidence of former ulceration. No traces of the epiglottis are visible. It appears to have been wholly destroyed, only a slight ridge marking its place of attachment.

1634.—The tongue and larynx of a man, who for some years before his death suffered severely from syphilis. He died suddenly, apparently suffocated. The mucous membrane covering the larynx, epiglottis, base of the tongue, and surrounding parts, is much

thickened and indurated. The papillæ circumvallatæ are considerably enlarged.

1638.—A larynx in which a gumma had probably formed around the greater part of the thyroid cartilage. A large portion of the right ala of the cartilage is destroyed, and nearly all the rest of both its surfaces is exposed.

1639.—A larynx, exhibiting necrosis and separation of the left arytenoid cartilage, and of part of the cricoid cartilage. Previous to the necrosis the separated portions of cartilage had become osseous. The opening in the front of the trachea was made during life, for the relief of dyspnœa.

The patient, a man between forty and fifty years old, had been profusely salivated for syphilitic disease. See also Nos. 1625, 1627, 1628, and 1629.

NEW GROWTHS, OR POLYPI.

The new growths found in the larynx may be enumerated as the papillomatous or warty, the fibrous, the adenomatous, the sarcomatous, and the carcinomatous.

Papillomatous or warty growths.

The papillomata are the most common of the morbid growths found in the larynx. They are especially frequent in early life. They spring from the mucous membrane, and have the same structure as papillomata in other situations. They assume the form either of warty, pedunculated excrescences, or of soft, flocculent, villous-like bodies. They more often spring from the front than from the back of the larynx, and occasionally grow from the vocal cords. They are frequently multiple, but after existing some time, generally coalesce into one mass, which may attain such a size as ultimately to lead to a fatal attack of dyspnœa.

1645.—The larynx of a child two years old. The surface of the mucous membrane lining the thyroid cartilage, the ventricles of the larynx, and the lower part of the epiglottis, is occupied by a wart-like growth composed of numerous small, pedunculated, oval bodies, closely set together, and of a firm consistence. The child had had dyspnœa from the time of birth, and died suffocated. See also Nos. 1645a and 1646.

1647.—The larynx and adjacent parts from a boy, aged nine years, who had suffered from symptoms of obstruction in the larynx for about six months before death, and had had occasional violent attacks of dyspnœa, in one of which he died suddenly. There is a well-marked papillomatous tumour on the vocal cords. The microscopic characters of the growth are those of well-marked papilloma, and differed remarkably from those of the ordinary epithelioma. See also No. 1648.

1649.—A larynx, laid open and presenting large growths attached to the vocal cords. The growth on the left side is warty in character. The growths appear to have almost completely obstructed the entrance to the glottis.

From a man, aged fifty-six, who for some months had suffered with extreme hoarseness, and then considerable difficulty of breathing, with occasional paroxysms of severe dyspnœa. He continued his occupation until a fatal paroxysm occurred, when he was brought to the hospital dead.

Fibromata or fibrous growths.

Fibrous polypi are much less common than the preceding variety. They occur as small, solitary, smooth, spherical, pedunculated or sessile growths, with a fibrous structure; and generally spring from the true vocal cords. The following specimen appears to be an example.

1650.—A larynx. On the upper and inner aspect of the right true vocal cord there is a small, conical, highly vascular, fibrous tumour. From a man, aged sixty-three. There was no history of any laryngeal symptoms.

Adenomatous growths.

Adenomatous growths in the larynx consist, like the adenomata in other situations, of an hypertrophy of the glandular elements of the mucous membrane. Hence they generally occur in those parts of the larynx where the gland-tissue is most abundant, *i.e.*, about the aryteno-epiglottidean folds and the ventricles. They are very rare.

There are no specimens in the Museum.

Sarcoma.

Sarcoma of the larynx is of less frequent occurrence than cancer. It more often grows from the intrinsic than the extrinsic portions. The tumour usually forms a distinct mass, which is sessile. It grows slowly, and shows but little tendency to affect the lymphatic glands or to form secondary growths. Death results from suffocation or exhaustion.

1653.—A pharynx, with the tongue, larynx and other parts. A sarcoma of nearly globular form, and about an inch in diameter, is situated on the right aryteno-epiglottidean fold. From a man, aged forty years, who had for some months suffered with pain in the throat, and difficulty of breathing and deglutition. A sudden attack of extreme dyspnoea coming on, tracheotomy was performed, but the patient shortly afterwards died.

Carcinoma.

Cancer of the larynx is either *intrinsic*, when it grows from the true or false vocal cords, from the thyroid angle, the ventricle, or from the parts below the cords; or it is *extrinsic*, originating in the epiglottis, the aryteno-epiglottic folds, the arytenoids and the upper and posterior parts of the inter-arytenoid fold. The extrinsic carcinoma spreads much more rapidly than the intrinsic form, and involves much larger tracts of tissue. The lymphatic glands in the extrinsic form are affected early, whilst in the intrinsic variety they are only occasionally infiltrated with the new growth. In neither form are there secondary growths in the internal organs, and both affect men far more frequently than women. Carcinoma of the larynx is essentially a disease of adult life; the intrinsic form usually destroys life in two to four years, whilst in the extrinsic form life is rarely prolonged for more than eighteen months. All varieties of carcinoma are found, although epithelioma is the commonest.

A. Epithelioma.

Epithelioma of the larynx is generally secondary to epithelioma of the pharynx or other adjacent parts. When it occurs primarily in the larynx, it springs from the mucous membrane covering the arytenoid cartilages, or from that forming the aryteno-epiglottidean folds. It commonly terminates in ulceration.

1652.—A larynx laid open from behind, showing an epithelioma, which is attached to the right aryteno-epiglottidean fold. *The intrinsic variety.*

1655.—The larynx, pharynx, and base of the tongue shown from behind. The base of the tongue, the tonsils, and portions of the larynx are involved in an epithelial growth (see also Nos. 1655a, and 1655b). *The extrinsic variety.*

B. Medullary carcinoma.

Medullary cancer but rarely occurs in the larynx. It soon involves the whole of the larynx and adjacent parts, and is rapidly fatal.

There is no specimen in the Museum.

C. Scirrhus carcinoma.

Scirrhus cancer of the larynx is very rare, but the following is a well-marked specimen:

1658.—Hard carcinoma of the pharynx and larynx encroaching upon the left vocal cord. The patient was a man aged sixty-three. Tracheotomy was performed. The symptoms had existed about six months.

OSSIFICATION OF THE CARTILAGES.

Ossification of the cartilages of the larynx and trachea is a senile change, and can hardly be regarded as a disease. It must, however, be carefully distinguished from the ossific changes which the cartilages sometimes undergo before suffering necrosis in syphilitic and other ulcerative affections of the larynx.

1610.—A larynx, from an old woman. The thyroid, cricoid, and arytenoid cartilages are almost entirely ossified. Osseous matter is also deposited in one of the thyro-hyoid ligaments and in the epiglottis.

Ossification of the epiglottis is so rare, that it is said in many text-books never to occur.

1611.—Portion of a trachea, from an old man. The cartilages are all ossified.

PARTIAL EXCISION OF THE LARYNX.

1656b.—The left half of the larynx, together with the true and false vocal cords, removed for an epitheliomatous growth situated upon the under surface of the true vocal cord. From a gentleman aged fifty, who suffered from hoarseness of two years' duration. He had a warty growth on the left vocal cord, which appeared to be non-malignant, although it presented some suspicious characters. At different times during a period of six months, portions of the growth were removed with forceps. Recurrence took place, and the cord exhibited impaired mobility. Hahn's tracheotomy tube was used during the operation, and was left in the trachea for two days. At the end of two days it was replaced by a smaller tube. During the first few days after the operation the patient was fed through an œsophageal tube by means of a syringe. The temperature never rose above 100°, and the pulse was, almost from the first, from 80 to 84. On the fifth day the patient began to swallow. On the seventh day the tracheotomy tube was permanently removed. Three weeks after the operation he drove to Wimbledon, and after a week at Wimbledon returned to his home in the country. The chief, and indeed the only, trouble from which he suffered was cough, which commenced as soon as the large tube was replaced by a smaller tube, but which gradually became less distressing, and finally ceased within a few days after the permanent removal of the tube. Three months after the operation, when the wound was healed with the exception of a small sinus at the lower part, there was no sign of recurrent disease, or of affection of the glands of the neck. His general health was excellent, and he was able to speak in a gruff whisper.

WOUNDS.

1663.—A larynx and os hyoides, partially separated by a transverse incised wound, which was the cause of death.

1663b.—Portion of the tongue and larynx from a man aged twenty-nine, showing a self-inflicted jagged wound which has completely destroyed the crico-thyroid membrane and the anterior portion of the cricoid cartilage. The thyroid cartilage has numerous gashes in it, which in some cases extend as far as the right lobe of the thyroid gland. The trachea has been divided through its second and third rings. See also No. 1663a.

IMPACTION OF FOREIGN BODIES.

Foreign bodies are apt to become impacted in the ventricles, in the glottis, or between the aryteno-epiglottidean folds. If not soon removed they cause death by inducing spasm or œdema of the glottis.

1660.—The larynx of a child, three years old, who was suffocated by a pill lodging just beneath the vocal cords.

1660a.—A larynx and the upper part of the trachea completely filled with a large mass of meat.

The specimen was taken from the body of a man who, while laughing and talking during a wedding breakfast, choked, and suddenly expired.

1615.—A larynx, exhibiting the lodgment of a fish-bone across the fauces immediately in front of the epiglottis.

SECTION XII.

DISEASES AND INJURIES OF THE THYROID GLAND.

BRONCHOCELE or goître, the commonest disease of the thyroid body, is usually a simple hypertrophy of the normal tissues of the gland. It commences as a gradual enlargement of all parts of the gland (No. 2310), but more especially of the vesicles, which contain an unusually large amount of colloid substance. As the disease progresses the vesicles become irregularly enlarged (Nos. 2314c and 2314g); and sooner or later this enlargement produces one or more cysts (Nos. 2313 and 2314c). Tumours which are definitely encapsuled (No. 2310b) are sometimes found in the gland, and occasionally the gland is invaded by a diffuse growth of fibrous tissue. The walls of the cysts frequently calcify (Nos. 2316 and 2317), and their contents in rare cases may suppurate (No. 2314).

The disease may affect one or both lobes, or only the isthmus. The enlargement may be solid or cystic; in the latter case the contents of the cyst may be serous or colloid, and it may or may not contain a proliferating growth. The enlarged gland sometimes undergoes secondary changes, the chief of which is calcification. Goître is often associated with protrusion of the eyeball, when the term exophthalmic goître is given to the disease. Malignant disease of the thyroid gland sometimes occurs; it may be either sarcomatous or carcinomatous in character, and is usually primary in origin. A special form of carcinoma is said to occur in some very rare cases, in which the secondary growths

resemble in structure the normal thyroid body. The primary growth is a pulsating tumour, whilst the secondary deposits infiltrate the lymphatic glands and bones.

SIMPLE BRONCHOCELE.

Simple Adenoma.

2310.—A thyroid gland, greatly and almost uniformly enlarged in all parts, but presenting no apparent morbid change of structure. A bristle is passed beneath two strong muscles (*Levatores glandulæ thyroideæ*) which extend from the body of the *os hyoides* downwards, to the inner part of each lateral lobe of the gland, and are attached to its surface. The superior thyroid arteries are of their ordinary size, the inferior thyroid arteries are enlarged; each of them is nearly equal in size to an external carotid. The trachea is compressed and flattened by the pressure of the lateral lobes of the enlarged gland. Laryngotomy was performed, in the hope of relieving the dyspnœa under which the patient—a boy of about fourteen years old—laboured. It was unavailing, and he died suffocated. See also No. 2311a.

FIBROUS BRONCHOCELE.

2319a.—A large tumour of the thyroid gland, with the adjacent parts. The tumour is extremely hard, and of similar shape to the gland in which it grows, being composed of two lateral lobes of equal size joined by an isthmus. The cut surface is fibrous, and microscopical examination shows that the enlargement is due to a uniform increase in the fibrous tissue of the gland. Each lobe reaches the level of the hyoid bone above, and of the bifurcation of the trachea below. They are joined by a broad isthmus, reaching from the cricoid cartilage over the upper half of the trachea. Above, the lobes present a rounded outline, and are quite separable from each other, and their limits are clearly marked. Behind, below, and laterally, the limits of the growth are quite undefined, the surrounding parts being infiltrated by the tumour, and not simply pushed aside. Thus the common carotid artery, the external and internal carotids, the internal jugular vein, the pneumogastric, recurrent laryngeal and sympathetic nerves, are on each side entirely included in the tumour. The depressor muscles of the hyoid bone are infiltrated and fixed; the œsophagus is infiltrated, and so compressed an inch and a half below the cricoid

cartilage that the tip of the little finger can barely be passed along it. The trachea has been compressed both laterally and in front; in the latter situation by the isthmus of the tumour (which has been divided), while its lower portion, which in life occupied the thorax and root of the neck, is infiltrated with new growths on each side. It is so narrowed by lateral compression that the little finger cannot be passed into it. The aorta and all its branches, the innominate veins, with the superior vena cava and the pulmonary artery, are all incorporated in the tumour to a greater or less extent; but although the calibre of these vessels is more or less diminished by pressure, in none of them is there any ulceration or clotting of blood. The apex of the left lung is seen in the specimen closely adherent to, and not separable from, the lowest portion of the growth. The bifurcation of the trachea with both bronchi is adherent to the tumour, as are also the bronchial lymphatic glands. Neither in the neck nor in the thorax were the latter at all enlarged or otherwise altered. The specimen is taken from a woman, the mother of four children. Three years before her death the neck became fuller, and after laughing she would occasionally have 'crowing inspiration.' One year before her death the thyroid appeared to be incorporated with the trachea. It was very hard, quite painless, and fuller than natural. There was no dyspnoea. The swelling enlarged very slowly, and extended backwards upon each side of the trachea, which appeared to be grasped by it. A laryngoscopic examination showed that the left vocal cord was paralyzed and that the trachea was narrowed to a chink. The patient gradually became worse, her breathing being stridulous and difficult after the slightest exertion, so that on several occasions suffocation appeared to be imminent. She was, however, generally relieved by chloroform inhalations. The tumour in front of the trachea was divided, and considerable temporary benefit was derived from the operation. The patient ultimately died.

A section of the tumour is preserved in **Series iv., No. 90h.**

CYSTIC BRONCHOCELE.

Single Cyst. 2314.—A larynx, pharynx, and adjacent parts, with the thyroid gland. The right lobe of the gland is enlarged by the formation of a cyst of more than four inches in diameter in its interior. The walls of the cyst appear to be formed by the distended tissue of the gland; its interior is rough, and has a large quantity of lymph deposited upon it, some of which hangs in it in loose

shreds. At its upper part, the cavity of the cyst communicates with that of the pharynx by a narrow ulcerated aperture (indicated by a piece of glass) near the arytenoid cartilage. The isthmus and left lobe of the thyroid are healthy. The patient was an elderly woman, and the enlargement of the gland had long existed. The cyst at first contained a fluid like serum, which when withdrawn spontaneously coagulated. After being twice emptied, the walls of the cyst inflamed, and it was rapidly filled with pus and lymph; its wall ulcerated, and the ulceration extending through the adjacent parts of the larynx, the patient was suffocated by the sudden discharge of its contents and the passage of some of them into the larynx. See also Nos. 2310a, 2310b.

Multiple Cysts. 2314c.—The trachea and thyroid gland from a case of goître. This specimen shows an hypertrophied condition of the whole gland, including a pyramid of Lalouette. The gland completely covers the anterior surface of the larynx, and extends upwards as far as the hyoid bone. The trachea is nearly surrounded by the growth, which has compressed it from side to side; the lateral lobes almost meet behind. A section through the left lobe shows a great increase in the connective-tissue of the gland, as well as numerous small cysts. During life the tumour extended as low as the posterior surface of the manubrium sterni.

2314g.—Part of a goître, trachea, and œsophagus, cut horizontally, to show the relations which they bear to each other. The left lobe of the gland is larger than the right; it has caused slight flattening of the left side of the trachea. The position of the inferior thyroid vessels and the recurrent laryngeal nerves may also be seen. The internal structure of an ordinary cystic goître is well illustrated by the specimen.

Calcification of the Cyst Wall.

2314e.—Cystic disease involving the whole of the thyroid gland. The right lobe has been laid open, showing numerous cysts in its interior. Some of the cysts are filled with the usual colloid material; others are more or less calcified. On the left side the outward displacement of the carotid vessels may be noticed. The relations which the recurrent nerves usually bear to a goître are also well seen. They lie in the grooves between the thyroid gland and the œsophagus.

2314f.—Portions of cyst wall and partially calcified colloid contents of a large cystic goître removed by operation.

The cyst was globular, measuring about five inches in diameter; the cyst-wall was thick and tough; the interior was completely filled with the solid material shown in this specimen. It consists of the ordinary mucoid contents of a thyroid cyst solidified together with the remains of blood-clot. Much calcification has occurred in it.

Photographs of the patient before and after operation are preserved in **Series lvii., No. 298qq.**

MALIGNANT BRONCHOCELE

Is a disease of adult life, and attacks men more often than women. It not infrequently occurs in persons who have long been the subjects of goître. It leads, by pressure and infiltration, to dysphagia and dyspnœa. The trachea is involved by the growth at a very early stage of the disease. Secondary deposits may take place in the lymphatic glands, lungs, brain, bones, kidneys, etc.

Sarcomata.

2319c.—The tongue, larynx, trachea, and thyroid gland from a case of primary sarcoma of the thyroid. The new growth forms a huge mass which ulcerated through the skin and has extended into the thorax. It completely compresses the left recurrent laryngeal nerve, and has flattened the two common carotid arteries. It has grown by a downward prolongation through the upper wall of the arch of the aorta, but without causing any extravasation of blood. From a woman aged forty-six. Sarcomatous deposits were found in the kidneys, in one rib, and in the brain. All the deposits consist of sarcoma cells, whilst those in the kidney have a stroma which has undergone hyaline degeneration. The growth had existed for about four months.

Portions of the brain are preserved in **Series xxx., No. 2499b**; sections of the brain, thyroid, and kidneys in **Series lv., Nos. 90r, 95c, and 102a.**

Carcinomata.

2318a.—A malignant growth attacking a bronchocele of many years' duration. From a middle-aged man who lived at Barnsley, in Yorkshire.

MYXŒDEMA.

Myxœdema is a disease characterized mainly by the general development of a kind of solid œdema in connection with a tottering, feeble gait, slow monotonous utterance, slowness of thought and movement, and atrophy of the thyroid body. The disease occurs more often in men than in women.

2317a.—A larynx with part of a thyroid gland showing the extreme amount of atrophy which has taken place in a woman aged sixty-three, who had suffered from myxœdema. The two lateral lobes are reduced to mere bags of fibrous tissue. The patient had chronic peritonitis, with great thickening of the capsules of the spleen and liver.

SECTION XIII.

INJURIES AND DISEASES OF THE DIGESTIVE TRACT.

DISEASES OF THE LIPS AND CHEEKS.

EPITHELIOMA OF THE LIPS.

EPITHELIOMA nearly always occurs on the lower lip. It generally begins as a small crack or ulcer covered with a dry scab, or as a warty induration of the mucous membrane. If an ulcer or fissure, it extends and deepens; if an induration, it increases to an irregular warty mass, which subsequently ulcerates. The cancer finally involves the whole lip and adjacent parts, and affects the neighbouring lymphatic glands, but it is not reproduced in distant organs, like other forms of cancer. It has generally been attributed to the heat and irritation caused by smoking clay pipes with short stems and unglazed mouthpieces.

Epithelioma is apt to be mistaken for hard chancre; the following facts should aid in the diagnosis: Epithelioma occurs more often on the lower, chancre on the upper lip; epithelioma is more frequent in men, chancre in women; epithelioma affects the glands at a late period of the disease, chancre generally within six weeks after its appearance; chancre, moreover, is sooner or later accompanied by secondary symptoms, and yields to treatment, whereas epithelioma steadily progress in spite of treatment.

1777.—An epithelioma of the upper lip, removed from a man sixty years old.

1777b.—The free margin of the lower lip, showing a very considerable ulceration. On the right side is a punched-out cavity, which measured in the fresh condition three-quarters of an inch in length by half an inch in width. The ulcer is epitheliomatous ; it is oval in shape and has inverted edges. The mucous membrane is involved in a papillomatous ulceration which extends beyond the angle of the mouth. The left side of the lip is also hard and papillomatous. From a man aged forty-nine. Thirteen years before the removal of the lip he noticed a hard, painless, immovable lump on the right side of his lower lip, of the size of a small shot, which grew slowly, and eventually began to ulcerate. See also No. 1777a.

Return of epithelioma, after removal from the lip, in the cheek, and subsequently in the lower jaw.

1778.—Section of a mass of epithelial cancer embedded in the right cheek. It occupies the whole thickness of the cheek, upraising equally the skin and the mucous membrane, and just projecting through them both at small ulcerated apertures. It appears as a circumscribed infiltration of the tissues, of irregular rounded shape, about two inches in diameter. Its section appears opaque-white, with some marks of blood-stains ; its substance is firm and close-textured, but friable, not creamy.

The patient was thirty-seven years old. A year before the removal of this disease a portion of his lower lip, with epithelial cancer, which had been four years in progress, was excised. Within three months of this second operation the disease reappeared beneath the scar and rapidly increased. It was removed together with a large portion of the lower jaw, to which the cancerous substance adhered. The wound did not completely heal ; but the cancer, which again appeared in it, made comparatively slow though extensive progress. Death occurred nearly three years after the first operation. The lip on which the first operation was performed remained healthy to the last. The specimen is drawn in No. 578.

LABIAL GLANDULAR TUMOURS.

Tumours, called by Sir James Paget labial glandular, consisting of gland substance surrounded by more or less fibrous tissue, and sometimes intermixed with cartilaginous

and myxomatous elements, and even occasionally with bone, are not of unfrequent occurrence in the lips. They are generally of slow growth, lobulated on the surface, and nearer the mucous membrane than the skin. They are more common in the upper than in the lower lip. Their general appearances are well seen in the following specimen, upon which Sir James Paget's original description was based.

1776.—Section of a tumour removed from an upper lip. A portion of the mucous membrane of the lip is closely connected with a part of its surface. The tumour was spheroidal in shape, nearly an inch in diameter, and was embedded in the whole thickness of the lip. It is lobed, firm, and elastic, closely connected, but not confused with the adjacent tissues. Its cut surface is creamy-white and grayish, with ruddy spots.

The patient was a healthy-looking middle-aged man. The tumour had been growing for twelve years, and was inconvenient only from its bulk. Its microscopic structure was that of a compound tubular gland, with well-formed veins and tubes lined and partly filled with nucleated cells, wanting only the system of branching ducts.

NÆVUS OF THE CHEEK.

3343.—Portions of a nævus, which were removed from the inside of the cheek of a boy fourteen years old. In the upper portion a section of the nævus is made, showing the consolidation which its structure had undergone from repeated attacks of inflammation. With the middle portion an inch and a quarter of the parotid duct are connected. A bristle is passed through the duct. On this portion a multitude of fine fringe-like processes have been formed by the enlargement of the papillæ of the mucous membrane of the cheek. No inconvenience followed the removal of the piece of the parotid duct.

CONGENITAL MALFORMATIONS OF THE LIPS.

HARELIP.

Harelip is a congenital malformation in which the upper lip is vertically cleft on one or both sides of the median line. It is the result of the non-union of the superior maxillary

processes, which form the lateral portions of the lip, with the naso-frontal process which forms the mesial portion. Hence the fissure will be opposite the suture between the superior and intermaxillary bones, the situation in which the union between the above-mentioned processes normally occurs. The malformation will be single or double, according as the arrest of development occurs on one or both sides.

The fissure may be little more than a notch in the free margin of the lip, or it may extend completely through the whole substance of the lip into the nostril above. It is frequently accompanied by a cleft of the hard palate, or of both the hard and soft palates, from the arrest of development affecting also the deeper parts. When the fissure is double, the central portion of the lip, viz., that part developed from the naso-frontal process, is generally shorter than natural, and the intermaxillary bone frequently projects forwards, carrying the incisor teeth with it.

3425.—Single harelip on the left side, combined with complete fissure of the hard and soft palates.

3426.—Harelip on the left side, combined with a cleft of the hard and soft palates. The intermaxillary bone is fused with the right superior maxilla.

DISEASES OF THE GUMS.

Epulis is the only disease of the gums illustrated in the Museum.

EPULIS.

The term "epulis" has been variously used by authors; some have applied it indiscriminately to any tumour growing upon the gums; others have restricted it to those having a fibrous structure; others, again, have applied it to those only of the many tumours of the gums that have a fibrous, myeloid, or epitheliomatous character. The last application of the term is, perhaps, more generally in use, and will be adopted here.

The fibrous epulis.

The fibrous epulis is little more than an hypertrophy of

the gums, and is composed almost entirely of fibrous tissue in which a few spindle-shaped cells are occasionally found. It commonly begins on one of the little tongue-like processes of gum which project between the teeth, and is nearly always connected with the periodontal membrane, that is, the periosteum lining the tooth-socket. It appears as a flattened, firm, dense, often slightly lobulated tumour, covered with mucous membrane of the same colour as that of the rest of the gum. As it increases in size the tooth or teeth with which it is connected become loose, and fall out; the bone below becomes hypervascular, and osseous spicula grow up from it into the deep part of the tumour. The fibrous epulis is usually of slow growth, but may attain a large size.

1796.—A tumour removed from the alveolar margin of a superior maxillary bone. It is of a rounded form, and consists of a very firm fibrous tissue, with specks of bone in it. See also No. 1798.

1797.—Sections of the front of a lower jaw which was removed with an epulis. The epulis is of a rounded oval form and of a firm obscurely fibrous texture; it rose to the height of half an inch from the margin of the jaw and overlapped both its surfaces. One of the sections shows that the part of the jaw on which the tumour rested is in its own texture sound; its surface was smooth and the periosteum healthy.

From a young woman in whom the disease had made slow progress.

1798a.—A molar tooth, with an epulis attached to the fangs. The epulis was composed entirely of fibrous tissue. See also No. 1798c.

The myeloid epulis.

The myeloid epulis bears a general resemblance to the fibrous variety, but is softer, more vascular, and has large myeloid cells interspersed amongst the fibrous elements. Like the fibrous, the myeloid variety is frequently connected with the periodontal membrane.

There are no specimens in the Museum.

The epitheliomatous epulis.

The epitheliomatous epulis has a structure resembling that of epithelioma in other situations.

There are no specimens in the Museum.

DISEASES OF THE JAWS.

NECROSIS OF THE JAWS.

The lower jaw is more frequently the subject of necrosis than the upper, a fact depending partly upon its poorer blood-supply and partly upon the tendency of necrosis to affect compact in preference to cancellous bone. The whole, or a part only, such as the alveolar margin of the upper and the anterior wall of the lower, may suffer. But for the same reasons that necrosis is more frequent, it is also more extensive in the lower than in the upper jaw. The teeth become loosened, and generally drop out; at times, however, they retain their connection with the gums and remain *in situ* long after the sequestrum is removed. In young subjects the germs of the permanent teeth usually perish along with the temporary set; yet in exceptional cases they have escaped destruction, and have been cut subsequently to the formation of new bone around them, a fact which has led some into the error of supposing that new dental germs had been formed.

Necrosis of the jaw is generally dependent upon periostitis induced by inhaling phosphorous fumes, by fever, syphilis, the abuse of mercury, or by cancrum oris or other ulcerative affections of the mouth. The necrosis may also be the result of injury to the jaw.

Phosphorous necrosis.

Necrosis of the jaw was formerly common in operatives engaged in lucifer-match manufactories, and was induced by inhaling phosphorous fumes. Since the introduction of matches tipped with the amorphous form of phosphorus,

this disease has not been so frequent. A case is reported by Sir James Paget where necrosis was induced by inhaling phosphoric acid as a supposed remedy for nervousness. The disease is now generally thought to be the result of a local periostitis, and to occur only where the teeth are carious or have been lost, with exposure of the dental periosteum to the direct action of the fumes. Langenbeck, however, still supports the older theory that it is dependent on a constitutional condition induced by the phosphorous fumes. No doubt constitutional symptoms are frequently observed, but they are rather the result than the cause of necrosis.

The peculiar pumice-like deposit of new bone, which nearly always covers the sequestrum in cases of phosphorous necrosis, and was formerly thought to be characteristic of it, has been occasionally found upon sequestra the result of causes other than phosphorus. It appears to consist of ill-formed bone, the Haversian canals of which are larger than normal and placed at right angles instead of parallel to the surface of the old bone. Some observers consider that this pumice-like material is formed by the periosteum, whilst the new bone ordinarily formed in jaw-necrosis is produced by the soft parts.

230.—The superior maxillary and portions of adjoining bones in a state of necrosis. The necrosis occurred in the patient after the removal of the lower jaw seen in No. 232.

231.—The greater portion of two superior maxillary bones in a state of necrosis, removed from a man aged thirty-four. The disease and death of the bone were the result of exposure to the fumes of phosphoric acid twelve weeks previously.

232.—The whole lower jaw in a state of necrosis from a boy who had worked in a match manufactory.

233.—The whole of the lower jaw, with the exception of the left condyle, in a state of necrosis, from a man, aged forty, who had worked in a lucifer-match manufactory for nearly twenty years. The jaw had been affected for about two years. It was in great part reproduced.

234.—The whole lower jaw, excepting the right condyle, in a state of necrosis.

From a man, aged forty, who had been for some time at work in a lucifer-match manufactory.

235.—Nearly the whole of the lower jaw in a state of necrosis, removed from a man who had been engaged for some time in a lucifer-match manufactory.

Syphilitic necrosis.

The parts of the jaw most frequently involved in syphilitic necrosis are the alveolar borders, the palatine processes of the upper, and the compact tissue of the anterior wall of the lower jaw.

344.—Section of a girl's face in which syphilitic necrosis and ulceration affected large portions of the maxillary and malar bones. The separate portions of bone were exfoliated.

Mercurial necrosis.

Since mercury has been more sparingly used, mercurial necrosis has been less common. There is but one specimen in the Museum, in which necrosis of the jaw is referred to the use of mercury, but as only a few grains were administered, and as the patient was suffering at the time from fever, it appears more likely to have been the result of the fever.

154.—A lower jaw, nearly the whole body of which suffered necrosis after the administration of a few grains of calomel in a case of fever. The dead bone is in part separated, and a small quantity of new bone is deposited around it. The necrosis should probably be ascribed to the constitutional condition of the patient.

Necrosis after fever.

Although necrosis has occasionally been observed after other fevers, it is as the result of the exanthemata (especially scarlet fever) that it has generally occurred. Necrosis following fever generally affects only the alveolar border, never the whole of the jaw. It especially occurs in children about the age of five or six, when the jaw contains the whole of the first and most of the germs of the second set of teeth; hence it would appear that the teeth, as dermal appendages,

frequently suffer in common with the skin, on which these fevers have a specific action.

The jaw is generally symmetrically affected—a distinguishing characteristic of this form of necrosis.

A specimen of necrosis of the jaw after rheumatic fever follows in No. 155.

152a.—The lower jaw of a child who has undergone acute necrosis of the central portion. On each side the section has been made through healthy bone. As a result of the necrosis the teeth have dropped out.

155.—A lower jaw, which has separated after necrosis, from a girl who had suffered from rheumatic fever.

Necrosis from cancrum oris.

Cancrum oris, in common with other ulcerative affections of the mouth, is apt to lead to necrosis of the jaw. A good specimen follows.

153.—A large portion of the upper jaw-bone of a child, which exfoliated after cancrum oris.

Necrosis from injury.

Necrosis of the jaw, as a result of injury, is somewhat common. Thus, small exfoliations, hardly worthy of a place in a Museum, are frequently met with after the extraction of a tooth, or after a blow or fall upon the face. A specimen of necrosis following a blow upon the jaw follows.

180.—Portion of an upper jaw, with two molar teeth, which separated by exfoliation. The necrosis was consequent upon a severe blow upon the face.

Reproduction of the jaw after necrosis.

It was formerly believed, and is still stated in several text-books, that new bone is never formed after necrosis of the jaw. As far as the upper jaw is concerned, this statement is substantially correct, for it is only in a few cases where the reproduction has been represented by a few scattered plates of bone that any fresh osseous material has

been observed. Except in the case of children, the subjects of exanthematous necrosis of the jaw, not even does fibrous tissue appear as a substitute for the old bone. The case, however, is very different after necrosis of the lower jaw, where very substantial reproduction takes place, and where even an attempt at the reproduction of the condyle and coronoid process may occur. The teeth, as might be expected, are not reproduced (see p. 377).

245.—A lower jaw, which was reproduced in nearly its entire state in the man from whom the necrosed jaw (No. 233) was taken. The present specimen was removed after death. It consists for the most part of well-developed bone with intervals of fibrous tissue in various stages of ossification.

246.—A similar specimen, with the exception that the reproduction is much more complete. The coronoid process is completely reproduced on the left side and partly on the right. There has also been an attempt at reproduction of the condyles.

TUMOURS OF THE JAWS.

FIBROMATA.

Fibrous tumours are not an uncommon affection of the jaws; they occur in both upper and lower with equal frequency. In structure they resemble fibrous tumours of other parts, being generally white, dense, hard, and fibrous on section. They have been supposed to be recurrent, but their occasional return is probably due to their imperfect removal. They are liable to the same degeneration as fibrous tumours in other situations.

Fibrous tumours of the upper jaw spring either from the periosteum covering the alveoli, or from that lining the antrum. They are generally lobulated, growing in all directions, and insinuating themselves into the different fissures and fossæ in their neighbourhood. When beginning in the antrum, they expand the walls of that cavity, encroaching upon the mouth, orbit, or nose, protruding forwards on to the cheek or backwards into the spheno-

maxillary fossa, or in several or all of these directions at the same time.

Fibrous tumours of the lower jaw arise either from the periosteum or from the interior of the jaw. In the former case they usually occur upon the front of the jaw, and have a more or less smooth surface and globular form; in some instances they almost surround the jaw. They differ from the fibrous tumours of the gums (epulides) merely in their situation and their larger size. In the latter case, *i.e.*, when they spring from the interior of the jaw, they gradually expand the bone around them, and finally cause absorption of their bony case and protrude externally, the external wall of the jaw generally yielding more and giving way sooner than the internal.

M. Broca states that there are fibrous tumours which occasionally originate from tooth-germs, but excepting that they are encapsuled, and only occur in young subjects who have not completed their second dentition, they do not differ from the ordinary kind.

In the upper jaw.

434.—An upper jaw-bone with a large oval tumour, which appears to have originated in its interior, and, in growing, to have separated and extended its walls in every direction. The tumour, elongated from above downwards, projected remarkably into the orbit, lifting up the orbital plate of the jaw-bone. It has a very dense, compact texture and a grayish basis, which is intersected by curved and reticulated shining white lines.

433.—The right superior maxilla, removed by operation, from a girl aged twenty-six. Seven years previously a small growth had been removed from the alveolar process of the same bone. The growth recurred four years afterwards. The whole of the interior of the bone is occupied by a firm fibrous growth.

1799a.—A pedunculated calcifying fibroma, which grew from the upper jaw of a man aged forty-six. The tumour had been growing for twenty-seven years, causing so little inconvenience that the patient was unwilling to have it removed. It sprang from the palate, just behind the incisor teeth.

In the lower jaw.

The periosteal variety. 436.—Part of the base of a lower jaw, and of a tumour which extended from its angle to the place of the canine tooth on the left side. The tumour appears to spring from both surfaces, as well as from the alveolar border of the jaw; it is intimately connected with them, and their periosteum is involved in it. It rises, with a nearly smooth, oval surface, to a height of almost an inch from the jaw. Its texture is dense, tough, elastic, white, with glistening bands, like a section of fibro-cartilage. Its posterior and lower surface is covered with a thin plate of bone, which appears to have grown over it from the lower border of the jaw.

The patient was a woman twenty-eight years old. The tumour had been growing for two years, and seemed to spring from the socket of a tooth which was extracted on account of caries. During the first eighteen months it was painful; in its later progress it was much less so. The patient remained well for at least a year after its removal. The microscope revealed a well-developed fibrous tissue.

The endosteal variety. 435.—A vertical section of the left half of a lower jaw-bone, the walls of which are disparted and extended round a large oval tumour growing within them. The tumour extends from the right side of the symphysis, along the entire length of the left horizontal portion of the jaw, and about one-third of its ascending portion. It is composed of a very firm, dense, fibrous tissue.

The investment of bone, formed for it by the walls of the jaw, is complete, and might be separated from it. An appearance of softening in its centre is due to an artificial perforation previous to its removal.

The patient was a healthy-looking woman, thirty-two years old. The tumour, ascribed to a blow, had been observed between seven and eight years, and had gradually increased without pain. Recovery followed its removal.

482a.—The left half of the inferior maxilla, greatly expanded by the growth of a calcifying fibroma, which, originating from the endosteum, expanded the bone in all directions to a considerable extent. The surface of the section is fibrous, with a number of small granular points where the lime salts have been deposited.

From a lady aged thirty-five, in whom the tumour had been growing for six years. Microscopic examination showed that it

chiefly consisted of fibrous tissue, in the meshes of which were oval cells. The growth was in parts undergoing calcification. It did not recur.

Fibrous tumours, although generally hard and firm, are occasionally soft and succulent, approaching the myxomata in consistency.

ENCHONDROMATA.

Cartilaginous tumours of the jaws are rare. They begin either on the surface of the jaws or in the antrum, and extend in all directions, causing great destruction of surrounding parts. In structure they resemble ordinary cartilaginous tumours, and, like them, are liable to calcareous degeneration. They are liable to return when removed, and have been known to affect distant organs.

1773.—Section of a large tumour, formed in the face of a lad sixteen years old. The greater part of it occupies the situation of the superior maxillary bones, which are completely absorbed. Above the tumour has extended through the left side of the base of the skull into its cavity, where it forms a large projection in the situation of the anterior lobes of the cerebrum; below, it is united to the soft palate; in front, it protrudes, and distends the left nostril, and has caused ulceration of a part of the integuments of the face. The outer surface of the tumour is nodulated; its interior, shown by the section, is formed of closely set nodules and masses of cartilage, partially and irregularly ossified, and in some parts intersected by layers of a softer, probably fibrous, tissue. A portion of its external surface, projecting below the left nostril, has sloughed.

OSTEOMATA.

Osseous tumours differ somewhat according as they implicate the lower or the upper jaw.

In the lower jaw they generally appear as pedunculated outgrowths springing from the body or from the ramus of the jaw, in the neighbourhood of the angle, and are commonly hard and compact, like the ivory exostoses. Occasionally, however, they occur on other parts of the jaw,

when they have usually a cancellous structure, and are tipped with cartilage. The latter are regarded by some as ossified enchondromata.

In the upper jaw two forms of osseous tumour occur. Of these, one kind resembles an ordinary exostosis, being composed of cancellous or of hard ivory-like bone, and generally grows upon the surface of the jaw. The other variety has already been described under the osteomata as "Diffused osseous growths" (p. 68). The latter begin in the walls of the antrum and grow inwards into that cavity until it is completely filled, while at the same time they frequently occur upon the outer surface of the maxilla and spread to the neighbouring bones (see Nos. 397, 400a).

In the lower jaw. 401.—A portion of the left side of the body of the lower jaw of a child, corresponding with the canine and the first two molar teeth; projecting from its external surface is a tumour composed of cancellous tissue covered with a layer of compact bone. The periosteum investing the tumour is greatly thickened, but was found under the microscope to be normal in its structure.

From a child ten years old. A tumour of the jaw had been observed for eighteen months, and a portion of it had been removed about four months before she came into the hospital. On her admission the growth was increasing so rapidly, and the parts over it were so vascular, that it was feared it was of a malignant nature. The child recovered after the operation.

Case G. 554a.—The lower jaw of a man, presenting an osseous tumour on its right half. The tumour has grown from the interior of the ramus, immediately above the mental foramen. Its upper surface is indented apparently by the action of the teeth in the upper jaw.

In the upper jaw. 400.—A dense osseous tumour, involving the whole of the left superior maxillary bone. From a boy aged nine years.

MALIGNANT GROWTHS.

Sarcomata as well as carcinomata invade the upper jaw and antrum. The sarcomata are usually round-celled, and occur in young people, whilst the carcinomata are spheroidal-

or squamous-celled, and are usually found during the later periods of life. The first indication of the disease in the case of *sarcoma* is the appearance of a swelling of the face, the result of an expansion of the antrum, in the mucous membrane of which the growth begins. As the tumour increases in size it may project through the roof of the antrum into the orbit, through the internal wall into the nasal cavity, through the posterior wall into the sphenomaxillary fossa, through the anterior wall under the skin of the cheek, through the floor into the mouth, or in several or all of these directions at the same time. The skin or mucous membrane finally gives way, and a fungating mass protrudes upon the cheek, in the nose, or in the mouth. The lymphatic glands seldom become affected. The growth is reproduced in distant organs.

In *carcinoma* of the upper jaw the new growth replaces the structures which it destroys, but seldom grows so far beyond or out of them as to produce actual swelling, except such as may be mistaken for the effects of inflammation and necrosis of the bone. The lymphatic glands are only rarely affected. The disease runs its course very rapidly.

Medullary or spheroidal-celled cancer in the lower jaw commonly begins in the interior of the bone, and as it increases in size expands the walls of the jaw around it, and finally protrudes through the skin or through the mucous membrane into the mouth. The lymphatic glands and distant organs may be affected in the same way as in cancer of the upper jaw.

Spindle-celled sarcomata.

Spindle-celled sarcomata occur both in the upper and in the lower jaw, but are rather rare. They generally spring from the periosteum, and invade the bone as they increase in size. To outward appearance they resemble fibrous tumours; microscopically they have the same structure as spindle-celled sarcomata in other situations. They are liable to return after removal.

442.—Sections of a tumour and of the portion of the lower jaw from which it originated, removed by operation. The portion of the jaw comprises its whole side, from the angle to within a short distance of the symphysis. The morbid growth consists of a gray, dense, fibrous substance, originating from the alveolar border and from the outer surface of the jaw. Part of the alveolar border of the jaw has been absorbed, and in this situation the morbid growth appears to extend into the bone. The contiguous substance of the jaw is of an ivory-like hardness, and its cancellous texture is consolidated. From a female aged thirty. Microscopically the tumour is a spindle-celled sarcoma.

Return of spindle-celled sarcomata.

443.—Sections of a tumour which formed in the side of the neck immediately below the seat of the operation by which the parts last described were removed. The tumour consists throughout of a firm fibrous substance. The irregularity of surface and looser texture which it presents in one situation result from the ulceration and sloughing of its substance, which commenced a short time before death. With the smaller section of the tumour is connected a part of the lower jaw; its texture is sound, but the morbid growth is closely attached to its surface.

444.—Part of a lower jaw, including one of its rami and the symphysis, embedded in a large spindle-celled sarcoma, taken after death from the patient from whom the tumour shown in No. 150 was removed two years previously. The tumour projects with an ulcerated surface into the side and floor of the mouth, displacing the tongue and soft palate, and rising as high as the condyle of the jaw. It has one or two smaller tumours of the same kind resting on its surface, but not connected with the jaw.

The tumour has the microscopic structure of the spindle-celled sarcomata. A section of the tumour is contained in the Microscopical Cabinet, No. 20.

Myeloid sarcomata.

The myeloid sarcomata may affect either the upper or lower jaw. They sometimes arise from the periosteum, but more commonly from the interior of the bone, which, as they increase in size, becomes expanded around them, and at last gives way, allowing them to protrude externally. They have all the characters of the myeloid sarcomata; they

are smooth, translucent, and waxy-looking; in colour either of a yellowish-gray, suffused with blotches of brown, crimson or purple, or of the uniform tint of voluntary muscle; they present under the microscope the characteristic myeloid cells. They are generally single and of slow growth, they rarely undergo ossification, but are liable to mucoid degeneration leading to the formation of cysts.

In the lower jaw.

457.—Section of the anterior part of a lower jaw, and of a tumour, formed within it. The anterior and posterior walls of the jaw are separated, and form a thin layer, like a capsule of bone, around the tumour, which has grown in between and gradually extended them. Their tissue appears unchanged. The tumour is of oval form, and its substance is generally firm and compact, without any distinct fibrous or other texture; immediately after removal it had a grayish tinge, suffused with deep crimson, brownish, and purple blotches; it presented the microscopical characters of a "myeloid" tumour. The cut surface of the tumour presents the sections of several cysts, which were irregularly placed within its substance and were filled with clear yellowish fluid.

The patient was a lad eighteen years old. The tumour had been observed gradually increasing, without pain, for eight months, and projected into the mouth through one of the alveoli. He remained well for more than four years after the operation.

461.—The front of the lower jaw of a child, which was removed by operation on account of a tumour arising in the cancellous texture of the bone, and thence protruding into the mouth. In the progress of the operation, the front of the jaw separated into an upper and a lower portion. With the upper portion there is a part of the tumour, which was lodged in a cavity of the bone formed by the absorption of its cancellous texture and by the separation of its anterior and posterior walls. The tumour consisted throughout of a red and fleshy mass, resembling a piece of lacerated spleen. Microscopically it has the structure of a myeloid sarcoma. A section of the tumour is contained in the Microscopical Cabinet, No. 29.

In the upper jaw. 458.—Section of the fore part of an upper jaw, with a myeloid sarcoma. The tumour, seated within and above the alveolar part of the jaw, has separated and distended in its growth

the anterior and the palatine walls of the bone, which form a kind of bony investment for it.

The patient was a girl, twenty years of age, of healthy appearance. The tumour had been observed, as a projection in the left nostril, ten weeks before it was removed.

459.—Portion of an upper jaw, including nearly the whole of its front wall, distended over a large myeloid sarcoma, which presented all the characters of the two preceding, except in that its substance had almost uniformly the colour of voluntary muscle. Nearly the whole of this colour was quickly discharged, as if by bleaching, when the tumour was immersed in alcohol. It now presents a uniform pale colour and a firm compact substance, in which portions of cancellous bony tissue are irregularly scattered.

The patient was twenty-two years old. Growths, like the common epulis, had been thrice removed from her right upper jaw before the growth of this tumour was observed. The last of the three growths extended through an alveolus into the cavity of the antrum, which it nearly filled. All, however, appeared to be removed, and the wound of the operation healed soundly. Nine weeks afterwards this tumour in the right upper jaw-bone was observed projecting in all directions. It regularly increased, and about two months later a similar tumour appeared in the left upper jaw. Both tumours grew rather quickly. Six months after the appearance of the first the greater part of the jaw-bone was cut away (including the part here preserved), and the rest of the tumour, which appeared to fill the whole interior of the jaw-bone, was removed piecemeal. The wound healed soundly, and during the nine months following the operation no reproduction of the growth had taken place; the tumour in the left upper jaw-bone had somewhat diminished in size and had become harder, and two small swellings which had long existed on one of the parietal bones disappeared.

Carcinomata.

In the upper jaw. 1771.—Part of the right side of a face, in which the antrum and other nasal cavities and passages are completely filled by a soft medullary tumour, which also projects with an extensive sloughing surface through the skin of the cheek and through the anterior part of the gum and of the hard palate.

1772.—The left side of a face with a soft medullary tumour filling the antrum, and thence extending into the nostrils and into the cavities of the mouth and orbit. The parts of the tumour

which are exposed are broken and flocculent, as if sloughing. See also No. 1772a.

In the lower jaw. 3312.—Portion of a lower jaw, comprising one side of the bone from the angle to the symphysis, which was removed by operation from a young woman. A soft medullary growth, originating in the interior of the bone, has caused the expansion of its surrounding walls. In the upper half of the section the morbid structure has been separated from the cavity in which it was embedded.

CYSTIC TUMOURS IN THE JAWS.

True cysts in the jaws must be distinguished from cysts due to cystic degeneration of other tumours. They may occur in the upper or the lower jaw, and may be either simple or multilocular. *The simple cysts* can often be traced to the irritation of a decaying tooth fang, or to the faulty development of a tooth (see Dentigerous Cysts). In the upper jaw they generally appear to originate in the dilatation of one or more of the follicles of the mucous membrane lining the antrum; as they enlarge they expand the walls of the antrum around them, encroaching upon surrounding parts like solid tumours. In the lower jaw they appear to begin in the endosteum lining the bone. Whether they occur in the upper or the lower jaw they expand the bone around them until it in some cases becomes so thin that it crackles under pressure like parchment, and in places may be completely absorbed, leaving nothing but the membranous cyst-walls. The cysts are commonly lined with a vascular membrane; they usually contain serum, or a glairy fluid like white of egg, or in some instances a brownish fluid containing crystals of cholesterin.

535.—Sections of a tumour, with the side of the body of the lower jaw in which it originated; removed by operation. Part of the mucous membrane of the mouth, unaltered in structure, is extended over the upper surface of the tumour. The disease originated in the cancellous texture of the jaw. The walls of the bone are expanded into a thin case enclosing the tumour, but, in consequence of the absorption of the bone in some situations, this case is incomplete. The morbid growth consists of soft fibrous

tissue, with cysts dispersed through it, which cysts contained a glairy fluid. The boundaries of some of the cysts are thin plates of bone, apparently the remains of the original cancellous texture of the jaw.

The cysts were probably the result of *mucoïd* degeneration of portions of the tumour.

A section of the tumour is preserved in the Microscopical Cabinet, No. 51.

The multilocular cysts are much more common in the lower than in the upper jaw. They grow slowly, but attain a very large size. The walls of the cysts are either bony or consist of fibrous tissue, whilst the cysts contain a viscid fluid. They occasionally recur after removal. Mr. Eve has shown that the solid part of the tumours is composed of irregular branching columns of small round epithelial cells, resembling those in the deeper layers of the epithelium of the gums, surrounded by a fibrous stroma. In some cases the cells at the circumference were columnar. The cysts are formed by colloid degeneration of the epithelial cells. These tumours, according to Eve, result from the ingrowth of the epithelium of the gum, the starting-point of the disease being in many cases the irritation caused by a diseased tooth; whilst other observers believe them to be of foetal origin.

535a.—A portion of the left half of an inferior maxilla removed by operation. The whole of the body and the greater part of the ramus is occupied by a new growth, which appears to have originated in the substance of the bone itself. The two bicuspid teeth are firmly fixed in their normal position; the first and second molars are absent, but the wisdom-tooth is thrust upwards by the growth, so that it now occupies the base of the expanded coronoid process. The body of the jaw is distended by a tumour, which has thinned and destroyed the compact bone. The growth protrudes both externally and internally, and in the former position has infiltrated the masseter muscle. The section of the body of the jaw shows that the tumour extends as far forwards as the canine tooth. The growth is soft and friable, in parts cystic, with its anterior portion definitely encapsuled. In the recent state these cysts contained a brownish blood-stained fluid. Microscopical examination

shows that the tumour is a cystic epithelioma. The bone is infiltrated with masses of epithelial cells, which are breaking down in their centre so as to form cavities. The stroma consists of connective-tissue.

The patient, a married woman, aged twenty-nine, had been admitted five years previously on account of a tumour which had grown for seven and a half years on the site of a left lower molar tooth. The tumour was removed by cutting away an outer shell of bone and subsequently gouging out the growth. On readmission to the hospital, the left side of the inferior maxilla was found to be very much swollen immediately above the scar resulting from the previous operation. The swelling extended on to the alveolar border of the jaw in such a manner that when the jaws were closed the growth covered the outer aspect of the upper molar teeth, whilst it extended for more than an inch and a half on the inner side of the jaw towards the middle line. The growth was ulcerating at the time when the excision was performed. After the operation the patient made a good recovery.

537.—An inferior maxillary bone, in the greater part of its extent irregularly expanded to form imperfect septa between cysts. These, independent of one another, had their origin in the interior of the bone, were lined with a highly vascular membrane, and contained thin, serous, or grumous blood-tinged fluid. Of some the walls were thin, of some thick and resisting, as in the case of the posterior mass, which in its increase pressed upon and caused absorption of the left ascending ramus and coronoid process.

This preparation was obtained from the body of an old man. The disease had been some years in progress. The age of the patient prohibited its removal, but the various cysts were from time to time punctured and their contents evacuated.

Dentigerous Cysts.

Dentigerous cysts are collections of serum, or some modification of serum, occurring in the maxillary bones, associated with, and dependent upon, impacted misplaced teeth (Salter). When a tooth is completely developed its fang will be found embedded in its bony socket, while its enamel will be immediately surrounded, and separated from the jaw, by a soft membrane which was formerly part of the enamel organ. When from some cause or other the cutting of the

tooth is delayed, a small quantity of serous fluid is secreted by this membrane, slightly separating it from the enamel. "This fluid ordinarily is discharged when the tooth is cut, but when from some cause the eruption of the tooth is prevented it increases in quantity, gradually distending the surrounding tissues in the form of a cyst" (Heath).

The cyst thus formed appears lined by a thick soft membrane, and the crown of the tooth, the fang of which is embedded in the bone, will commonly be found projecting into its deeper part. Occasionally, however, the tooth may be found loose in the cyst or but slightly attached to the lining membrane; in such a case the tooth socket has been encroached upon and absorbed by the pressure of the cyst. Dentigerous cysts are nearly always developed in connection with the *permanent* teeth. They must be distinguished from cysts depending upon the irritation of a decayed tooth fang; in the latter the fang will commonly be found associated with or projecting into the cyst, whereas in the dentigerous the crown alone, or the whole of the tooth in cases where the bony socket has been absorbed by the pressure of the cyst, will be found in the inside of the cyst.

539.—Portion of a bony cyst which was removed from the external and lateral part of a lower jaw. The cyst is lined by a thick and soft membrane, which has been in part separated from it. The cavity of the cyst was filled by a glairy fluid, and at the bottom of it a canine tooth of the second set was adherent to the lining membrane. Upon the exterior of the cyst are some branches of the facial nerve which were removed with it. At the bottom of the bottle is the tooth which was contained in the cyst.

539a.—A dentigerous cyst. A part only of the cyst-wall has been preserved; but attached to its inner surface may be seen a permanent central incisor. A portion of the bone and of the cyst-wall attached to it is suspended in the upper part of the bottle. From a boy aged eight years.

540.—Part of a bony cyst formed by expansion of the walls of the lower jaw of a sheep. The cyst was full of fluid, and an incisor tooth is loosely attached to its walls.

DISEASES OF THE PALATE.

NECROSIS OF THE HARD PALATE.

Necrosis of the hard palate is usually of syphilitic origin. It is due either to ulcerative destruction of the soft structures covering the palate, or to the breaking down of a gumma under the periosteum. After the necrosed portion of the palate has been exfoliated, a communication is generally established between the nose and the mouth.

The following specimen illustrates the deleterious effects produced by endeavouring to stop such a perforation by a plug.

Case E. 14.—The base of a skull, from an elderly woman, who appeared to have been long in the habit of wearing a plug to close an opening in the palate, probably of syphilitic origin. The opening, gradually enlarging, attained such a size that nothing remains of the palatine portions of the superior maxillary and palate bones, and the alveolar border of the jaw is reduced to a very thin plate without any trace of the sockets of the teeth. The antrum is on both sides obliterated by the apposition of its walls, its inner wall having probably been pushed outwards as the plug was enlarged to fit the enlarging aperture in the palate. Nearly the whole of the vomer also has been destroyed, and the superior ethmoidal cells are laid open.

The plug is preserved. It is a large circular cork, with tape wound round it, and measures an inch and three-quarters in diameter, and an inch in depth.

TUMOURS OF THE HARD PALATE.

These are for the most part allied to the epuloid growths already described as affecting the gums, and like them consist of fibrous tissue, or of fibrous tissue intermixed with myeloid elements. In rare cases they are carcinomatous. They spring from the periosteum, and are covered with healthy mucous membrane. Spicula of bone growing out from the hard palate are frequently found in them.

Warty, fatty, and encysted tumours, as well as carcino-

matous tumours both of the epithelial and medullary variety, have also been observed.

Fibrous tumours. 1800.—An elongated oval tumour removed from the palate, to which it appears to have been attached by a broad base. It is composed of a firm, very close-textured, obscurely fibrous substance, with interspersed specks of bone, like the epulis which more commonly grows from the gums.

Fatty tumours. 1799.—Sections of a tumour removed from the palate, to which it was attached by a base of much less extent than its circumference. Its surface is covered by thick, but apparently healthy, mucous membrane; and in its anterior it appears composed of lobules of fatty matter.

Carcinomata.

Epithelioma. 1800b.—A section of a tumour removed from the palate of a woman aged twenty. The tumour had been growing for a period of four years. Microscopically it resembles a glandular formation in which the gland-tissue is in most parts very imperfectly formed. The cells are evidently epithelial, and are for the most part arranged in irregular masses, separated from one another by a homogeneous stroma, which appears to be formed by a degeneration of the cells themselves. A few definite gland-tubes are met with, and in one part there are some cell-nests. The epithelial cells are generally small and round, but in the neighbourhood of the nests they become solid.

A section is preserved in **Series lv., No. 73 i.**

1800c.—A tumour removed from the palate. It is seen in section to be of firm consistence, with numerous minute cavities in it. It measures two inches in length by an inch and a half in breadth. Microscopically the stroma is composed of fibrous tissue and hyaline material. It contains small irregular masses of epithelial cells, amongst which are a few cell-nests. At one margin of the tumour the cells are larger and more numerous, whilst in places they are collected into masses which are enclosed in definite alveoli. Within a month of the removal of the tumour from the palate, where it had been growing for twenty years, it was found necessary to remove the superior maxilla. The growth infiltrating the bone was composed of a fibrous stroma enclosing very definite alveoli filled with large epithelial cells; it was evidently carcinomatous. From a man aged fifty-five. The tumour of his palate had existed for twenty years. It was pear-shaped, and was attached to the

left side of the arch of the palate, the soft palate being free. He had noticed a swelling of the left cheek and an overflow of tears for two months.

A section of the growth in the superior maxilla is preserved in Series lv., No. 73k.

TUMOURS OF THE SOFT PALATE.

Many varieties of tumours have been met with in the soft palate. The most usual, however, are the sarcomata and fibro-adenomata. The sarcomata are most frequently round or spindle celled, but the melanotic form has occasionally been found.

The sarcomata appear as rounded and elastic tumours, which are usually confined to one side of the palate; they grow rapidly, and recur after removal.

1800a.—A tumour removed from the palate of a gentleman aged sixty. It had been noticed two years previously, but had probably grown more quickly during the latter part of this period. It occupied the right side of the palate, extending a little across the middle line. It was elastic, almost fluctuating. It had a well-marked capsule, from which it was easily shelled out, as it had no firm connection with the bone. The wound healed quickly, and without any exfoliation of bone. Microscopically the growth is a fibro-sarcoma.

The fibro-adenomata grow much more slowly, and have a more definite capsule than the sarcomata. They neither recur after removal, nor do they affect the neighbouring lymphatic glands. In some cases they show a remarkable tendency to ulcerate deeply in their centre. Microscopically these tumours exhibit a very complex structure.

There are no specimens in the Museum.

The myxomata are usually soft, pendulous, pedunculated, polypoid growths. They spring from the mucous membrane, usually in the neighbourhood of the uvula. The peduncle is often so long that it allows the tumour to fall into the larynx, giving rise to spasmodic cough, and sometimes even causing suffocation, as in the case of the patient from whom the following specimen was taken.

1803.—Section of a boy's head with a large lobed tumour, of myxomatous structure, in the soft palate. The tumour was of slow growth. The patient was suddenly suffocated.

Dermoid tumours occasionally occur in the soft palate.

1803a.—Section of a dermoid tumour removed from the soft palate. It consists of a layer of cartilage covered by a tissue having the histological characters of ordinary skin.

ULCERATION OF THE SOFT PALATE.

Ulceration of the soft palate is either tubercular or syphilitic in origin.

TUBERCULAR ULCERATION OF THE SOFT PALATE.

1781a.—The larynx and trachea, with a portion of the soft palate, from a man aged fifty-six, who died with tubercular phthisis. The epiglottis and larynx are deeply ulcerated over the greater portion of their surface. The edges of the epiglottis are eroded by the ulceration, and there is some considerable thickening of the aryteno-epiglottidean folds. The soft palate has also undergone a process of diffuse ulceration.

1801a.—A soft palate, fauces and larynx affected with tubercular disease. A superficial ulceration of the mucous membrane extends over the greater part of the superior surface of the soft palate and uvula; the mucous membrane of the fauces is thickened and penetrated by numerous small ulcers. The margins of the epiglottis are superficially ulcerated, and also the mucous follicles upon it; the aryteno-epiglottidean folds, and arytenoid cartilages are unnaturally distinct, and infiltrated with tubercular material. From a boy, aged fifteen years, who was admitted to the hospital for sore throat, which he stated had only existed about a week. The cervical lymphatic glands had been enlarged for eight months. The patient died exhausted, and the post-mortem examination revealed general tuberculosis of the lung, and tubercular ulceration of the intestines. See also **No. 1781.**

SYPHILITIC ULCERATION.

1839a.—A tongue and larynx with a portion of the soft palate, showing the narrowing of the pharynx, which has resulted from the cicatrization of long-standing syphilitic ulcers. The calibre of the œsophagus is greatly narrowed at a point corresponding with the

cricoid cartilage, whilst the vocal cords are ulcerated. The soft palate had ulcerated completely through, but the ulcer had healed, leaving a perforation through which a rod has been passed. From a woman aged thirty-six, who had borne ten dead children.

CONGENITAL MALFORMATIONS OF THE PALATE.

CLEFT PALATE.

Cleft palate is due to an arrest of development of the processes which normally grow inwards from the superior maxillary bones, and, meeting in the middle line, separate the cavity of the nose from that of the mouth.

The cleft is always in the middle line, and may involve the whole of the palate, or only a part of it. In the former case the fissure generally bifurcates in front, leaving the intermaxillary bone in the angle of bifurcation, and each fork of the fissure is continued in the course of the suture between the maxillary and intermaxillary bones, through the alveolar process of the jaw and through the lip on either side (double hare-lip); or the fissure may be deflected to one side, following the course of one of the above-mentioned sutures, and extend through the alveolar process and lip on one side only (single hare-lip), the intermaxillary bone in such cases remaining fused to the maxilla on the side opposite to the cleft. The septum, which is continuous in front with the intermaxillary bone, terminates in a free border in the middle of the cleft, or it may be attached to one or other margin of the cleft. (See also p. 375.)

When the cleft of the palate is partial it may be confined to the uvula, which then appears bifid. In other cases it may involve the whole of the soft palate; or even the whole of the soft and part of the hard palate.

In rare instances, only an aperture in the middle line of the hard palate may exist; or the fissure may be confined to the alveolar process on one or other side of the intermaxillary bone. The conditions of the muscles of the soft palate are well seen in one of the following specimens, in which they have been dissected.

3424.—The head of a foetus with a wide fissure extending through the whole length of the palate and uvula. The lower border of the nasal septum projects into the middle of the fissure.

3425.—The head of a mature foetus with a fissure extending through the entire length of the hard and soft palate and uvula. The tongue and larynx have been divided through the median line, and their halves are held apart. The muscles of the soft palate are dissected. It was found that all the muscles occupied their natural positions. The palato-glossus was found proportionally larger than in the adult. The tensor palati was in its outer portion very short, the pterygoid plates appearing imperfectly developed; its inner portion did not appear fibrous. The azygos uvulæ was large, each half of the uvula having its proper muscle. The levator palati was large, and passed between some of the fibres of the palato-pharyngeus. The last-named muscle appeared normal.

DISEASES OF THE PAROTID GLAND.

The diseases of the parotid gland may be enumerated as parotitis, or mumps, abscess, salivary calculus, salivary fistula, and malignant, non-malignant, and cystic tumours. A few specimens of non-malignant tumours and salivary calculi are the only representatives of these affections in the Museum.

TUMOURS OF THE PAROTID.

Tumours of the parotid, when innocent, are generally composed of a mixture of cartilage and glandular elements. They may occur either in the substance of the gland itself, or merely upon it. They are generally encapsuled, of slow growth, and may attain a large size, in extreme cases even occupying the whole side of the neck. The skin, though non-adherent, becomes tightly stretched over them as they increase in size, and may finally ulcerate. They have frequently very deep attachments; thus, they may extend between the ramus of the jaw and the internal lateral ligament, or behind the styloid process, and may involve the bloodvessels and nerves situated in the substance of the parotid gland; they have even been known to extend to the pharynx. When completely removed they do not return.

Their general appearance is well seen in the accompanying specimens.

Similar tumours, but containing myxomatous and sarcomatous elements, also occur in the parotid; these, unlike the ones above described, may return on removal.

An enlargement of the lymphatic glands situated over the parotid may be mistaken for a tumour of the parotid.

1827.—Section of a tumour removed from over the parotid gland of an apparently healthy woman about thirty years old. It is nearly pyriform, measuring about three inches and a half in length and three inches in its greatest breadth. Its upper half is composed of white, semi-transparent, and compact cartilage; its lower half of a pale, obscurely fibrous, soft substance. The boundary between the two substances is clear, though in no regular line; for a few small portions of cartilage are seen embedded in the softer substance.

The tumour had grown very slowly and without pain. It was loosely connected with the surrounding parts.

1828. — Half a large tumour removed from over a parotid gland. The tumour formed a somewhat kidney-shaped mass, with its concavity resting on the parotid and adjacent structures. It is composed of large lobes, the partitions between which are in many places ossified. Its cut surface has a generally ochre-yellow or fawn colour varied with paler tints, and with small nodules of cartilage and a few portions of bone-like grains embedded in it. Its substance is very firm, hardly compressible, but easily rending or breaking. A few small cysts lie scattered in it; a large cyst filled with fluid was connected with a part of the tumour, not shown here.

The patient was a woman sixty-five years old. The tumour had been slowly increasing for thirty-three years; and within the last year the skin over it had ulcerated, allowing a portion of it to protrude. It reached from just below the ear to the lower part of the neck, overhanging the clavicle; forwards it extended nearly to the median line, and backwards nearly to the margin of the trapezius. The patient's general health was not materially affected by it, and she recovered after its removal. But a portion left in the operation subsequently increased rapidly, and then ulcerated, and by discharge and pain destroyed life in about twelve months. See also Nos. 1829 and 1830.

1830a.—Section of a similar tumour removed from the same situation as the preceding specimens. In its centre is a cyst which contained some viscid mucoid fluid.

From a man, aged thirty-eight, in whom it had been growing three years. In microscopic structure it consisted of a fibrous tissue mixed with fibro-cartilage, and traces of gland acini.

Microscopic sections are preserved in the Histological Cabinet, No. 73e.

1832a.—Section of adeno-sarcoma removed from the parotid gland of a boy. It consists of embryonic connective-tissue containing tubules of gland-tissue lined with small round epithelial cells.

SALIVARY CALCULI.

Calculi are occasionally found in the ducts of the salivary glands. They are generally composed of animal matter impregnated with phosphate of lime, and a trace of carbonate of lime. They are commonly of an elongated form, and may attain a considerable size; they have been found measuring more than an inch in length.

1826a.—A submaxillary gland removed with a large submaxillary calculus. There is a deep depression at the upper and inner part of the gland, where the calculus lay. At the bottom of this depression is Wharton's duct, cut across at the point where it leaves the gland. A piece of glass rod has been passed along its lumen into the gland tissue. The gland itself is indurated, but otherwise appears to be healthy.

The gland was removed from a gentleman aged fifty-two, through an incision in the neck. The presence of the calculus was suspected, but was not discovered until after the removal of the gland. The patient had been subject to an occasional swelling of the submaxillary region for more than forty years. There had been permanent enlargement and suppuration of the salivary gland for some time before the operation was performed.

The calculus is preserved in **Series liii., No. 245a**, and a cast of it in **Series lvi., No. 117a**.

Series liii., No. 243.—Two small calculi from a parotid duct.

Series liii., No. 245.—A very large calculus removed from a woman's submaxillary duct. A portion of it was crushed in the extraction. When entire it measured an inch and a half in length,

and a third of an inch in diameter. Its composition is phosphate of lime with animal matter, and a trace of carbonate of lime.

Series liii., No. 248.—Three calculi which were removed from the submaxillary duct.

Series liii., No. 252.—A minute calculus removed from the submaxillary duct of a child.

Series liii., No. 251.—A calculus from the submaxillary duct of an old man, the grandfather of the child from whom the preceding specimen was taken.

DISEASES AND INJURIES OF THE TONGUE.

MACROGLOSSIA.

Hypertrophy of the tongue is a disease of early life; it is often congenital. The hypertrophy, which chiefly affects the anterior part of the tongue, may be so considerable as to cause displacement of the teeth, and even in extreme cases to occasion suffocation.

A variety of hypertrophy is described by Virchow as consisting in the dilatation of the lymphatic spaces of the tongue with clear serous fluid.

1779.—A horizontal section of a portion of an hypertrophied tongue removed by the *écraseur* from a child aged three years. The tongue had increased in size since the age of sixteen months.

The portion removed always protruded from the mouth. The child never complained of it, but could masticate without trouble and talk very well. The lower teeth, however, had become pushed downwards, and pointed unnaturally outwards from the pressure above. The structure seems to be that of healthy tongue, with a thickened mucous membrane.

GLOSSITIS.

Glossitis, or inflammation of the tongue, is either acute or chronic. The acute form is a deep inflammation of the tongue, which may be due to mercury, fever, iodism, carious teeth or other causes of injury to the organ. It is not of very frequent occurrence. Chronic superficial glossitis, which is also known as psoriasis, leukoplakia, or ichthyosis of the tongue, is frequently seen. It may be induced by

syphilis, excessive smoking, some forms of dyspepsia, the abuse of spirits, jagged teeth, etc. It begins as a hyperæmia of the papillary layer, and at first presents slightly raised red patches, which are best seen after drying the surface. This is followed by an excessive growth of the epithelium, the cells of which assume a horny character, whilst the patches, which were previously red, become bluish white, and later opaque white. Several of the patches may now coalesce, so that in severe cases the whole of the dorsum of the tongue may be covered. It is this condition to which the term *psoriasis* (Mr. Butlin's drawings, **Plate vi., No. 3**) has been applied, from its superficial resemblance to psoriasis of the skin. Still later, from excessive heaping up of the epithelium, the surface of the organ becomes cracked and nodular, simulating *ichthyosis* (Mr. Butlin's drawings, **Plate vi., No. 2**), a name by which it has also been called. After a varying period the hypertrophied papillæ may atrophy, or ulceration may occur, or the epithelium may grow into the substance of the tongue and the disease become epitheliomatous (Mr. Butlin's drawings, **Plate vii., No. 3**).

Ulceration of the tongue.

Ulceration of the tongue is of various kinds.

Simple ulceration may depend upon digestive disturbances (*dyspeptic ulcer*). This variety usually occurs on the dorsum of the tongue near the tip, as a small circular ulcer, which is well seen in Mr. Butlin's collection of drawings (**Plate iii., No. 4**). It may, however, be extensive and multiple, and is often accompanied by some superficial glossitis.

The *dental ulcer* is another variety of simple ulceration, which is, as its name implies, the result of the irritation produced by a jagged or carious tooth. It commences as a red abrasion of the mucous membrane. The edges are abrupt, and a little raised, but not everted; the base is depressed, sloughing and sometimes phagedænic, but not indurated, unless the ulcer has become *chronic* (see Mr. Butlin's drawings, **Plate iv., Nos. 1 and 2**, and **Plate iii., No. 2**).

The *aphthous ulcer*, as its name implies, results from the irritation consequent upon the growth of the oïdium albicans, or thrush fungus (Mr. Butlin's drawings, **Plate iii., No. 1**).

Tubercular ulceration is rare; it occurs in young adult males who have pulmonary phthisis or general tuberculosis. It usually begins as a small pimple or nodule on the dorsum of the tongue, especially near the tip. This breaks down into a round, oval, or irregular ulcer, whose edges are slightly inverted and undermined. The base is uneven or nodular, and covered with coarse granulations, or with a slough. Sometimes several ulcers may appear round the one first formed, and may coalesce with it. See Mr. Butlin's collection of drawings (**Plate iv., No. 3**).

The tubercular ulcer of the tongue may generally be distinguished from cancer by its uneven granular base, its inverted, undermined edges, and the absence of induration and glandular enlargement. The following is a specimen of this affection :

1782.—The right half of a tongue, on the border of which is an ulcer with an uneven, coarsely granular base, and an inverted and somewhat undermined margin. It has destroyed the whole thickness of the mucous membrane of the tongue, exposing at irregular depths the muscular tissue.

The patient, a man thirty-seven years old, died with advanced tuberculous disease of the lungs and larynx. The ulcer of the tongue was of eight months' duration. For a short time before his death it appeared to be healing, but before this time it had presented so close a resemblance to the common tuberculous ulcer of the intestines that it was believed to be of tuberculous nature. The coexistent disease in the lungs and larynx, and the absence of any cancerous tissues near the ulcer, further justified this belief. See also **No. 1781**.

Syphilitic ulceration is either superficial or deep. The superficial ulcers affect the side of the tongue, and are frequently associated with similar ulcers on the lips, cheeks, palate, gums and fauces. They are usually of an oval or irregular shape, and have sharply-cut edges, an ashen gray base, and a surrounding areola of inflammation. Such

superficial ulcers are often associated with mucous tubercles.

The deep ulcers are due to breaking down of syphilitic gummata. They generally occur in the centre of the dorsum of the tongue as deep irregular excavations, with raised, slightly concave, or undermined edges and a base covered with a yellow slough and débris of breaking-down tissue. They are usually surrounded with a red areola. On healing they leave a characteristic, cracked, or stellate-looking scar. Their situation at or near the middle of the tongue, the absence of induration or glandular enlargement, the history of the gummatous swellings and of syphilis, serve to distinguish them from epithelioma or other forms of carcinoma (Mr. Butlin's drawings, **Plate v.**, Nos. 2 and 3).

Carcinomatous ulceration is usually due to the breaking down of an epithelioma. It may be grafted upon the scar of a syphilitic ulcer, or it may be the result of some chronic irritation of the tongue; occasionally it commences as a wart or pimple. The ulcer is irregular, with raised, sinuous, hard and everted edges; the base is uneven, warty and excavated; whilst the tissues around are infiltrated and indurated. Its growth is generally rapid and painful. It is most common upon the side of the tongue opposite the bicuspid teeth (Mr. Butlin's drawings, **Plate xv.**, No. 3, and **Plate xvi.**, No. 2).

Lupoid ulceration also occurs, but it is too rare to be of much importance. Mr. Butlin's drawing (**Plate iv.**, No. 4) shows a case in which such an ulcer occurred in connection with lupus of the lip.

SYPHILITIC DISEASES OF THE TONGUE.

There are no specimens of syphilitic affections of the tongue in the Museum, though there are numerous excellent drawings. See the Case of drawings presented by Mr. Butlin: Mucous patches and condylomata, **Plate viii.**, Nos. 1, 2, 3, 4; furrowed tongues from tertiary syphilis, **Plate ii.**, Nos. 2, 3, 4; tertiary plaques with glossitis, **Plate ix.**, No. 1; gummata, **Plate v.**, Nos. 1, 2, 3, 4, and **Plate ix.**, No. 2; syphilitic atrophy, **Plate x.**, No. 4.

FATTY DEGENERATION OF THE TONGUE.

1780.—A tongue, reduced to fat, from a case of progressive muscular degeneration. The subject was a man, aged sixty, who had gradually lost health and strength for two and a half years before he died. At the same time speech and the first act of deglutition failed, and he was compelled at last to communicate all wants in writing, and to force food within the grasp of the faucial arches after mastication by means of a common spatula. The tremulous twitchings of the muscles of the tongue, and eventually of others, were remarkable. Becoming slowly emaciated from imperfect nutrition, he died without additional symptoms. The nerve-centres, the nerves, and the organs generally, were examined after death, and presented a natural appearance. The tongue is converted into a mass of fat, and some other of the patient's muscles showed symptoms of the same disease in its earliest stages.

*MALIGNANT DISEASE OF THE TONGUE.**Sarcoma.*

Sarcoma of the tongue is extremely rare, but the following is a good example of it:

1786a.—A portion of a tongue which was removed on account of a sarcomatous growth. The section exhibits a soft white tumour, oval in shape, of about the size of a fives-ball, and measuring one and a half inches in length by an inch in breadth. It is situated immediately beneath the mucous membrane of the middle third of the left side of the tongue. It is circumscribed, and at one part exhibits traces of a capsule. Microscopically it consists of sarcoma cells, which are large, round, and granular. The matrix is homogeneous, but in parts granular. Numerous small bloodvessels run amongst the cells.

From a man aged forty, who first noticed a soreness about the middle of the left side of his tongue three months before admission to the hospital, though it was not until two months later that he observed any swelling. The tumour rapidly increased in size, but was only painful during mastication. One half of the tongue was removed, and the patient made a good recovery. A drawing is preserved in Mr. Butlin's case (*Plate xv., No. 1*).

Carcinoma.

Cancer of the tongue is always epithelial.

It commonly begins on one side of the anterior part of the tongue, and can often be attributed to the irritation of the sharp crown of a tooth. At first it appears as a small ulcer or fissure, with indurated edges, or as a flattened indurated tubercle; in other cases as a wart or a nodule. As the disease advances, the ulcer or fissure spreads, or the tubercle or nodule undergoes ulceration. At this stage the ulcer is generally of irregular form, with indurated, everted, and sinuous edges, a hard base and ragged sloughy surface. The submaxillary lymphatic glands become affected, and the cancer involves the whole tongue and spreads to the adjacent parts. There are excellent drawings of tongues affected with epithelioma in Mr. Butlin's case on the floor of the Museum (**Plates xv. and xvi.**).

It is often difficult to distinguish cancerous from syphilitic affections of the tongue. The general appearance of the tongue, the condition of the glands, the result of the treatment, the age and history of the patient, are the principal points to be attended to in the diagnosis. It must be remembered, however, that any chronic affection of the surface of the tongue, such as chronic superficial glossitis, or one of the several conditions which are due to it, such as ichthyosis, psoriasis, and leucoma, are often conditions predisposing to cancer.

1790.—The tongue of a man, aged fifty-five, removed by Syme's operation of dividing the symphysis of the lower jaw and removing the whole organ with the knife. The tongue is completely infiltrated with epithelial cancer, and a deep longitudinal fissured ulcer is to be seen on its superior surface. The disease had existed for nine months.

1791.—Cancerous ulceration of the tongue, from a man aged forty, who died suddenly after one profuse hæmorrhage. The disease had existed for five months. The whole right half of the tongue had been destroyed quite to the root. Another surface of the ulcer was in a sloughing state. Immediately in front of the

anterior palatine arch the ulcer communicates with a distinct cavity, with sloughing walls, below the submaxillary gland and beneath the hyoglossus muscle. Into this cavity the lingual artery opens about three-quarters of an inch beyond its origin. A bristle has been passed from the carotid through the lingual artery into the cavity, and another from the cavity through the opening into the mouth.

1788h.—The anterior two-thirds of a tongue affected with epithelioma. The front portion of the dorsum is smooth and fissured; it was the seat of chronic glossitis. The left margin presents an extensive epitheliomatous ulcer. The ingrowth extends deeply beneath the ulcer, so that it invades the muscular tissue.

From a man aged forty-four, who suffered from syphilis twenty years previously. The growth on his tongue was only noticed for two months before the operation. See also **Nos. 1781a, 1788e, and 1788f.**

INJURY TO THE TONGUE SUSTAINED IN AN EPILEPTIC FIT.

The tongue is frequently lacerated by the teeth in epileptic fits. In the following specimen the tip was completely bitten off.

1795.—The anterior half of a tongue, which was bitten off in an epileptic fit. The patient recovered and retained the power of articulation.

DISEASES OF THE FLOOR OF THE MOUTH.

Ranula.

A ranula is a semi-transparent, bluish-white swelling situated under the tongue, containing a glairy mucoid fluid. It is produced by the enlargement of one of the mucous glands so abundant in that situation. It was formerly thought to be a dilatation of the submaxillary duct.

There is no specimen in the Museum. (Drawing in Mr. Butlin's case, **Plate xi., No. 3.**)

Dermoid cysts.

Encysted tumours containing sebaceous-looking material are occasionally found under the tongue. They are generally congenital, and often attain a large size, frequently

extending into the neck and projecting as large semi-fluctuating tumours between the chin and hyoid bone. A specimen follows :

3371.—A cyst, with thin, tough walls, which was removed from beneath the tongue. It projected into the mouth, and extended so far downwards as to be prominent in the front of the neck. Its contents are a firm, grumous, and granular suet-like substance.

See also drawings in Mr. Butlin's case (**Plate xii.**, Nos. 1, 2, and 3).

DISEASES OF THE TONSILS, FAUCES, AND PHARYNX.

CHRONIC ENLARGEMENT OF THE TONSILS.

Chronic enlargement of the tonsils is generally the sequel either of chronic or oft-repeated attacks of acute inflammation of the tonsils. The enlargement usually consists in a uniform hypertrophy of the adenoid tissue of the organ, but occasionally it is produced by a distinct outgrowth from the tonsil, which resembles it in structure. The mucous membrane covering the enlarged tonsil is thickened, and either hypervascular and purplish-red, or anæmic and whitish in appearance; its surface is uneven and dotted with small pits and depressions (the mouths of enlarged follicles), filled with a sticky sebaceous secretion. The presence of this secretion gives the tonsil the appearance of being superficially ulcerated, a condition which sometimes actually exists.

The enlarged tonsil is firm and semi-elastic to the touch. On section, the adenoid tissue appears greatly increased, and the follicles, enlarged and filled with accumulations of retained secretion and epithelial debris.

1805.—A tongue, with the soft palate and its arches, exhibiting an enlargement of the right tonsil, with deep and ragged ulceration of its substance.

1806.—Portion of a large tonsil, removed by operation.

1807.—A tumour, which commenced in the right tonsil and grew out into the fauces. It was removed from a man aged forty, and

had existed eighteen months. More than a year previously a considerable portion of the right tonsil had been excised. In its general characters and structure it resembled the tonsils.

FIBROUS TUMOUR OF THE TONSIL.

1807a.—A polypoid growth which was removed from the tonsil. The tumour consists of a larger and a smaller portion, each of which is crescentic in shape. The two portions of the growth are attached to each other by a narrow bridge of tissue. Microscopically, the tissue is a soft fibroma, consisting entirely of connective-tissue.

From a man aged twenty-five, who stated that for ten years he had repeatedly suffered from sore throat. The swelling, however, gave him no inconvenience, and he did not know how long it had been growing.

ULCERATION OF THE FAUCES, TONSILS, AND PHARYNX.

The pillars of the fauces, the tonsils, and the back of the pharynx, are very subject to ulceration. The ulceration may follow simple inflammation, as in the ordinary ulcerated sore throat, or it may depend upon syphilis, tubercle, or scarlet fever.

Syphilitic ulceration.

1784.—A tongue and pharynx, exhibiting extensive sloughing of their mucous membrane, which was considered to be the effect of mercury administered to a syphilitic patient.

1838.—Part of a pharynx and œsophagus, with the larynx. The mucous membrane of a part of the pharynx and œsophagus is destroyed by ulceration. The surface of the ulcer is uneven and ragged, and in one point, marked by a bristle, the ulceration extends through the adjacent lateral wall of the trachea.

1839.—The base of a tongue, with the pharynx and other adjacent parts. A large portion of the mucous and submucous tissues of the pharynx, and of one margin of the epiglottis, is destroyed by sloughing and ulceration. The mucous membrane covering the upper part of the larynx is œdematous and, in some parts, superficially ulcerated.

From a girl who was greatly debilitated by the effects of syphilis and mercury.

1839a.—A tongue and larynx with a portion of the soft palate, showing the narrowing of the pharynx which has resulted from

the cicatrization of long-standing syphilitic ulcers. The calibre of the œsophagus is greatly narrowed at a point corresponding with the cricoid cartilage, whilst the vocal cords are ulcerated. The soft palate had ulcerated completely through, but the ulcer had healed, leaving a perforation through which a rod has been passed.

From a woman aged thirty-six, who had borne ten dead children.

Tubercular Ulceration.

1801a.—A soft palate, fauces and larynx affected with tubercular disease. A superficial ulceration of the mucous membrane extends over the greater part of the superior surface of the soft palate and uvula; the mucous membrane of the fauces is thickened and penetrated by numerous small ulcers. The margins of the epiglottis are superficially ulcerated, and also the mucous follicles upon it; the aryteno-epiglottidean folds, and arytenoid cartilages are unnaturally distinct, and infiltrated with tubercular material.

From a boy, aged fifteen, who was admitted to the hospital for sore throat, which he stated had only existed about a week. The cervical lymphatic glands had been enlarged for eight months. He died exhausted. The post-mortem examination revealed general tuberculosis of the lung, and tubercular ulceration of the intestines.

Cause of ulceration not stated. 1801.—The larynx and adjacent parts, removed from a man who died under the following circumstances: He was a soldier, and was admitted into the Military Hospital with a sloughing ulcer of the throat, but without venereal taint. There was a considerable loss of substance, and his condition for many days was most critical. He improved under treatment, and all that could be seen of the ulcer healed, and the patient rapidly gained flesh. He was considered convalescent. While sitting up in the ward his mouth was suddenly filled with blood; he ejected about a pint of bright arterial blood, and died before he could reach his bed. On examination after death it was found that, although the ulcer on the soft palate and back of the pharynx had healed, a small aperture existed behind the remains of the left tonsil, which led downwards into a pouch of elongated form, the lining of which was still ulcerated. At the bottom of this pouch a small clot was found adherent, and by carefully tracing the branches of the external carotid it was found that the superior thyroid artery opened into the cavity, and thus caused the fatal hæmorrhage.

Carcinomatous Ulceration of the Fauces, Tonsils, and Pharynx.

Cancer in these situations is usually epitheliomatous or medullary. Whether it begins at the base of the tongue, in the tonsils, fauces, or wall of the pharynx, it rapidly involves the adjacent parts, converting them into a confused mass of cancer. Ulceration of the cancerous mass follows, and an irregular cavern with hard and everted edges is the result.

1792.—A larynx, with part of the fauces. A large growth of soft medullary substance, partially ulcerated, covers the base of the tongue, the soft palate, the tonsils, and the upper and posterior wall of the pharynx.

1844.—A pharynx and larynx, with the base of the tongue and other adjacent parts. A large ulcer, destroying a great part of the lower portion of the pharynx, has extended into the trachea directly below the cricoid cartilage. The margins of the ulcer are sharp and abrupt; its base is irregular, and was covered with a soft creamy matter, containing the débris of epithelial cancer.

DISEASES AND INJURIES OF THE ŒSOPHAGUS.

INFLAMMATION.

Inflammation of the œsophagus is rare. When it occurs, it is generally from traumatic causes, such as swallowing boiling water, strong acids, alkalies, etc. Inflammation, diphtheritic or other, of the pharynx has been known to spread downwards to the œsophagus. A catarrhal inflammation of the mucous membrane of the œsophagus is also occasionally met with.

From swallowing nitric acid. 1870.—An œsophagus; its mucous membrane is shrivelled, of a bright yellow colour, and thrown into longitudinal folds. The yellow discoloration stops abruptly with an irregular, jagged border at the commencement of the stomach, the epithelial and mucous coats of which are wanting, its surface being rough and of a brownish-red colour.

From the body of a man who died fifteen hours after drinking one ounce of strong nitric acid. A drawing of the stomach and œsophagus is preserved in the Museum (No. 211).

From swallowing sulphuric acid. 1940.—The stomach and œsophagus of a person who died in consequence of having taken sulphuric acid. The deep-red colour, mottled with black, and extending throughout the interior of the stomach, is occasioned by blood effused from the eroded vessels and acted on by the acid. The greater part of the mucous membrane is destroyed, and the surface exposed is rough and shaggy. In the œsophagus and near the pyloric end of the stomach, portions of the mucous membrane remain, and are red, thickened, and corrugated.

From diphtheria (?). 1835.—An œsophagus, in which the whole of the mucous membrane is covered by a uniformly thin layer of inflammatory material. Strips of the inflammatory material, which is soft as if recently effused, are reflected. In the portion of the pharynx which is preserved, inflammatory material of the same kind is deposited in separate patches.

The patient was a man thirty-five years old. He died on the seventh day of acute pleuro-pneumonia. No sign of an affection of the pharynx and œsophagus had been observed during life, and it is not probable that he had taken any large quantity of antimony. See also Nos. 1836 and 1837.

STRICTURE OF THE ŒSOPHAGUS.

Three forms of stricture of the œsophagus are described : the spasmodic or hysterical, the fibrous or simple, and the carcinomatous or malignant. The lumen of the œsophagus, moreover, may be diminished by the pressure of aneurysms, tumours, etc., external to the tube. Spasmodic stricture, which is due to the contraction of the muscular fibres of the œsophagus, will not receive further notice.

The usual situations of stricture are opposite the cricoid cartilage, opposite the bifurcation of the trachea, and at the entrance of the œsophagus into the stomach—situations where a slight contraction of the tube naturally exists.

In the fibrous and the more chronic forms of malignant stricture the œsophagus becomes dilated and its muscular coat hypertrophied, while the part below tends to become smaller.

Fibrous stricture.

Fibrous stricture is due to the contraction of cicatrices

following the destruction of the mucous membrane by corrosive poisons, strong acids, strong alkalies, or boiling water; or to the contraction of inflammatory material which has been produced in the submucous tissue as the result of syphilis or of the irritation set up by the impaction of a foreign body.

1840.—A pharynx and œsophagus, with the larynx and other adjacent parts. Just below the lower border of the cricoid cartilage, the canal of the œsophagus is reduced to a quarter of an inch in diameter, and appears flattened from before backwards. The tissues for some distance around this part are thickened, indurated, and consolidated. The mucous membrane of the anterior wall of the pharynx above the stricture is ulcerated, and appears œdematous, as if an abscess had been discharged through it. Below the stricture the œsophagus is healthy.

Carcinomatous Stricture.

Cancer of the œsophagus is usually of the epitheliomatous, occasionally of the scirrhus, and rarely of the medullary or the colloid type.

Epithelioma.—Epithelial cancer may begin as a distinct cauliflower-like excrescence springing from one side of the tube; or as a nodular induration of the mucous membrane, involving ring-like the whole circumference of the œsophagus. By some it is thought to be often secondary to a fibrous stricture. In whatever way the cancer begins, it gradually encroaches upon the lumen of the œsophagus, and eventually causes a more or less complete obstruction. Ulceration of the cancerous mass at length sets in, giving rise to a foul cavernous-looking ulcer with indurated and sinuous edges. As the ulcer spreads it may involve the mediastinum or pleuræ, or eat its way into the larynx, trachea, or bronchi. The corresponding lymphatic glands often become enlarged, but distant organs remain unaffected. Epithelial cancer is most common opposite the cricoid cartilage, the bifurcation of the trachea, and the entrance of the œsophagus into the stomach, situations where there are either changes in the character of the

epithelium, or where the developmental processes have been more than usually complex.

Opposite the Cricoid Cartilage.

1844.—A pharynx and larynx, with the base of the tongue and other adjacent parts. A large ulcer, destroying a great part of the lower portion of the pharynx, has extended into the trachea directly below the cricoid cartilage. The right half of the cricoid cartilage is denuded and separated from its connections with the upper ring of the trachea ; on this side, also, a portion of the thyroid cartilage is exposed. The margins of the ulcer are sharp and abrupt ; its base is irregular, and was covered with a soft, creamy matter, containing, probably, the débris of epithelial cancer.

Opposite the Bifurcation of the Trachea.

1844a.—Œsophagus, trachea, aorta, and glands. The œsophagus presents a large cancerous ulceration, which has extended through the anterior wall into the trachea. The opening from the œsophagus into the trachea is large and ragged ; it is divided by a septum which runs transversely across its centre. The glands are enlarged.

1852.—A larynx with part of the trachea, pharynx, and œsophagus, from a woman aged forty-nine. The specimen shows a large ulcer, two inches across, nearly round, almost surrounding the gullet, possessing very thick cancerous margins, on a level with the top of the manubrium sterni, and opening into the trachea by a hole the size of a sixpenny-piece.

1846a.—Œsophagus, pharynx, and trachea. The œsophagus is contracted by a narrow ring of epitheliomatous cancer. The stricture was treated by the retention for ten weeks of a soft rubber tube similar to the one suspended by the side of the specimen.

At the Cardiac End of the Stomach.

1847.—The lower half of an œsophagus, with the cardiac portion of the stomach. Within and just above the cardiac orifice there is an annular, flattened, spongy growth, ulcerated in its centre ; by which growth, as well as by the thickening and contraction of the surrounding tissues, the termination of the canal of the œsophagus is reduced to a very small calibre. Above the stricture the œsophagus is dilated, its muscular coat is hypertrophied, and its mucous membrane appears œdematous, and is at one part superficially ulcerated. The walls of the stomach are healthy.

1848.—An œsophagus from a man aged fifty-six, showing an epithelial cancer in a state of ulceration involving the whole circumference of the tube in its lower third. At one part the coats are entirely perforated, and the tube of the œsophagus communicated with an ulcerated cavity which lay in the tissue of the posterior mediastinum in contact with the right lung. No disease was found elsewhere.

Scirrhus cancer.—Scirrhus cancer of the œsophagus probably begins in the submucous tissue. It appears as a hard, nodular infiltration of the coats of the œsophagus, rendering the walls of that tube rigid and unyielding, and gradually producing, by its contraction and shrinking, complete obstruction of the canal. The neighbouring parts and distant organs sooner or later become affected by the cancer, and ulceration of the mass finally ensues, as in the epitheliomatous form.

1853.—Part of an œsophagus, with the trachea and bronchi. Opposite the bifurcation of the trachea the walls of the œsophagus are nearly surrounded by a firm cancerous growth. The surface of this growth where it projects into the œsophagus is ulcerated, and the ulceration, penetrating at one part through its whole thickness, has extended into the right bronchus, in the course indicated by the piece of quill.

Medullary Cancer.—Medullary cancer generally occurs as a distinct tumour projecting into the œsophagus. It grows more rapidly than the other forms of cancer, and involves sooner and more frequently the neighbouring parts and distant organs. It is very rare.

1843.—A pharynx, with the soft palate, and part of the base of the skull. The upper part of the pharynx is completely filled by a nearly globular growth of soft medullary substance with a warty surface. The growth appears to have had its origin in the walls of the pharynx, from which it projects, not only into the pharyngeal cavity, but also forwards into the mouth under the soft palate, and backwards towards the spine.

The patient was not aware of the existence of the tumour till within a few weeks of his admission into the hospital, at which time it was nearly as large as it now appears. It often bled, and it

destroyed life by the hæmorrhage, and by the impediment which it caused both to deglutition and respiration. A part of the same tumour projected through the basilar portion of the occipital bone, and extended along the outside of the œsophagus, where it was connected with enlarged lymphatic glands full of soft cancer.

In the following specimen the cancer has undergone *colloid degeneration*.

1855.—Part of an œsophagus, in which nearly the whole of the submucous tissue is occupied by a substance resembling that of colloid cancer. In many places the mucous membrane is upraised, with a low tubercular surface, by the colourless and nearly pellucid clustered cystic growths beneath it; and at one part a globular mass of the same structure, about two-thirds of an inch in diameter, is suspended from the submucous tissue into the cavity of the œsophagus.

Condition simulating stricture of the œsophagus.

1856.—A portion of the œsophagus of an elderly woman. The whole of the tissues and a part of its anterior surface are penetrated by an ulcer of an oval form with irregular edges. The base of the ulcer is formed by a mass of bronchial glands.

GASTROTOMY PERFORMED FOR THE RELIEF OF CANCEROUS
STRICTURE OF THE ŒSOPHAGUS.

Gastrotomy is the operation of establishing a fistulous opening in the stomach for the purpose of feeding the patient in cases of strictured œsophagus.

1846b.—An œsophagus and stomach, from a case of cancer of the œsophagus, in which gastrotomy had been performed eight months before death. The œsophagus is narrowed and ulcerated for a distance of three and a half inches above its cardiac extremity; the ulceration has commenced at a point opposite the bifurcation of the trachea, and has extended downwards. It has not invaded the stomach. The ulceration at its upper part had perforated the walls of the œsophagus, and has exposed a bronchial gland, which appears as a black mark extending transversely across the tube. The cancer is of the scirrhus type. There were no secondary deposits, nor were the glands infiltrated. The stomach appears to

be normal. The gastrotomy opening is situated at the lowest point in the greater curvature, midway between the cardiac and pyloric orifices. The skin with its orifice, and a portion of the costal cartilages adherent by the results of old inflammation to the greater curvature of the stomach, are left *in situ*. See also No. 1950a.

DILATATION OF THE ŒSOPHAGUS.

Dilatation of the œsophagus is generally consequent upon some form of stricture, the dilatation being limited to the portion of tube above the obstruction. In rare instances, however, the whole tube has been found uniformly dilated, even to the size of a man's arm, without any very evident cause; some, however, have thought the dilatation to be dependent upon muscular paralysis induced by chronic catarrh or ulceration of the mucous membrane. The muscular walls in such a case are usually hypertrophied, but occasionally thinned, and the mucous membrane is healthy or superficially ulcerated. When consequent upon stricture the dilatation is greatest immediately above the obstruction, and gradually decreases towards the upper end. Sometimes the dilatation is confined to limited portions of the œsophageal walls, giving rise to outgrowths or diverticula, which may consist either of a protrusion of all the coats or of a hernia of the mucous membrane between the fasciculi of the muscular fibres.

1833. *General dilatation.*—An œsophagus with a portion of the stomach. A dilatation of the œsophagus commences immediately below the larynx, and gradually increases to its termination in the stomach. In its lower half the œsophagus measured nearly six inches in circumference. In the upper half of the dilated œsophagus the lining membrane is sound; whilst in its lower half the greater part of this membrane is superficially ulcerated, and shreds of it hang in the interior of the tube. Just above the stomach, the complete removal of the lining membrane exposes the muscular fibres of the œsophagus, which are here, as in every part of the canal, hypertrophied. The passage from the œsophagus into the stomach was free, and the stomach was healthy. The patient was twenty years old. He had signs of this disease for about eighteen months

before his death, with frequent sickness about two hours after taking food, pain and tenderness in the epigastric region, and a feeling as if his food stopped at the lower part of the œsophagus. He died with peritonitis. See also No. 1834.

1847. *Dilatation from stricture*.—The lower half of an œsophagus exhibiting a stricture just above the cardiac portion of the stomach. Above the stricture the œsophagus is dilated, and its muscular coat is hypertrophied.

POST-MORTEM DIGESTION OF THE ŒSOPHAGUS.

The œsophagus, like the stomach, is liable to undergo post-mortem digestion. Such a condition may be readily distinguished by the characteristic ragged, flocculent and pulpy appearance of the edges of the digested portion from ante-mortem ulceration, in which the edges of the ulcer are generally smooth, even, and indurated.

1861.—An œsophagus with a small portion of the stomach. About half the circumference of the walls of the œsophagus at its lower end is thin, soft, and pulpy, and in the centre of this part there is a large aperture with ragged flocculent margins partially blackened. The adjacent parts of the œsophagus and stomach are healthy.

1862.—An œsophagus with a portion of the stomach. There is almost entire destruction of the coats of the œsophagus for three inches above the stomach, and in nearly the whole circumference of the tube. The portion of the œsophagus which remains in this situation is pale, soft, and pulpy. The stomach appeared healthy.

RUPTURE OF THE ŒSOPHAGUS.

1863.—An œsophagus and stomach, exhibiting an extensive laceration of the muscular fibres of the former, which occurred in the act of vomiting. Both layers of the muscular fibres of the œsophagus are torn through at their point of connection with those of the stomach; and, by their retraction towards the upper part of the œsophagus, its submucous tissue is exposed over the whole extent of its last four inches. A similar retraction of the muscular fibres on the fundus of the stomach has taken place, exposing a large portion of its submucous tissue. There is a small laceration of the mucous and submucous tissues of the œsophagus about two inches from the cardiac end.

The patient was a man sixty-five years old. For about a year before his death he had dyspepsia, and was believed to have stricture in the lower part of the œsophagus, for which probangs were passed. He was subject to vomiting, and could not swallow anything solid. He felt the rupture of the œsophagus during a slight act of vomiting, thirty-six hours before death. There is no appearance of stricture or of any change of structure having existed in the œsophagus previous to the rupture.

PERFORATION OF THE ŒSOPHAGUS DURING THE PASSAGE OF A TUBE.

1838a.—The œsophagus with a portion of the stomach. The œsophagus is ulcerated at a point close to the stomach. The ulceration is not cancerous. At a short distance above the ulcerated portion the softened wall has been perforated by a catheter.

IMPACTION OF FOREIGN BODIES.

Foreign bodies, such as a piece of meat, a fish-bone, a coin, or artificial teeth, frequently become impacted in the œsophagus. The impaction generally occurs at the commencement of the œsophagus, opposite the cricoid cartilage, or at its termination where it passes through the diaphragm into the stomach. If the foreign body be not removed, ulceration or, in the case of a sharp substance such as a pin or fish-bone, perforation of the œsophageal walls may ensue, leading to suppuration in the neighbouring parts, or even to perforation of one of the large bloodvessels or air-tubes. In other instances the foreign body may become embedded in the walls of the œsophagus, and there remain quiescent for months or even years.

Injuries sustained by the impaction are liable to lead to stricture.

1866.—Part of an œsophagus and pharynx with the surrounding structures. At the commencement of the œsophagus, just below the level of the cricoid cartilage, a fragment of bone, fixed across the axis of the canal, has its pointed extremities embedded in an ulcerated and sloughing mucous membrane.

On either side of the pharynx are cavities which contained pus, surrounded by sloughing tissue. One of these, on the right side,

extends between the œsophagus and the trachea. These abscesses communicate freely with the ulcers which surround the impacted extremities of the foreign body.

1804.—A set of artificial teeth, of which this is a model, slipped into the fauces of a man during syncope or a slight epileptic fit, and remained fixed between the root of the tongue and the epiglottis for fourteen weeks, occasioning great difficulty of deglutition and other distressing symptoms. It was at length extracted. See also Nos. 1804, 1867, and 1868.

INJURIES AND DISEASES OF THE THORACIC AND ABDOMINAL VISCERA.

INJURIES SUSTAINED IN THE OPERATION OF PARACENTESIS.

1759d.—A portion of the left lung of a patient exhibiting wounds made during aspiration of the thorax. The lung is collapsed, and was adherent to the chest wall. In the lower lobe is a wound corresponding to an external opening measuring half an inch in length, which was situated in the eighth costal interspace. On a level with the sixth interspace are two punctures which extend through the whole thickness of the lung tissue and penetrated the substance of the heart. Two green glass rods have been inserted into the punctures and a red rod into the incision.

From a child aged two and a half years, who was thought to have an empyema. After death, however, it was found that she had pericarditis with effusion.

1894.—Two specimens from a case in which fatal hæmorrhage followed the operation of paracentesis. In the upper a coloured clot is seen to project into the peritoneal sac from the inner orifice of a puncture made by a trocar in the ordinary situation. The patient died twelve hours after. The sac was filled with blood.

In the lower the anterior wall of the abdomen has been removed. On one side is seen the omentum, in which are many large veins; on the other, the thick wall of an ovarian cyst. In puncturing the latter, which was one of many resulting from a colloid growth, the trocar passed through a vein belonging to the omentum; the latter was spread over the front of the cysts between them and the abdominal wall. The sac of the peritoneum and that of the punctured cyst contained fluid and coagulated blood. The patient died a few hours after the operation.

2241.—Portion of a liver, the anterior part of which was

punctured by a trocar. The wound was made a fortnight before death in puncturing a cyst connected with the pelvis of the kidney. No ill-consequences were apparent.

RUPTURE OF THE ABDOMINAL VISCERA.

Rupture of the abdominal viscera is generally the result of great violence; as a common cause may be mentioned a squeeze between the buffers of railway-carriages.

Rupture of the stomach is sometimes produced by a blow upon the abdomen while the stomach is distended with food.

Rupture of the liver.

2240.—Portion of the liver of a child, deeply and extensively lacerated by a blow upon the abdomen.

Rupture of the gall-bladder.

2267.—A gall-bladder, in which there is a rent about three-quarters of an inch long, extending through all its coats, close to its attachment to the liver.

From a man fifty years old, who was kicked near the region of the liver while stooping. He died in fifteen hours. The gall-bladder appears to have been distended in consequence of a small calculus in its neck.

Rupture of the spleen.

2308.—The spleen of a child, deeply and extensively lacerated by a blow on the abdomen.

2308a.—A spleen which has been torn upon its anterior and external surfaces, the laceration extending completely across the organ. The site of the injury is occupied by a firm white scar, measuring one-eighth of an inch across. The outermost convex border is still soft and lacerable; it tore when it was separated from the superjacent clot.

From a woman aged forty-two, who jumped out of a second-floor window ten weeks before her death. She sustained a fracture of the left femur in addition to the abdominal injury.

Rupture of the stomach.

1939.—Portion of a stomach and duodenum. There is an irregular aperture, more than an inch in width, extending through all the coats of the stomach near the pylorus. In several other

parts the peritoneal coat is irregularly torn. These injuries were produced by the crushing of the abdomen, the stomach at the time being full of food.

1938.—Portion of the stomach and œsophagus of a middle-aged man, who, it was supposed, had attempted to poison himself with laudanum. There is an extensive laceration through all the coats of the stomach a little beyond the entrance of the œsophagus. These lacerations were the effects of over-distension, the stomach-pump having been too freely used for the removal of the poison.

Rupture of the duodenum.

2040a.—A portion of the duodenum, exhibiting two large rents with jagged edges, in addition to two small circular apertures. All the injuries were inflicted during the life of the patient, who died collapsed five hours after a blow upon the abdomen.

Rupture of the small intestines.

2040.—A portion of an ileum, exhibiting a complete transverse rupture of its coats. A thin shred alone connects the two portions. The result of external violence.

Rupture of the mesentery.

2041.—The mesentery and a portion of small intestine from a boy, aged eleven, who fell between the side of a cart and its wheel, and was dragged along for some distance. He died from peritonitis, and on examination a rent of the mesentery was found, about three and a half inches in extent. The coil of intestine corresponding to part of the rent in the mesentery was folded on itself, of a dark claret colour, sodden and œdematous, and united to the adjacent parts by bands of recent lymph. This portion of intestine looked as if dead, and it seemed doubtful whether its condition was due to altered blood-supply, in consequence of the rent in the mesentery, or to direct injury. The subperitoneal tissue of the abdominal wall situated over the portion of intestine was infiltrated with blood.

Rupture of the kidneys.

2394a.—A right kidney which has undergone extensive laceration upon its outer and anterior surface.

From a patient who was brought into the hospital dead. See also No. 2394b.

Rupture of the bladder.

2440a and 2440b.—See under “Diseases and Injuries of the Bladder.”

IMPACTION OF A PIN IN THE VERMIFORM APPENDIX.

2032.—An appendix vermiformis, from a man aged forty-three, who died of abscess in the brain and liver. The point of a pin may be seen protruding from it into the cæcum, while the head is embedded in a mass of hardened fæces. There was no sign of ulceration, or of either recent or old peritonitis. See also No. 2032a.

IMPACTION OF FÆCES IN THE VERMIFORM APPENDIX.

2031.—An appendix vermiformis, from a child who died with acute peritonitis. A mass of hardened fæces is lodged in the intestine. See also No. 2031a.

REMOVAL OF VERMIFORM APPENDIX.

2032c.—A vermiform appendix, which was removed during life on account of its gangrenous condition. It measures in its shrunken condition nearly four inches in length. Its walls are thickened by inflammation, and are gangrenous at one spot, situated about its middle. It contained the small mass of hardened fæces which is preserved in the next specimen (No. 2032d). From a boy, aged sixteen years, who had suffered from symptoms of typhlitis for six days before the operation. He made a good recovery.

INTESTINAL OBSTRUCTION.

The conditions which may give rise to intestinal obstruction are very numerous; they are generally divided into the *acute*, which are productive of sudden and complete obstruction, are attended with acute symptoms, and if not soon removed, prove rapidly fatal; and the *chronic*, which are productive of gradual obstruction, are attended by less alarming symptoms, and although frequently fatal, may, either spontaneously or as the result of treatment, terminate favourably.

The conditions which commonly give rise to *acute intestinal obstruction* may be classed as:

1. Impaction of foreign bodies in the intestine, such as gall-stones.

2. Internal strangulation, *i.e.*, obstruction in consequence of a loop of intestine becoming strangulated in a hole in the omentum or mesentery, or by bands of adhesions, by diverticula, etc.

3. Volvulus, or the twisting of a portion of intestine on itself or its mesentery.

4. Intussusception, or the invagination of a portion of intestine into the lumen of that portion which is immediately below it.

5. The various forms of external hernia.

6. Congenital malformations of the intestine.

The conditions, which commonly give rise to *chronic intestinal obstruction* are :

1. Impaction of fæces, the result of habitual or accidental constipation.

2. Changes in the walls of the intestines themselves, consequent upon inflammation, ulceration, or the growth of cancerous or other tumours. (Under this head are included the various forms of stricture of the rectum.)

3. Pressure upon the intestine by tumours external to it.

4. Various forms of chronic peritonitis.

5. Contraction following injuries of, or operations upon, the intestines.

Although the conditions productive of intestinal obstruction have been divided into the acute and chronic, "it must not be taken as a fact in every case," says Mr. Pollock, whose classification of the causes of intestinal obstruction is similar to the above, "that acute symptoms cannot or do not depend on any one of the latter causes of obstruction; or a more chronic state of symptoms on any of the conditions noted in the first division; but, as a general rule, we may venture with some degree of assurance to assert that the several symptoms which will mark the cases coming under the first division are urgent, acute, and rapidly result in collapse and death, if not relieved by

nature or art ; while the greater number comprised in the second division are attended by symptoms which come on by degrees, may last many days, often weeks, or even months in some cases ; are generally by so much the less urgent than the former in character, and permit of delay in treatment as regards surgical interference ; allow time for consultation ; are often capable of medical relief ; and if surgical treatment be considered requisite, offer many more features favourable towards the prolongation of life than do the acute cases of obstruction." Moreover, it must be remembered that cases of gradual contraction of the intestine, consequent upon the conditions here denominated "chronic," may often terminate suddenly in complete obstruction, when acute and alarming symptoms supervene.

Whether the obstruction be acute or chronic, the intestine above becomes sooner or later enormously distended with fæcal matter and flatus, and if the obstruction be not removed, the case will terminate fatally from exhaustion, peritonitis, or rupture of the intestine, followed by collapse or peritonitis.

A. *The conditions commonly productive of acute intestinal obstruction.*

1. IMPACTION OF FOREIGN BODIES IN THE INTESTINES.

Gall-stones.

2030.—Portion of an ileum, the cavity of which is distended by an oval biliary calculus. The peritoneal coat of the distended part of the intestine is burst ; the other coats are thin and tense.

The calculus here shown had passed through a large ulcerated opening from the gall-bladder into the ileum.

See also **Series liii., No. 274b.**

2. INTERNAL STRANGULATION.

Strangulation of a loop of intestine in a hole in the omentum.

2176.—Portion of mesentery having in it a circular opening with dense, resisting, fibrous margins. Through this opening there passes a portion of small intestine, from the strangulation of which at the ring in question gangrene of the intestine and subsequent

peritonitis proved fatal to the patient. From a woman, aged fifty-six.

2177.—Coils of small intestine. One of these having slipped through an aperture in the omentum, the gut has been constricted and strangulated by the margins of the opening. In the upper part of the preparation the intestine retains its natural appearance; in the lower it is of a dark, and in the recent condition it was almost of a black, colour, its walls thickened and œdematous—in fact, bordering upon a state of gangrene. Over portions of the serous surface lymph has been effused, and may be seen smeared over the outer wall, most abundantly about the seat of stricture.

The man from whose body these parts were removed was straining violently, when he fancied that something gave way within the abdomen. Suddenly local pain ensued, rapidly becoming intense, and then general peritonitis. On the fourth day he was brought into the hospital. A few days after his admission he sank and died.

Strangulation of a loop of intestine by a band of adhesion.

2164a.—A portion of the ileum in the neighbourhood of the ileo-cæcal valve, which has become strangulated by the formation of a band of adhesion, the result of peritonitis eight months before death. The patient had complete obstruction for a week; abdominal section was performed, but he died unrelieved forty-eight hours after the operation.

See also Nos. 2165, 2166, 2172, and 2173.

Strangulation of a loop of intestine by a Meckel's diverticulum.

The diverticula, which are observed stretching from the ileum towards the umbilicus, are generally supposed to be the unobliterated remains of the vitelline duct. They are usually situated about two feet above the ileo-cæcal valve, and vary in length from one to ten inches. The diverticula are commonly single, but they may be multiple (No. 3638a).

2167.—Portion of a small intestine from which a diverticulum is continued. The extremity of the diverticulum is adherent to the contiguous part of the mesentery, so as to form a circular aperture or ring. Through this aperture a portion of intestine twelve inches long passed, and became strangulated. The patient, a lad subject to constipation, died four days after the commencement of the signs of strangulation of the intestine.

2168.—A diverticulum, arising from the ileum at about fifteen inches from its termination in the cæcum, and attached at its blind extremity by a ligamentous cord to the umbilicus. The portion of the ileum between the origin of this appendage and the cæcum had become twisted and entangled about it, causing strangulation, which terminated fatally in thirty-six hours. From a boy, aged twelve years.

2169.—A diverticulum from the small intestine, to the free extremity of which a fibrous cord is attached; the other end of the cord is adherent to the mesentery. Through the loop thus formed a considerable portion of small intestine has slipped and become strangulated. See also No. 2175.

3. VOLVULUS, OR THE TWISTING OF A PORTION OF INTESTINE UPON ITSELF OR ITS MESENTERY.

Volvulus is the twisting or bending of a coil of intestine in such a manner as to completely obliterate the lumen of the gut at the point of torsion. This form of intestinal obstruction is said to present itself in three varieties:

(i.) The intestine may be simply bent upon itself, a form which only occurs in the colon.

There is no specimen in the Museum.

(ii.) The intestine may be twisted round its own mesentery, so that a loop really becomes twisted round itself. This form only occurs in the small intestine.

There is no specimen in the Museum.

(iii.) The intestine may have become wound round another coil of intestine, as in cases where the colon has been found encircling a coil of small intestine or other part of the intestinal canal.

Volvulus of the cæcum.

2177b.—The cæcum, the lowest part of the ileum, and the beginning of the colon, are involved in a volvulus, which has resulted in the intestine being twisted three times on its transverse axis from right to left. The cæcum is gangrenous in patches, and in one place has completely ulcerated, so as to lead to a perforation of the intestine. No fæces have escaped, however, owing to the surrounding adhesions. On tracing the gut backwards, it is seen that the

colon beyond the splenic flexure, instead of passing across the abdomen to form the transverse arch, descends vertically to the left iliac fossa. From this point it returns to the lower border of the stomach, forming a U-shaped bend. It then turns to the right, and having reached the median line of the abdomen, again runs downwards to end in the cæcum, which was situated over the last lumbar vertebra, almost in the middle line.

From a man aged sixty-three, who was seized suddenly with severe abdominal pain and vomiting. His bowels, which had been regular up to the time of the seizure, became obstinately confined. On his admission to the hospital two days later nothing could be found to account for the pain, but there was a slight fulness and tenderness in the right iliac region. Stercoraceous vomiting set in eight days after the initial symptoms had appeared, and the abdomen was opened in the middle line, and a portion of inflamed and distended gut was secured by sutures to the abdominal wall. The patient died on the following day.

2177a.—A portion of the descending colon, showing a well-marked constriction produced by the twisting of two portions of large intestine around each other, so that a loop was strangulated.

From an old man, who died with symptoms of acute intestinal obstruction.

4. INTUSSUSCEPTION.

By intussusception is meant the invagination of a portion of intestine into the lumen of the intestine immediately below, so that the appearance presented is that of three tubes, one within the other. To facilitate comprehension, Rokitansky has called the outer tube *the sheath*, the innermost *the entering tube*, and the middle one *the receding or inverted tube*; the last two together form the intussuscepted portion. It follows, therefore, that there are two peritoneal and two mucous surfaces of intestine in contact with each other, *i.e.*, the contiguous surfaces of the outer and middle tubes are mucous membrane, and the contiguous surfaces of the middle and inner peritoneum. Between the inner and middle tubes is necessarily found a portion of mesentery or meso-colon, the dragging of which causes the intussuscepted portion to assume a greater curvature than its sheath, and its orifice to be directed towards the mesen-

teric attachment. This constant traction causes the packing seen along the concavity of the intussuscepted portion, and its slit-like instead of circular aperture. [No. 2186.]

The intussusception increases at the expense of the lower portion of the intestine, the sheath becoming more and more infolded, so that should the invagination occur at the lower part of the ileum, no more of the ileum above the intussusception will be involved (*ileo-cæcal*), but only the cæcum and the colon below. In rare cases the ileum is protruded through the ileo-cæcal valve, so that the intussusception increases at the expense of the upper portion of the intestine, more and more of the ileum being protruded through the valve; this constitutes the *ileo-colic* variety.

If the intussusception is not relieved, the bloodvessels of the involved mesentery become constricted where the latter enters into the sheath, causing obstruction to the circulation in the receding tube, the mucous and peritoneal surfaces of which consequently become intensely congested and inflamed, giving rise to great swelling and tumefaction, and to the sanious discharge from the mucous surface so diagnostic of the disease. The sheath and the entering tube are at first but little affected; as the tumefaction, however, of the receding tube increases, the intussuscepted portion becomes tightly constricted at its entrance into the sheath, and the contiguous peritoneal surfaces become united by adhesive inflammation. Should the peritonitis thus set up remain localized, the strangulated portion may slough at the constricted spot and be passed from the anus, and the patient recover. Stricture of the intestine is, however, apt to occur subsequently at the spot where the portions of intestine have become united.

The amount of intestine which may be intussuscepted varies from a few inches to many feet. Intussusception may occur in any part of the intestine; the parts most liable to it, however, are the lower portion of the ileum and the large intestine. It is rare in adults, but common in children, especially in infants.

2182.—A portion of ileum inverted into the cavity of the adjoining cæcum. The relations of the layers of the intestine implicated may be recognised by tracing the mucous membrane lining the cæcum, the ensheathing layer, which passes down over the inverted layer, and is thence continued upwards through the central canal, and passes on to the upper portion of the ileum above the intussusception. Tracing these layers from without, we find first two mucous, then two serous, and, again, two mucous surfaces opposed to one another.

Between the serous layers is a band of mesentery carried down with the portion of ileum forming the entering tube, and to its tense condition is due the curved direction of the central canal. The inverted layer of mucous membrane is thickened, especially where it curves round to be continued up the central tube.

2191a.—A portion of intestine from an infant who had recovered from an attack of intussusception. The large intestine has almost entirely disappeared, being represented by three inches of the rectum, which has been cut just above the anus, and may be seen at the lower part of the specimen. At the junction of the rectum with the small intestine (*i.e.*, the place where the continuity of the canal has been re-established), the calibre of the gut is slightly narrowed by an annular constriction, the peritoneum at this place being scarred and puckered. Immediately above, the small intestine is thinned and dilated into a large pouch, while two and a half inches higher is a polypus composed of glandular and fibrous structures one and a quarter inches in length. Around this growth the intestine is inflamed, ulcerated, and adherent to the neighbouring mesenteric glands. The rest of the intestine was normal.

The patient was a child aged thirteen months, and was admitted into the hospital with the history that twelve days previously she had been seized with severe pain in the abdomen, and since then had passed only blood and mucus. On admission, a portion of gangrenous gut was found protruding from the anus, and was removed; three days later another and smaller portion came away, and in another week the patient had completely recovered. Two months later she died of congenital syphilis.

2191b.—The two portions of intestine alluded to in the descriptions of the preceding specimen. The upper one consists of a part of the cæcum and vermiform appendix, the lower, apparently, of part of the large intestine.

2189.—A portion of small intestine, nearly three feet long, which was discharged in a gangrenous state from the anus.

2190.—The cæcum and a portion of ileum connected with it from the same person as the preceding specimen. The cæcum is opened to show the condition of its mucous membrane, which is extensively ulcerated, and portions of it which hang in shreds in the cavity of the intestine. A straw is passed from the cæcum through the ileo-cæcal valve. The ileum is opened to show the adhesion of its extremity to the cæcum, and the continuity of their mucous membrane.

The patient was a woman forty-eight years old, subject to constipation. Seventeen days before the discharge of the portion of intestine in No. 2189, she was seized with signs of internal strangulation of the intestinal canal, which continued for six days, and then became less. Subsequent to the discharge of the intestine, which took place eleven days after the partial cessation of the intestinal obstruction, the patient had fæcal evacuations, but she died exhausted ten days after the discharge.

It is probable that there had been an intussusception of the ileum into the cæcum and colon, and that the ensheathed portion had sloughed off after it had become adherent at the point of inversion to the portion in which it was ensheathed.

2185.—Portion of intestine showing an intussusception. The cæcum and right lumbar portion of the colon are inverted and protruded into the arch of the colon, which is laid open to show the intussuscepted intestine projecting into its cavity. A piece of glass is introduced into the orifice of the intussuscepted intestine, which in some degree retains the dark colour it presented in the recent state. From a child two years old, who died after a few days' illness in consequence of obstruction in the alimentary canal.

2186.—Intussusception from a child. The cæcum and a portion of the ileum are inverted and protruded into the colon. Inflammatory material is deposited on the protruded portion of the intestine, the effect of its inflammation. The intussusception was fatal by its obstruction to the passage of the intestinal contents.

2187.—Large intestine of a boy aged three and a half years. The cæcum, ascending, and part of the transverse colon, are invaginated into the lower half of the large intestine, so that during life the inverted cæcum and appendix protruded two and a half inches through the anus. The external aperture is transverse, and situated at the middle of the anterior aspect of the protruded portion, which is formed by the lower end of the ileum at its junction with the cæcum.

The child had suffered for eight months with alternate diarrhoea and constipation. The prolapsus of the bowel was first noticed four months before death. See also Nos. 2180, 2181a, 2183, 2184, 2185a, 2188a.

5. EXTERNAL HERNIA.

For obstruction consequent upon the various forms of external hernia, see "Hernia" (page 437).

6. CONGENITAL MALFORMATIONS.

With the exception of a hernia into the fossa intersigmoidea, there are no specimens of obstruction from congenital malformations of the intestine in the Museum other than those of congenital deficiency of the rectum and of imperforate anus. See "Diseases of the Rectum."

HERNIA INTO THE FOSSA INTERSIGMOIDEA.

2176a.—A portion of the ileum, with the cæcum and colon, from a case of strangulated hernia in which about six inches of the lower end of the ileum had passed through an opening (the foramen intersigmoideum) in the sheet of peritoneum which extends from the posterior surface of the sigmoid flexure to the left iliac fossa. The opening in the peritoneum is oval, its long diameter measuring about half an inch. It is situated close to the left side of the sigmoid flexure, its lower margin being about an inch above and to the outer side of the sacro-iliac synchondrosis, and the same distance from the ovary. The opening leads into a sac of peritoneum having very thin walls, which were attached to, or continuous with, the margins of the opening. The sac is pyriform, measuring three inches in its long diameter, and it extends upwards and backwards and beneath the large intestine. Its posterior surface is in contact with the iliacus and lumbar muscles, and was only loosely connected with them, but its anterior surface is adherent to the peritoneum and posterior surface of the large bowel. The sigmoid flexure is nearly surrounded by peritoneum, but it has not a distinct mesentery, since the two layers of peritoneum reflected from it are nowhere in contact. Above the opening of the hernia the sigmoid flexure is bound down to the

iliac fossa by three bands of thickened peritoneum. This portion of the intestine is displaced towards the middle line. The distended cæcum occupies a position immediately to the right of the middle line. (The ascending colon took a course obliquely across the abdomen to the left hypochondrium, where it turned sharply to the right and followed the course of the diaphragm until it reached the middle line; it then bent upon itself and returned above and parallel to its former course as far as the lower edge of the spleen; thence it took the usual direction to the sigmoid flexure.) Both the ascending and descending portions of the large intestine are closely united and almost surrounded by a single layer of peritoneum. There is no transverse colon. Immediately above the cæcum the ascending colon and the adjacent curve of the sigmoid flexure are bound together by a ribbon-like band of fibrous tissue three-quarters of an inch in breadth and half an inch in length; the adhesion to the sigmoid flexure is two inches below the level of the hernial opening. The ascending colon is slightly narrowed by the tension to which the band gives rise, but the calibre of the lower bowel is unaltered. From a woman aged sixty-three, who was suddenly attacked with symptoms of acute intestinal obstruction. On the following day she passed a small motion with a little slime and blood. Two days later she had fæcal vomiting. Eight days after the onset of the symptoms right lumbar colotomy was performed, and she died three days afterwards.

A drawing is preserved in **Series lvii., No. 260b.**

2115b.—A retro-peritoneal hernia of the vermiform appendix from a child aged ten weeks, who died after an operation for the relief of strangulated hernia. The appendix lay in an isolated sac by the side of the pouch of an inguinal hernia. The hernial sac formed by the upper part of the processus vaginalis is very long, and is throughout blended with the fibres of the internal cremaster muscle. A glass rod has been passed into the lumen of the vermiform appendix, which is situated immediately behind the sac.

B. The conditions commonly productive of chronic intestinal obstruction.

1. IMPACTION OF FÆCES.

There is no specimen of obstruction consequent upon the impaction of fæces in the Museum.

2. ALTERATIONS IN THE WALLS OF THE INTESTINES THEMSELVES
CONSEQUENT UPON INFLAMMATION, ULCERATION, OR THE
GROWTH OF CARCINOMATOUS OR OTHER TUMOURS.

Contraction consequent upon the healing of an ulcer.

2022.—Portion of a jejunum and two portions of ileum. In both portions of intestine there is a circular constriction by which the canal is completely closed. At each of the constricted parts a deep irregular ulcer extends in a narrow band around the whole circumference of the mucous membrane.

Obstruction consequent upon carcinoma of the intestines.

2021.—Portion of the sigmoid flexure dilated, but not materially hypertrophied, above an annular stricture of the intestinal canal. Below this stricture is a crop of exuberant granulations, springing up from an irregular, warty, ulcerated surface. At the point of stricture the walls are thickened and infiltrated with a cancerous deposit, upon which has grown the soft medullary mass seen below. A bougie is passed through the narrow portion of the canal.

2023.—Part of a sigmoid flexure of the colon laid open. A soft, villous, malignant growth springing from the mucous membrane surrounds and almost obliterates the canal. From the body of a woman, aged forty-nine, who, having had for a few weeks occasional abdominal pain and constipation, which at length amounted to nearly complete obstruction, was suddenly attacked with extreme abdominal pain and with faintness, and died in a state of collapse in about three hours. On dissection it was found that the transverse colon had been drawn down in the shape of a V by a piece of omentum that was adherent in the sac of an old left femoral hernia. The colon thus displaced had, on the occurrence of obstruction at the sigmoid flexure, become enormously distended and then inflamed, and at length the softened coats having given way through a large thin-edged ulcer, fæcal matter had freely escaped into the peritoneal cavity.

2029.—An ileo-cæcal valve, with parts of the cæcum and ascending colon. The several tissues forming the valve appear thickened and indurated with morbid deposit, which, in the recent state, had the characters of colloid cancer. The surface of the mucous membrane is roughly ulcerated. Similar disease, in less degree, exists in the immediately adjacent walls of the cæcum and colon.

The aperture of the valve is an oval opening about one quarter of an inch in diameter, apparently fixed in both size and form.

Obstruction consequent upon the growth of fibrous tumours in the ileum.

2019.—Fibrous tumours in the ileum, causing partial obstruction of the bowel and a pouch-like dilatation above. From a woman, aged forty-three, who died from pyæmia.

Obstruction from stricture of the rectum, which is included under this head, will be found treated of under “Diseases of the Rectum.”

3. PRESSURE UPON THE INTESTINE BY A TUMOUR EXTERNAL TO IT.

By an aneurysm. 1533.—A large false aneurysm of the abdominal aorta. The aneurysm by pressure had produced well-marked symptoms of constipation for about four months, which terminated in complete intestinal obstruction lasting for ten days.

4. VARIOUS FORMS OF CHRONIC PERITONITIS.—5. CONTRACTIONS FOLLOWING INJURIES OF, OR OPERATIONS UPON, THE INTESTINE.

The above causes of intestinal obstruction are not illustrated by specimens in the Museum.

SECTION XIV.

HERNIA.

HERNIA, or, more correctly speaking, abdominal hernia, is the protrusion of any of the contents of the abdomen or pelvis partially or completely through the abdominal or pelvic walls.

A hernia consists of a sac and its contents.

ANATOMY OF HERNIA.

I. THE SAC.

Two kinds of sac are described: the *acquired* and the *congenital*. The acquired sac consists of a pouch of peritoneum which the intestine or other viscus protrudes before it in its escape from the abdominal or pelvic cavity. The "congenital sac" consists of the "vaginal process of the peritoneum," a tubular prolongation of the peritoneum, which is protruded in front of the testicle as the latter descends into the scrotum, and into which, when unobliterated, the intestine or other viscus may escape.

In the female a similar pouch of peritoneum (the canal of Nuck) is protruded in front of the round ligament, and may also become the sac of a hernia.

The sac consists of a body and neck.

The body is the expanded part of the sac: it is generally globular or pear-shaped, and varies greatly in size. It is at first thin-walled and transparent, but may afterwards become thickened and laminated. In some cases of long-standing umbilical hernia, however, it becomes greatly thinned, and even deficient, in places.

The neck is the constricted part where the sac communicates with the peritoneal cavity. In a recent hernia it is thin and somewhat puckered, but after a time becomes smooth and thickened.

A. *Usual appearance of the sac.*

1. *When recent.*

There is no specimen of a quite recent sac in the Museum, but see Nos. 2081, 2130, and 2143.

2. *When the hernia has existed some time.*

2082.—Congenital hernia from an adult, with general thickening of the sac.

2124.—The sac of an inguinal hernia slightly thickened and indurated.

B. *Unusual appearances of the sac.*

Bilocular form of sac.

2084.—Oblique inguinal hernia from a female. The sac has enlarged within the inguinal canal, and has thence extended through the opening in the aponeurosis of the external oblique muscle, so that it presents a bilocular form, part of the sac being lodged within the inguinal canal, part in the labium, and the two parts being in communication by a narrow neck, which lies within the external abdominal ring.

2085.—A very large congenital hernia. The sac is divided as if by a deep constriction from below upwards into two portions, which communicate by a large oval aperture at the upper part. The anterior division of the sac is the larger; the posterior has the testicle at its inner and back part.

2087.—Inguinal hernia. The sac, which is of large size, is divided into an anterior and a posterior portion by a membranous partition, in the upper part of which there are several small apertures. A quill is passed from the mouth of the sac across its anterior portion, and through one of the apertures in the partition into the posterior portion. Except by these apertures, the posterior division of the sac has no communication with the anterior or with the cavity of the abdomen.

It is probable that the part which is now the posterior division

of the sac was at one time an ordinary hernial sac, the mouth of which was subsequently closed; that after this had occurred another sac was protruded in front of the former one; and that the apertures of communication between them were formed by the gradual thinning and absorption of their adjacent walls.

See also Nos. 2123 and 2140d.

Lobulation and partial deficiency of the sac.

A lobular condition and absence of portions of the sac in places is common in umbilical herniæ; in such cases the contents of the sac are in contact with the skin, and are liable to be wounded during an operation.

2153.—Part of a large umbilical hernia, the sac of which presents many irregular pouches, and appears in some parts deficient.

2155.—Section of an umbilical hernia, containing omentum. The omentum is firmly adherent to the sac, except in one situation where, a part of the sac being deficient, the omentum is in contact with the skin. See also No. 2140e.

Inflammation of the sac.

See "Inflamed Hernia" (page 451).

Sloughing of the sac.

2091.—A femoral hernia, the sac of which has sloughed.

2092.—A similar specimen.

The sac combined with a hydrocele.

2134.—Inguinal hernia, combined with hydrocele of the tunica vaginalis testis. The hernial sac extends downwards to a short distance behind the upper part of the distended tunica vaginalis.

2135.—Inguinal hernia, combined with hydrocele of the tunica vaginalis testis, and a large membranous cyst, or encysted hydrocele, in the spermatic cord immediately above the testicle. The coverings of the hernial sac, which is situated above the hydroceles, are very thick.

See also Nos. 2115, 2120, 2133, and 2143a.

Two distinct sacs.

2088.—Inguinal hernia. There are two distinct hernial sacs side by side and closely united by their intermediate walls. Each sac has its separate orifice of communication with the abdomen, but

the orifice of one is very small. The spermatic cord is behind both the hernial sacs.

The sac of a hernia is sometimes incomplete, as in those cases where the protruded viscus (*e.g.*, the cæcum, **Nos. 3632a** and **3632b**) is usually only in part covered with peritoneum; or there may be no sac at all, as in those cases where the protruded viscus has naturally no peritoneal covering.

Incomplete sac.

2086.—Inguinal hernia, in which the cæcum has protruded into the scrotum, carrying with it a partial peritoneal sac. The intestine is fixed to the outer side of the sac by its natural peritoneal connections. See also **Nos. 3632a** and **3632b**.

Absence of sac.

No specimen.

II. THE CONTENTS OF THE SAC.

Although each of the abdominal or pelvic viscera has at one time or other formed the contents of a hernial sac, it is the intestine or omentum that most frequently constitutes this part of the hernia. When the sac contains intestine alone, the hernia is called an *enterocele*; when omentum alone, an *epiplocele*; and when both intestine and omentum, an *entero-epiplocele*.

The quantity of intestine forming an enterocele varies from a small knuckle to several feet, but when once a portion has descended there is a constant tendency for more to follow. The intestine is at first natural in appearance, but after a time it becomes thickened and narrowed, whilst the portion of mesentery which is drawn down with it becomes hypervascular and hypertrophied.

Any part of the small or large intestine may descend to form an enterocele, but generally it is a part of the ileum, or, in the case of the large intestine, generally the cæcum.

The omentum constituting an epiplocele also varies from a small to a very large quantity; and, as in the case of the intestine, when it has remained down for some time, it

becomes thickened, hypertrophied, and matted together, and its veins assume a varicose condition.

In an entero-epiplocele the omentum descends first, and usually occupies the greater part of the sac, whilst the intestine that follows generally consists merely of a small knuckle, and lies at the back of the sac, surrounded and hidden by the omentum.

The intestine has occasionally been found strangulated in consequence of the protrusion of a loop through an aperture in the omentum.

More rarely the intestine precedes the omentum, constituting the so-called epiplo-enterocele.

A. *Usual appearance of the contents of the sac.*

There are no good specimens illustrating the usual appearance of the contents of the sac. See, however, Nos. 2098, 2146, and 2155.

B. *Unusual appearances of the contents of the sac.*

Thickening of the intestine. See No. 2111.

Induration and thickening of the omentum. 2093.—A large portion of omentum, which was removed in the operation upon an inguinal hernia. It is in many parts thickened and indurated.

Apertures in the omentum. 2094.—A large portion of omentum, which was removed in an operation for strangulated inguinal hernia. Its tissue is generally indurated, and it exhibits numerous apertures bounded by bloodvessels, which form in some parts a kind of irregular network.

Protrusion of a knuckle of intestine through a hole in the omentum. 2122.—Inguinal hernia. A portion of omentum has become adherent to the inside of the sac in two situations, so as to form an aperture or ring, through which the intestine was protruded. A portion of glass is passed through the mouth of the sac and the ring formed by the omentum and the wall of the sac.

Adhesions between the contents of the sac and the sac-wall and between one another, and congestion, inflammation, and gangrene of the contents of the sac, are illustrated

under "Irreducible Hernia" (page 444) and "Strangulated Hernia" (page 446).

c. *Unusual contents of the sac.*

The cæcum and part of the colon. 2115.—Inguinal hernia, combined with hydrocele of the tunica vaginalis. The contents of the sac were the cæcum and part of the colon. See also Nos. 3632a and 3632b.

The vermiform appendix. 2111a.—Hernia of the vermiform appendix. The hernia is funicular. The cæcum was found after death lying immediately within the neck of the sac, the vermiform appendix extending downwards half-way along the back of the sac. The upper two-thirds of the appendix is devoid of mesentery; the lower third lies free in the sac. The spermatic artery and vein lie upon the back of the sac, exactly opposite the attachment of the vermiform appendix. The vas deferens and its artery lie a little to the inner side. The tunica vaginalis is very thick, and is puckered over the testis.

The sigmoid flexure. 2111.—Large inguinal hernia. A portion of the sigmoid flexure of the colon, displaced from its natural situation by the dragging of the peritoneum into the hernial sac, is situated close by the mouth of the sac. See also No. 2139a.

The sigmoid flexure, omentum, and portion of small intestine. 2112.—Femoral hernia, of unusually large size. The contents of the sac are omentum, with part of the sigmoid flexure of the colon and a portion of small intestine.

The ovary and Fallopian tube. 2113.—Part of the uterus, with the left inguinal canal and other adjacent parts, of a woman on whom an operation was performed for what was supposed to be a strangulated hernia. Below and in front of the inguinal canal, at the upper part of the left labium, a sac, like that of a large tunica vaginalis testis, and having no communication with the abdomen, is laid open. This sac was filled with fluid, and the left ovary and the extremity of the Fallopian tube are fixed to its posterior wall, with portions of the lining membrane of the sac reflected over them. A bristle is passed into the orifice of the Fallopian tube; the ovary is shrivelled.

The patient was a woman between thirty and forty years old. A fortnight after her delivery she had peritonitis, and gave such an account of the swelling produced by the sac in her groin, that it was supposed to be a hernia. The operation was performed, and she died three days afterwards.

The case may be regarded as one in which the ovary and Fallopian tube passed through the inguinal canal into the labium, in the same manner, and probably about the same time, as, in the male, the testicle and vas deferens passes into the scrotum ; and in which, after such passage, the communication between the peritoneal pouch (carried with the ovary) and the general peritoneal cavity was closed.

The gall-bladder. 2114.—The gall-bladder of a woman, aged forty-five. She was admitted into the hospital with a femoral hernia on the right side. The sac was opened and the contents were returned. She died of peritonitis some days later. On post-mortem examination the gall-bladder was found close to the ring, and a decided constriction was visible some little distance beyond the fundus. A portion of the groove on the inner side was ulcerated. The constriction and ulceration are still visible. The liver did not present the ordinary form ; it was elongated from above downwards and drawn towards the ring. There was no evidence that any portion of the intestine or other structure, besides the gall-bladder, had passed through the femoral ring.

D. *Effects of treatment upon the sac.*

Obliteration of the neck of the sac by the pressure of a truss. 2089.—The remains of an inguinal hernia, after the closure and obliteration of the mouth of the sac. The peritoneum presents a puckered appearance and a funnel-shaped depression in the situation where the mouth of the sac formerly existed. The obliteration was the consequence of the long wearing of a truss.

2090.—A similar specimen, with the depression in the peritoneum on the abdominal aspect more strongly marked.

THE CONDITION OF A HERNIA.

A hernia may be reducible, irreducible, strangulated, incarcerated, or inflamed.

REDUCIBLE HERNIA.

A hernia is said to be reducible when the contents of the sac can be returned into the abdominal or pelvic cavity, leaving the sac empty. The sac itself, of course, cannot be put back into the abdomen, but remains in the position it occupied before the reduction of its contents.

IRREDUCIBLE HERNIA.

A hernia is said to be irreducible when the contents of the sac cannot be returned into the abdomen; this condition is owing to some impediment existing (1) outside the sac, (2) in the sac-walls, or (3) inside the sac.

1. *Impediments to reduction outside the sac.*

Impediment to reduction outside the sac consists in the constriction of the neck of the sac consequent upon (a) contraction, spasmodic or other, of the rings or other apertures through which the hernia has passed, or (b) the inflammatory condensation and contraction of the tissues around the neck.

Impediment consequent upon contraction of the rings, etc., will be illustrated under "Special Forms of Hernia."

A specimen, exhibiting inflammatory thickening and contraction of the parts around the neck of the sack follows:

2083.—The sac of an old inguinal hernia. The neck is surrounded by a very tough and firm ring of condensed fibrous tissue, which is prismatic in shape, being wide at its attachment and tapering to a very sharply defined and thin free margin. The diameter of the ring is only half an inch. Directly below this the sac dilates into a chamber, which, in the fresh state, was three inches across, and which rises into a pouch at its upper part, which runs up behind the ring above described.

2. *Impediment to reduction in the sac-walls.*

Under this head are placed inflammatory thickenings and contractions of the neck of the sac itself and inflammation of the sac.

2123.—The sac of an inguinal hernia, presenting, about an inch below its mouth, an annular contraction produced by thickening and induration of a narrow portion of the peritoneum.

It is probable that the thickened part of the sac had been its mouth, and had been enclosed within one of the abdominal rings, the pressure of which had produced the thickening, and that, by a larger protrusion of intestine, the mouth of the sac had been pushed outwards. The thickened part of the sac formed the stricture by which the intestine was strangulated.

3. *Impediments to reduction inside the sac.*

The chief of these may be enumerated as: The great bulk of the protruded intestine or omentum; the adhesion of the intestine or omentum to the walls of the sac or to each other; the adhesion of two coils of the intestine or of two portions of omentum to each other; the collection of a large amount of fluid in the sac; the distension of the intestine with fæces or flatus; bands of adhesion stretching across the cavity of the sac or across its neck; the contraction of adhesions between the protruded intestine and the parts around, as when a portion of intestine incompletely covered by peritoneum descends to form the hernia.

Adhesion of intestine to the sac-walls. 2121.—Inguinal hernia. A portion of small intestine has become extensively and firmly adherent to the walls of the sac.

Adhesion of omentum to the sac-walls. 2133.—The hernial sac is large; it communicated with the abdomen by a wide orifice, and there is a portion of omentum adherent to its lower part.

2121a. An inguinal hernia. A portion of omentum has become adherent to the inner surface of the sac, close to the fundus. See also No. 2122.

Adhesion of omentum to intestine. 2095. — A large portion of omentum, partially indurated, which was cut off in an operation for strangulated inguinal hernia. The narrow portion by which it is suspended was attached to a protruded piece of large intestine; the rest was unattached.

The patient, an elderly woman, recovered after the operation, so that it is impossible to say under what circumstances so large a portion of omentum had become connected with the large intestine alone, and with it by only a narrow pedicle.

Adhesion of coils of intestine to one another. 2120.—Several folds of intestine are firmly adherent to each other and to the hernial sac. The enlarged tunica vaginalis testis is situated in front of, and nearly envelops, the sac of the hernia. Bristles are passed beneath the spermatic vessels, which are placed at some distance from each other behind the tunica vaginalis.

The adhesion of a portion of intestine only partly covered by peritoneum to parts around. 2086.—Inguinal hernia, in which the cæcum

has protruded into the scrotum, carrying with it a part of the peritoneal sac. The cæcum is fixed to the outer side of the sac by its natural peritoneal connections.

STRANGULATED HERNIA.

A hernia is said to be strangulated when a portion of intestine or omentum is so tightly gripped that not only is its return into the abdomen prevented, but its circulation is obstructed to such a degree that inflammation and gangrene speedily result if the constriction is not quickly relieved.

Causes of strangulation.

Strangulation may be induced by a sudden protrusion of a portion of intestine or omentum through a narrow aperture ; or, in the case of an old hernia, by a sudden addition of a fresh portion of intestine or omentum to that already in the sac ; or, by swelling and congestion of the intestine, such as occur in functional disturbance of the alimentary canal ; or by distension with fæces or flatus ; or by the swelling and congestion of the mesentery or omentum, or of the neck of the sac ; or by the slipping of a portion of intestine through an aperture in the omentum or mesentery ; or by constriction caused by bands of adhesions stretching across the cavity of the sac.

Seat of the stricture.

The seat of the stricture in a strangulated hernia may be (1) outside the neck of the sac, (2) in the neck of the sac itself, or (3) within the sac.

The seat of the stricture when outside the neck of the sac is at one of the tendinous rings or other apertures through which the hernia has escaped, and will be further referred to under the head of "Various Forms of Hernia."

Seat of the stricture in the neck of the sac itself. 2126.—Incomplete inguinal hernia, strangulated. The intestine is contained within the inguinal canal. The aponeurosis of the external oblique muscle is divided and turned upwards. The sac, containing the small por-

tion of strangulated intestine, is opened from the front. The lower border of the internal oblique and transversalis muscles crosses over the neck of the sac. Two bristles are passed between the mouth of the sac, where the thickened peritoneum constitutes the stricture, and the strangulated intestine. Another bristle is passed beneath the epigastric vessels.

Seat of the stricture inside the sac.—When the seat of the stricture is inside the sac the strangulation may be due to the constriction of the intestine by bands of adhesion stretching across the cavity of the sac or the slipping of a loop of intestine through a hole in the mesentery or omentum, in which it may become tightly gripped in consequence of the swelling of the included intestine.

2122.—Inguinal hernia. A portion of omentum has become adherent to the inside of the sac in two situations, so as to form an aperture or ring, through which the intestine was protruded.

2166.—Inguinal hernia. A portion of small intestine was found just behind the external inguinal ring, strangulated by a band of adhesion, extending from the peritoneum near the ring to the mesentery. The testicle is situated within the upper opening of the inguinal canal.

Mechanism of strangulation.

When from one or more of the causes above enumerated a portion of intestine or omentum becomes constricted, the compression of the veins at the seat of stricture impedes the return of venous blood from the protruded part, which consequently becomes congested and ultimately passes into a gangrenous condition. The congestion also induces paralysis of the muscular coat and consequent cessation of the peristaltic action and onward flow of the intestinal contents.

For strangulation to occur it is not necessary, however, that the whole circumference of the bowel be included in the stricture; an inclusion of only a small portion of the circumference, as occurs in Richter's hernia (No. 2105 and 2105a), in consequence of the venous congestion and subsequent inflammation which it induces, is sufficient to cause it.

Appearances of the strangulated intestine and omentum.

The first changes seen in the strangulated intestine are due to congestion caused by the partial arrest of the circulation. The intestine does not appear altered except that it is red and swollen, while a small amount of serous fluid is poured out between it and the sac. When the arrest of the circulation is complete, the congestion becomes more intense, the intestine appears more swollen, dark purple and mottled; it is no longer shining, and it feels sticky to the fingers. When the strangulation has lasted some time, the congestion passes into gangrene, the intestine appears black or ashen-gray, doughy in consistence, and pits on pressure. The fluid in the sac, which was at first serous, is darker, turbid and fæculent in odour. Finally, the gangrenous intestine sloughs, and its fæcal contents are extravasated into the sac. Sloughing or ulceration of the intestine frequently begins at the seat of stricture, where the intestine at an early stage often exhibits the impression of the stricture upon its coat.

The changes in the strangulated omentum are similar to those which occur in the intestine. The omentum, at first red and injected, passes gradually into a state of gangrene, when it appears black or yellowish gray, the blood in its veins is coagulated, and it feels crisp and emphysematous to the touch.

2096.—Strangulated femoral hernia, upon which no operation was performed. The sac and its coverings are in great part removed. The portion of small intestine contained in the sac presents a black and mottled appearance, from the intense congestion of its vessels. The small calibre of the intestine below the strangulated part is strongly marked. See also Nos. 2099, 2099a, and 2104.

2103.—Portion of small intestine, which was strangulated in the sac of a femoral hernia. On one side it exhibits but a slight indentation from the stricture; on its other side, which corresponded with Gimbernat's ligament, there is a large aperture in it, and its coats are very thin. See also Nos. 2106, 2107.

2100.—Section of a portion of small intestine, which was strangulated in a femoral hernia, to show the sharp-edged fold of

mucous membrane which projects into the canal of the strangulated portion from the angle formed by the portions above and below it.

2102.—Portion of a jejunum, which was strangulated in an umbilical hernia. In the situation of the stricture the intestine is contracted, and immediately above it is a small, round, ulcerated aperture, into which a portion of glass rod is passed. Recent inflammatory formations are seen around these apertures on the mucous covering.

2105.—A portion of jejunum, of which a part of the circumference was strangulated in one of the crural canals. The strangulated portion has been drawn out like a short diverticulum from the rest of the intestine, and has a wide ulcerated aperture through its coats at the part which was nearest to Gimbernat's ligament.

2108.—A portion of the small intestine of a man, aged sixty-nine, who was admitted with an umbilical hernia, which had been strangulated six days. In the operation it was found, from the escape of fluid fæcal matter, that the intestines had given way. Across the portion of intestine preserved a constriction is seen, which corresponded with the tight margin of the umbilical aperture at its lowest part. A line of intestine at the constricted part had perished, and was of an ashen hue. In the centre of this is an aperture, through which, at the time of the operation, a slough more than an inch long escaped, which, no doubt, came from the mucous and muscular coat at the seat of stricture, for at that part the peritoneal coat alone remains.

Laceration of the coats. 2116.—Portion of small intestine, from a femoral hernia upon which an operation had been performed a few days before death. A considerable opening was found in the intestine, apparently from laceration of its coats, and its edges were drawn together by suture. Inflammatory matter formed upon the peritoneal and upon the mucous surface and round the opening, so that the latter is completely closed by it.

2095.—A large portion of omentum, which was cut off in an operation for inguinal hernia.

Condition of the intestine above and below the strangulated portion.

The intestine above the strangulated portion is distended with fæcal matter, and congested, the congestion gradually ceasing as the intestine is traced towards the stomach.

The intestine below the strangulated portion appears empty and contracted, but not congested.

Result of strangulation when not relieved by taxis or operation.

When the strangulation is not relieved the intestine or omentum, as we have seen, becomes gangrenous and sloughs or ulcerates, and the fæcal contents of the intestine are extravasated into the sac. Extravasation of fæces into the general peritoneal cavity, however, does not occur, as the intestine internal to the stricture becomes glued to the parietal layer of the peritoneum by adhesive inflammation. The irritation caused by the extravasated fæces sets up inflammation of the sac, which extends to the surrounding tissues, and rapidly runs on to suppuration, and the fæcal abscess thus formed ultimately opens upon the surface. The inflammation, moreover, generally spreads to the peritoneal cavity, and the patient dies of local or general peritonitis.

2092.—A femoral hernia, in the male. The hernial sac and its contents have sloughed; their remains are a pulpy mass, in which no distinction of parts can be recognised. Three portions of small intestine were protruded into the hernial sac. A portion of straw is passed into each of their orifices.

Accidents liable to occur during attempts at reduction (réduction en masse—rupture of the sac).

During attempts at the reduction of an inguinal hernia, either by the patient or surgeon, if too much force is used, the sac, as well as its contents, may be pushed back into the upper part of the inguinal canal or into the abdominal cavity, *i.e.*, between the parietal layer of peritoneum and fascia transversalis (*réduction en masse*), the strangulation in either case remaining unrelieved. Or in other instances, as pointed out by Mr. Birkett, the posterior wall of the sac may be ruptured and the intestine forced through the rent into the subserous connective-tissue behind the sac, the intestine, as in the former case, being still constricted by the neck of the sac. This latter accident is said by Mr. Birkett

to occur most frequently in the congenital form of inguinal hernia. Although "*réduction en masse*" is most frequent in cases of inguinal hernia, it sometimes happens in femoral hernia.

2117.—A congenital hernia, for the reduction of which an operation was performed. At the front of the preparation is a portion of the hernial sac, which extended from the inguinal ring into the scrotum, and within which some small intestine and the testicle are seen. At the back is another portion of the sac, which was found after death pushed back and inverted into the abdomen.

It is probable that before the operation a portion of the hernial sac had been pushed backwards into the abdomen, and that in the operation the strangulated intestine was pushed from the lower part of the hernial sac, which still remained external to the abdomen, into that part of it which was still within the abdomen.

2118.—An inguinal hernia, for the reduction of which an operation was performed a short time before death. On one side of the preparation there is a portion of the spermatic cord, and a little above it is an opening which, during the operation, was made into the inguinal canal. On the other side of the preparation is the hernial sac, extending downwards into the pelvis by the side of the urinary bladder, to which it was attached. In the upper part of this sac is a circular orifice; this was the mouth of the sac through which the intestine passed from the cavity into the abdomen. The outer and larger opening in the sac was made in the examination of the parts after death.

It is probable that the hernial sac, which now appears extending downwards into the pelvis, was originally situated in the scrotum, and that in the efforts to reduce the hernia, previous to the operation, both the contents and the sac had been pushed into the cavity of the abdomen. The intestine in the sac was found mortified from the tightness of the stricture, which was formed entirely by the peritoneum at the mouth of the sac; and it will be observed that by the displacement of the sac its mouth had become situated deep in the abdomen, at a great distance from the internal abdominal ring.

INFLAMED HERNIA.

Irreducible herniæ, exposed as they necessarily are to injury, are liable to become inflamed, and are then generally

spoken of as inflamed herniæ. The sac appears red, congested, swollen and covered on its internal surface with inflammatory exudation. The contents of sac are not materially affected. If the inflammation is long continued the sac becomes indurated, thickened, and consolidated with the surrounding parts.

2146.—A femoral hernia. The coverings of the sac are displayed by the separation of the fascia superficialis and fascia propria. Within the latter the sac itself is shown, covered with inflammatory material on its internal surface. The mouth of the sac is about a quarter of an inch in diameter. The epigastric vessels are situated three-quarters of an inch from the outer border of the mouth of the sac.

2082.—An oblique inguinal hernia. The sac and its coverings are thickened, indurated, and consolidated by inflammation; and its internal surface is roughened by the deposit of inflammatory products.

INCARCERATED HERNIA.

A hernia is said to be incarcerated when the protruded portion of intestine becomes obstructed by hardened fæces, foreign bodies, flatus, etc. Such a condition is most commonly met with in irreducible herniæ in old people. There is no specimen of it in the Museum.

EFFECTS OF OPERATION.

In some cases where the intestine at the time of the operation for the relief of a strangulated hernia is found to be gangrenous, it may be necessary to form *an artificial anus*. In such cases the openings of the upper and lower portions of the intestine can be seen to be separated by a spur-like process which is formed by the projection forwards of the posterior wall of the bowel (No. 2100). Before the artificial anus can be closed, this "spur" may have to be removed by means of Dupuytren's enterotome. See the instrument-case. No. 2109a is a "spur" which has been removed by this means.

RADICAL CURE.

2089a.—A portion of the abdominal wall taken from the neigh-

bourhood of the crural ring. The sac of a femoral hernia had been cut off, and the peritoneum sutured eight days before death. The peritoneum on the crural ring is slightly puckered, but it is quite closed, and there are no traces of the hernial sac. From a man aged sixty-three, who had a strangulated femoral hernia. He died of perforation of the bowel six feet above the ileo-cæcal valve. The external bowel was soundly healed.

SPECIAL FORMS OF HERNIA.

INGUINAL HERNIA.

An inguinal hernia is one which escapes into or passes through the inguinal canal. There are two chief varieties, the oblique or external, and the direct or internal.

OBLIQUE OR EXTERNAL INGUINAL HERNIA.

The oblique or external inguinal hernia is so called because it escapes *obliquely*, leaving the abdomen by the internal abdominal ring, *externally* to the deep epigastric artery. When the hernia stops in the canal it is called incomplete, or, from its resemblance to a bubo, a bubonocèle; when it passes completely through the canal and protrudes at the external ring, it is said to be complete, and is sometimes called a scrotal or a labial rupture, according as it descends into the scrotum or labium. Whilst traversing the inguinal canal the direction of the hernia is downwards, inwards and forwards, but on emerging from the canal it passes downwards, inwards and a little backwards.

The coverings of an oblique inguinal hernia.

The coverings of an oblique inguinal hernia vary slightly according as the hernia is complete or incomplete, and according as it occurs in the male or female.

1. *Coverings of a complete oblique inguinal hernia.*

A. *In the male*—The coverings of a complete oblique inguinal hernia in the male are seven. 1. Skin. 2. Superficial and deep fascia. 3. Intercolumnar fascia. 4. Cremasteric

fascia. 5. Infundibuliform fascia. 6. Subperitoneal fat. 7. Peritoneum, which constitutes the sac.

B. *In the female*.—In the female the cremasteric fascia is wanting, otherwise the coverings are the same as in the male.

2127.—A complete oblique inguinal hernia, the sac of which has just passed through the external abdominal ring; its cavity is laid open from the side, and its several coverings are displayed. A bristle is passed beneath the epigastric artery, where it passes on the inner margin of the internal ring, showing that the neck of the sac is external.

2. *Coverings of an incomplete oblique inguinal hernia—male or female*.—The coverings of an incomplete oblique inguinal hernia are the same in both male and female. They are: 1. Skin. 2. Superficial and deep fascia. 3. Aponeurosis of the external oblique (instead of the intercolumnar fascia, as in the complete). 4. Lowermost fibres of the internal oblique and transversalis muscles. 5. Infundibuliform fascia. 6. Subperitoneal fat. 7. Peritoneum.

2081.—An incomplete oblique inguinal hernia. Portions of the aponeurosis of the external oblique, and of the lower border of the internal oblique and transversalis muscles, are raised from their connections to show the passage of the hernial sac through the internal inguinal ring. The coverings of the sac are displayed, and its cavity is opened.

2126.—An incomplete oblique inguinal hernia. The intestine is contained within the inguinal canal; the aponeurosis of the external oblique muscle is divided and turned upwards. The sac containing a small portion of strangulated intestine is opened from the front. The lower border of the internal oblique and transversalis muscles crosses over the neck of the sac. A bristle is passed under the epigastric vessels.

Varieties of oblique inguinal hernia.

Several varieties of oblique inguinal hernia have been described, of which the following are the chief: 1. The common form (or the inguino-scrotal of Birkett). 2. The congenital (or hernia into the vaginal process of the peri-

toneum of Birkett). 3. The infantile (or hernia behind the funicular portion of the vaginal process of the peritoneum of Birkett). 4. The encysted congenital.

A. *The common or acquired form.*—In this variety the sac consists simply of a protrusion of peritoneum into or through the inguinal canal, and when complete may extend into the scrotum or labium, according as it occurs in the male or female. In the male the testicle can always be felt either below or in rare instances behind the hernia.

2084.—An oblique inguinal hernia, from a female. The sac has enlarged within the inguinal canal, and has thence extended through the opening in the aponeurosis of the external oblique muscle, so that it presents a bilocular form, part of the sac being lodged within the inguinal canal, part in the labium, and the two parts being in communication by a narrow canal, which lies within the external abdominal ring. The aponeurosis of the external oblique is reflected from the part of the sac which is in the inguinal canal, the neck of which part is crossed by the internal oblique and transversalis muscles.

Cast from the subject of this hernia, No. 124.

2127.—An oblique inguinal hernia, the sac of which has just passed through the opening in the aponeurosis of the external oblique muscle.

B. *The congenital, or hernia into the vaginal process of peritoneum.*—In this variety the intestine descends into the vaginal process of the peritoneum, which is protruded in front of the testicle in the descent of that organ into the scrotum. Several varieties of congenital hernia are described, for an account of which the student is referred to the larger works on surgery. In the common variety the testicle is found in its normal situation in the scrotum, and is generally surrounded by and in contact with the hernia, but the testicle may be found in the abdomen, in the inguinal canal, or just external to the external abdominal ring, in which cases the hernia will be incomplete.

In the female a similar congenital oblique inguinal hernia may occur, the intestine descending into a pouch-like pro-

longation of peritoneum, in front of the round ligament of the uterus (*the canal of Nuck*).

2085.—A very large congenital hernia. The sac is divided, as if by a deep constriction from below upwards, into two portions, which communicate by a large oval aperture at the upper part. The anterior division of the sac is the larger; the posterior has the testicle at its inner and back part.

2131.—A congenital inguinal hernia. The testicle has not passed through the inguinal ring; it was found within the canal, and is connected with the upper part of the hernial sac. It is smaller than natural, but its structure is healthy. The lower part of the epididymis is removed from the body of the testicle, and passes down the posterior part of the hernial sac. The vas deferens also passes along the same part, and becoming small and very tortuous, reaches nearly as far as the end of the epididymis just described.

2138.—A congenital hernia, from an adult. The roll of paper [which was introduced by Percival Pott] is passed through the inguinal canal into the cavity of the tunica vaginalis testis, in the place formerly occupied by the protruded intestine.

2139.—A congenital hernia, from an adult, for the removal of which an operation was performed. The testicle and the hernial sac are situated within the inguinal canal. See also No. 2139a.

2140a.—The sac of a funicular hernia. A portion of the anterior wall has been cut out, so as to show the septum which separates the cavity of the tunica vaginalis from that of the sac.

c. *The infantile*.—In this variety the intestine, enclosed in its sac, descends behind the funicular portion of the tunica vaginalis which has not been obliterated, so that when an operation is necessary three layers of peritoneum have to be cut through, viz., the anterior layer of the unobliterated funicular portion of the tunica vaginalis, the posterior layer of the same, and finally the true sac.

There is no specimen in the Museum.

d. *The encysted congenital*.—In this variety the sac of the tunica vaginalis is separated from the general peritoneal cavity by adhesions. These adhesions yield to the pressure of some portion of intestine, and become elongated and invaginated before it into that portion of the tunica vaginalis which still remains unobliterated. In this case, should an

operation be necessary, the anterior layer of the tunica vaginalis and the spurious sac formed by the elongated adhesions would have to be cut through before the intestine could be exposed.

2140c.—An inguinal hernia constituting an example of the form described by Hey as 'encysted.' The funicular portion of the peritoneum is unclosed, except at its upper extremity. A hernial sac has been formed by the gradual invagination of the closed upper extremity into the unobliterated portion of the funicular process of the tunica vaginalis.

Relation of the cord to the sac in oblique inguinal hernia.

In recent cases the spermatic cord is situated *behind* the sac, but in old-standing cases its constituents may become separated and spread over the body of the sac.

2130.—Two inguinal herniæ, one direct, the other oblique. On the right side the hernia is oblique, and has descended into the scrotum. The spermatic cord is behind the sac.

2132.—An oblique inguinal hernia, exhibiting the separation and displacement of the vessels of the spermatic cord in consequence of its pressure. The spermatic artery and the vas deferens are situated close together on the inner and posterior part of the sac; the spermatic veins are nearly an inch distant from them. Large fasciculi of the cremaster muscle are interlaced over the front of the hernial sac.

Relative position of the rings in an oblique inguinal hernia of long standing.

2129.—An oblique inguinal hernia, dissected to show the change in the relative position of the external and internal inguinal rings, in consequence of the existence of an oblique hernia of long standing. In the front of the preparation the aponeurosis of the external oblique and the external ring are shown; at the back, the pubic portion of the fascia transversalis, with its edge forming the internal boundary of the inner ring, which edge lies directly behind the middle of the opening of the external ring.

Seat of the stricture.

The stricture when external to the sac may be at the external ring, at the internal ring, or at any part of the

inguinal canal. (Stricture within the sac, or in the neck of the sac itself, has already been illustrated under the head of "The Anatomy of Hernia," and will not be further referred to while discussing the seat of stricture in the special forms.)

Relation of the epigastric artery to the neck of the sac.

The epigastric artery, in oblique inguinal hernia, is internal to the neck of the sac.

2127.—An oblique inguinal hernia: a bristle is passed beneath the epigastric artery, where it passes across the inner margin of the internal ring—*i.e.*, internal to the neck of the sac.

2128.—An oblique inguinal hernia, showing the injected epigastric passing round the inner side of the neck of the sac.

DIRECT OR INTERNAL INGUINAL HERNIA.

The direct or internal inguinal hernia is so called because it escapes directly through the external abdominal ring (without passing through the internal ring and inguinal canal) internal to the epigastric artery.

Coverings of a direct or internal inguinal hernia.

The coverings from without inwards are: 1, skin; 2, superficial and deep fascia; 3, intercolumnar fascia; 4, fascia transversalis; 5, sub-peritoneal fat; 6, peritoneum, which forms the sac. Sometimes the conjoined tendon forms one of the coverings; usually, however, the hernia passes through that structure, or under or over it.

It will thus be seen that the coverings of a direct hernia differ from those of an oblique in the absence in the former variety of the cremasteric fascia and the substitution of the fascia transversalis for the infundibuliform fascia.

2135.—A direct inguinal hernia, combined with a hydrocele of the tunica vaginalis testis, and a large membranous cyst or encysted hydrocele in the spermatic cord immediately above the testicle. The coverings of the hernial sac, which is situated above the hydrocele, are very thick.

Relation of the cord to the sac in direct inguinal hernia.

In internal or direct hernia the spermatic cord along with the cremaster muscle lies external to the sac.

2130.—A direct inguinal hernia situated on the right side of the abdomen. The spermatic cord is on the outer side of the sac.

Seat of stricture.

The stricture may be situated at the external abdominal ring, or at the aperture in the conjoined tendon through which the hernia has passed.

Relation of the epigastric artery to the neck of the sac.

2130.—Two inguinal herniæ, one direct, the other oblique. On the right side, the hernia is oblique, and has descended into the scrotum. The epigastric artery is close to the inner margin of the mouth of its sac, and the spermatic cord is behind the sac. On the left side the hernia is direct, having passed from the abdomen directly through the external inguinal ring. The epigastric artery is near the *outer margin* of the mouth of its sac; and the spermatic cord is between the sac and the outer column of the external ring. The sac of this hernia is withdrawn from the covering of the fascia transversalis, which was protruded before it, and is inverted towards the abdominal cavity.

FEMORAL HERNIA.

Hernia is called femoral when it escapes through the femoral ring. It first takes a direction downwards, through the femoral ring into the femoral canal, and arriving at the saphenous opening passes forwards through that aperture, and then upwards and outwards on to the aponeurosis of the external oblique muscle.

2142.—A femoral hernia, in a male, dissected so as to show the peculiar form of the tumour.

Coverings of a femoral hernia.

The coverings of a femoral hernia from without inwards are: 1, skin; 2, superficial fascia; 3, cribriform fascia; 4, fascia propria (*i.e.*, the anterior wall of the femoral sheath);

5, subperitoneal fat ; 6, peritoneum, which constitutes the sac.

2144.—A femoral hernia, of recent occurrence. On the front of the preparation the fascia propria is shown, laid open from the front, and crossed above by the semilunar edge of the fascia lata. At the back, the hernial sac is separated from the fascia propria, withdrawn from beneath the crural arch, and inverted towards the abdominal cavity.

2146.—A femoral hernia, for the reduction of which an operation was performed. The coverings of the sac are displayed. The fascia superficialis is separated from the fascia propria. The fascia propria is also raised ; it is thick, and its internal surface is cellular. Within the fascia propria the remains of the sac are shown.

Seat of stricture.

The stricture may be at the superior cornu of the saphenous opening (Hey's ligament), at Gimbernats's ligament, or at the deep crural arch.

2091.—Femoral hernia, for the reduction of which an operation was performed. The sac has sloughed ; its remains are soft and black. The incision of the stricture has been carried from the anterior part of the sac directly upwards.

2150.—Femoral hernia, for the reduction of which the operation was performed. The sac is collapsed and thickened. The incision of the stricture has been carried from the anterior part of the sac upwards and inwards.

Relations of the neck of the sac.

The neck of the sac is situated at the femoral ring, and has therefore, in the supine position of the body (No. 2147), Poupart's ligament and, at some short distance, the spermatic cord above it, Gimbernats's ligament on its inner side, the femoral vein on its outer side, and the bone below it.

Relation of arteries to the neck of the sac.

There are usually no arteries of consequence in immediate relation with the neck of the sac. When, however, as frequently happens, the anastomosis between the pubic branch of the epigastric and the pubic branch of the ob-

turator becomes enlarged, or when the obturator artery itself is given off directly from the epigastric, a large artery will be found winding round either the outer or the inner side of the neck of the sac. In the latter situation the artery is very liable to be wounded should an operation be performed, as the incision for the division of the stricture in femoral hernia is usually made either directly inwards or obliquely upwards and inwards.

2147.—Two femoral herniæ, in the male, exhibiting different relations of the obturator artery to the mouth of the hernial sac. Both the obturator arteries arise by common trunks with the epigastric arteries. On the right side, the obturator artery descends to the obturator foramen close to the outer margin of the mouth of the sac; whilst on the left side, the obturator artery in its course to the obturator foramen turns round the inner border of the mouth of the sac. On the right side, the common trunk of the two arteries is about a quarter of an inch long; on the left, it is about three-quarters of an inch long. [The specimen is on the bottom shelf to the left-hand side of the door.]

2148.—Portion of a male pelvis, with parts of the abdominal muscles, exhibiting the sacs of two femoral herniæ. On each side the obturator artery, arising with the epigastric by a common trunk, about half an inch long, turns round the inner border of the sac; while the obturator vein, arising separately from the epigastric, passes round the outer border.

Unusual forms of femoral hernia.

Several rare forms of femoral hernia have been described. Of these the "femoral hernia through Gimbernat's ligament" (or "the hernia of Langier," as it is sometimes called after Langier, who was the first to describe it) alone is represented in the Museum.

2149.—Femoral hernia. A small peritoneal sac has been protruded between the fibres of Gimbernat's ligament. A bristle is passed beneath the portion of the ligament which intervenes between this peritoneal sac and the space through which the femoral hernia usually passes.

The author is not aware that the variety seen in the following specimen has been described:

2143.—Femoral hernia. In the peritoneum covering the femoral ring there are the orifices of two distinct hernial sacs close together. The outermost of these sacs extends beneath the semilunar edge of the fascia lata, and over the femoral vessels. The inner sac is so small that it does not protrude behind Poupart's ligament.

UMBILICAL HERNIA.

An umbilical hernia is one that escapes through the umbilical ring, or through an aperture in the linea alba in the neighbourhood of the umbilicus.

The sac always consists, according to Mr. Birkett, of a protrusion of the parietal layer of the peritoneum, and never, as is sometimes stated, of a natural protrusion of the peritoneum, through the umbilical ring.

“In infants the protruding viscus pushes before it that portion of the parietal peritoneum lying immediately behind the aperture through which the umbilical vessels enter the abdominal cavity. The hernial sac is thus formed before the closure of the ring is effected, and may pass into the connective-tissue of the cord itself before that structure has separated.” In youth the hernia dilates the partially closed ring, and so escapes. In adults it passes between the fibres of the linea alba in the neighbourhood of the umbilicus (Birkett). An umbilical hernia is generally of large size, and of a somewhat globular or irregularly lobulated shape. It nearly always extends in a direction downwards towards the pubes.

The sac is generally very thin and attenuated, often lobular and frequently cribriform, or altogether deficient in places. The contents of the sac usually consist of omentum and of a small knuckle of intestine, which often lies concealed by the omentum near the neck of the sac.

3456.—A congenital umbilical hernia. The lower end of the ileum, the cæcum, and the ascending colon, are protruded through the umbilicus, and were contained in a cavity bounded by the extended substance of the umbilical cord. See also No. 2156a.

2154.—Portion of the abdominal muscles, exhibiting a large

circular opening in the linea alba through which an umbilical hernia was protruded.

2156.—Portion of an anterior wall of an abdomen, exhibiting a large umbilical hernia. The hernial sac is divided by deep constrictions into three parts of unequal size. It is filled by omentum.

Coverings of an umbilical hernia.

The coverings of an umbilical hernia are generally very thin and adherent to one another.

They are : 1, skin ; 2, superficial and deep fascia with a very thin layer of fat between them ; 3, fascia transversalis ; 4, peritoneum, which constitutes the sac. It must not be expected, however, that these coverings can always be demonstrated in practice. They become so attenuated and adherent to one another, or even perforated in places, that the contents of the hernia are often in contact with the skin, or merely separated from it by a thin layer of fascia.

2155.—Section of an umbilical hernia containing omentum. The omentum is firmly adherent to the sac, except in one situation, where part of the sac being deficient, the omentum is in contact with the skin.

OBTURATOR HERNIA.

An obturator hernia is one that escapes through the obturator foramen. The hernia leaves the pelvis through the aperture for the obturator artery and nerve in the upper and outer part of the obturator membrane. It either pushes the obturator externus muscle before it, or it passes over the upper border or through the fibres of that muscle and protrudes under the pectineus behind and a little to the inner side of the femoral vessels. The obturator nerve and artery are generally above the neck of the sac, but their position is not constant ; sometimes the nerve is a little to the outer, and the artery a little to the inner side of the hernia. The sac, which is always an acquired one, is formed of the parietal layer of peritoneum which lines the cavity of the pelvis. The contents of the sac have

generally consisted of small intestine, frequently of a small portion only of the circumference of the intestine; other viscera, however, have been found in the sac: the intestine has frequently been found adherent to the walls of the sac.

The coverings of an obturator hernia are: 1, skin; 2, superficial and deep fascia; 3, pectineus muscle; 4, external obturator fascia; 5, obturator externus muscle (occasionally); 6, pelvic fascia; 7, peritoneum, which forms the sac.

2161a.—The right side of a pelvis with a portion of the femur, showing a strangulated obturator hernia. The sac is about the size of a plover's egg, and is protruded over the upper edge of the obturator externus muscle, the peritoneum forming it being considerably thickened and in immediate contact above with the ramus of the pubes. The obturator nerve and artery (both cut short) lie on the anterior surface of the hernial protrusion, the former occupying the more external position. A large artery from the internal circumflex winds around the outer side of the sac and anastomoses behind it with a branch from the obturator. A deeply-congested portion of the ileum occupies the sac, and in the recent condition was slightly adherent to its front wall, there being scarcely any fluid present. The difference in calibre between the intestine above and below the stricture is well marked. The peritoneum at the crural ring is slightly bulged, and the head of the femur is the seat of osteo-arthritic changes.

From a woman aged sixty-nine, who, without having suffered from any previous symptoms, was suddenly seized with severe pain in the abdomen, followed by continuous vomiting and constipation. She died exhausted on the eleventh day of her illness. [The specimen is on the bottom shelf on the left-hand side of the door.]

2161b.—Portion of the left side of the pelvis from the same patient as the preceding specimen. An empty hernial sac rather larger than a nut occupies the upper part of the obturator foramen, immediately above the free edge of the obturator externus muscle. The obturator nerve lies directly over the front of the hernial tumour, while the artery divides at the posterior surface into its two main branches, which encircle the neck of the sac. See also Nos. 2160 and 2161, and drawings Nos. 260c and 260d.

DIAPHRAGMATIC HERNIA.

A diaphragmatic hernia is one that protrudes through the diaphragm into the thoracic cavity. The aperture in the diaphragm through which the viscus escapes may be a wound or laceration, or may be due to some congenital deficiency, or to the enlargement of one of the natural openings. The hernia has usually been observed on the left side, the liver tending to prevent any protrusion taking place on the right. The stomach or transverse colon is the viscus that usually escapes; but other portions of the intestine, the omentum, and even the pancreas, have occasionally constituted the hernia. There is no peritoneal sac in diaphragmatic hernia, the viscus commonly passing into the pleural cavity, or, as in **No. 2163** (a unique case), into the pericardium.

2162.—Diaphragmatic hernia. The preparation exhibits a portion of the left lateral half of the diaphragm, in which there is a large opening, presumed to have existed from birth. Through this opening, parts of the arch of the colon, omentum, and pancreas protruded into the chest. The strangulation of the intestine by the margin of the opening was the cause of death.

The patient, a lad nineteen years old, died with complete obstruction of the intestines of three days' duration.

2163a.—Diaphragmatic hernia, the consequence of a stab through the diaphragm six months before death. Through the aperture in the diaphragm a large portion of the jejunum and ileum, and a part of the arch of the colon, have been protruded.

The patient was a man thirty-one years old. He was always healthy till he stabbed himself below the left nipple. The wound was not considered dangerous, but after it he had several severe attacks of obstruction of the intestines, the last of which was fatal.

2163.—Pericardial diaphragmatic hernia of the omentum. In the skin over the cardiac region a transverse linear scar, nearly an inch in length, was found, a couple of inches below, and about the same distance to the right of the nipple; and corresponding with the position of this scar, the structures occupying the space between the fifth and sixth ribs were found thin and depressed. At

the same spot a piece of the cartilage of the fifth rib lay partly separated from its former connections. All the parts had, however, long healed, the wound, probably a stab, having been almost certainly inflicted many months or years before. The hernia was doubtless a consequence of a wound of the floor of the diaphragm, inflicted at the same time as the wound in the chest-walls. [The specimen is on the bottom shelf on the left-hand side of the door.] See also Nos. 2163b and 2163c.

VENTRAL HERNIA.

A ventral hernia is one that protrudes through the abdominal walls in situations other than those of the herniæ already described. In the majority of cases the protrusion occurs in the linea alba, either above or below the umbilicus; more rarely in the linea semilunaris, in the angle formed by the costal cartilages and the ensiform cartilage (*epigastric hernia*), or in the lumbar region (*lumbar hernia*).

The coverings when the hernia occurs in the linea alba are skin, superficial and deep fascia, fascia transversalis, subperitoneal fat, and peritoneum.

2158.—Two herniæ in the linea alba above the umbilicus. The superior and larger sac contains omentum; the lower one is empty. Below the smaller sac is a hole in the linea alba, through which the fat protrudes.

2159c.—A portion of the left abdominal wall. One of the appendices epiploicæ has passed through an opening in the peritoneum, and so through the left linea semilunaris at a spot a little below the level of the umbilicus. The protruded portion is invested by an extremely thin hernial sac, to which it is adherent. At the point where the sac pierces the linea alba there is a distinct ring like that seen at the umbilicus.

Other rare forms of hernia, such as ischiatic, perineal, rectal, pudendal and vaginal, occur. There are no specimens of any of these in the Museum.

APPEARANCES WHICH MAY BE MISTAKEN FOR HERNIA.

It occasionally happens that a portion of the subperitoneal fat may be protruded through the overlying abdominal

muscles. In such cases a tumour may be formed which closely resembles an ordinary hernia. Examples of such a case follow :

2159a.—A portion of the abdominal wall in the neighbourhood of the linea alba. A small tumour consisting of fat and sub-peritoneal tissue has made its way through the linea alba. During life the tumour could be felt as a lobulated mass situated beneath the skin ; it was freely movable, and partly reducible.

2159b.—A similar specimen taken from a man aged sixty-five, who was supposed to have a ventral hernia. The tumour was exposed, and was returned into the abdominal cavity, through the aperture in the linea alba, which was then sewn up. The patient died of peritonitis five days after the operation.

SECTION XV.

INJURIES AND DISEASES OF THE RECTUM.

PERFORATION OF THE COATS OF THE RECTUM BY A METALLIC CLYSTER-PIPE.

2078.—Portion of the rectum from a young person. A quill is passed through an aperture in the upper part of the intestine, where it is covered by peritoneum ; this aperture was made by the end of a metallic clyster-pipe. The clyster was injected into the peritoneal cavity and produced fatal peritonitis.

2078a.—Portions of a rectum and sigmoid flexure at the junction of which is a wound of the intestine produced by an enema-tube. The mucous surface of the gut is ulcerated at the seat of injury, but not elsewhere. On the peritoneal surface the intestine is slightly discoloured, but there is no extensive peritonitis, the inflammation being limited to an exudation of lymph over the wounded surface and the silk sutures, which had been inserted shortly after the accident. Small portions of the stitches may be seen on the outer surface of the gut under the overlapping appendices epiploicæ, which at the post-mortem examination were found to be adherent to the subjacent intestine completely covering the sutures. No trace of the silk is visible on the internal surface of the intestine.

From a woman, in whom the injury occurred during the passing of a long enema-tube, a soap injection being subsequently thrown into the peritoneal cavity. Abdominal section was performed shortly afterwards, and the gut was sewn up. She died in about forty-eight hours. See also No. 2079a.

FISSURE OF THE ANUS.

By fissure of the anus is meant a small crack or oval ulcer in the folds of mucous membrane surrounding the anus. There is no specimen in the Museum.

ULCERATION OF THE RECTUM.

Ulceration of the rectum may be simple, syphilitic, dysenteric, tubercular, or cancerous.

Simple Ulceration.

Simple ulceration is generally superficial and limited in extent, but it may penetrate deeply, occasionally perforating the walls of the rectum, and causing ischio-rectal abscess and fistula. Mr. Bryant relates five cases in which it extended into the bladder (examples of such perforations of the bladder are seen in the following specimens: **Nos. 2055a, 2057, and 2057a**; whilst in **No. 2055** the ulceration has made its way into the peritoneal cavity. The ulceration, moreover, may sometimes be widely diffused, spreading over a considerable extent of the surface of the mucous membrane, as is shown in **Nos. 2046 and 2073**, or it may even destroy the entire intestinal wall, as in the case of ulcerative colitis seen in **Nos. 1987a, 1987b, and 1987c**.

The edges of the ulcers when distinct are usually neither indurated nor nodular, and their base does not, as a rule, show any thickening. When the ulceration is superficial the submucous tissue and muscular coat, with the exception of being slightly thickened, are not affected.

2046.—The rectum of a girl twenty-five years old. Its mucous membrane is entirely removed by ulceration for several inches above the anus; and above the ulcerated part it is slightly thickened. The muscular and other coats of the intestine are thicker and denser than is natural, but exhibit no other morbid alteration of their tissue. See also **No. 2046a**.

2057.—Portion of a rectum. Just above the anus there are numerous ulcerated apertures, which lead into short fistulous

passages in the surrounding tissues ; one of these penetrates the coats of the bladder.

2055.—A rectum. The whole of the mucous membrane for about nine inches above the anus is removed in consequence of ulceration. On the surface thus exposed there are several apertures, which lead to fistulous passages in the tissues around. Upon the anterior aspect of the rectum there is one aperture higher up than the rest, which passes through the walls of the rectum, and which opened directly into the peritoneal cavity. The patient from whom the specimen was taken died of peritonitis. See also No. 2055a.

Syphilitic ulceration.

Syphilitic ulceration of the rectum is generally associated with the growth of condylomata or mucous tubercles about the anus.

“The affection,” says Sir James Paget, in a clinical lecture (*Med. Times and Gaz.*, 1865), “commonly extends from the anus, as if by continuity with the excrescences, to about five inches above the rectum ; but it is rarely so marked in the first inch of the rectum as it is higher up.” The characteristic appearance of the ulceration is well seen in the following specimen. The small, regular, round, or oval ulcers seen in the colon are very suggestive of the breaking down of gummata in the mucous and submucous coats.

2058.—The rectum and adjacent portion of the colon, laid open, showing syphilitic ulceration of the mucous membrane. The whole mucous membrane of the rectum is destroyed, except in one small patch, which is thickened and opaque. The exposed submucous tissue is uneven, tubercular, and thickened by infiltration. On the mucous membrane of the colon there are ulcers of regular, round, or oval shape, from one-sixth to about two-thirds of an inch in diameter, with clean, sharply cut, scarcely thickened edges, surrounded by healthy or only too vascular mucous membrane. Their bases are, for the most part, level, flat, or with low granulations resting on submucous tissue, nowhere penetrating to the muscular coat, with no marked subjacent thickening or hardening. On some of them are ramifying bloodvessels ; on some few there is,

at the centre of the base, a small island of mucous membrane. At some places two or more of these ulcers, extending and uniting, have coalesced into a large ulcer of irregular shape. By such coalescence some of the ulcers in the lower part of the colon are continuous with the ulcerated surface of the rectum, making it probable that at first similar forms of ulcers may have existed in the rectum, though now superadded thickening and partial scarring have destroyed nearly all traces of any primary shapes of ulcer. No ulcers were found in the cæcum, or in the small intestine, except one very small and of rather doubtful character in the ileum.

From a woman, aged twenty-eight, who had contracted syphilis seven years previously.

In the clinical lecture before referred to, Sir James Paget, in reference to the ulcers in this specimen, says: "The only question as to the diagnosis of these ulcers may be whether they are syphilitic or tuberculous. They are so different from all the forms of catarrhal, follicular, typhoid, dysenteric, and cancerous ulceration of the rectum, that there is no need to compare them; but from the tuberculous they must be distinguished, not so much because of any near resemblance between them, but because the patient had tuberculous disease of the lungs, and was therefore not unlikely to have it in the intestines."

"The shape and characters of the ulcers are quite unlike those of intestinal tuberculosis; they are regular, with sharp, even, well-defined edges, with level bases; they are not excavated; they do not extend through the submucous tissue; their edges are nowhere eroded or undermined, sinuous, thickened or brawny, or infiltrated; the subjacent and intervening structures appear healthy, except at the rectum. These ulcers are not grouped, and when, by extension and coalescence, they have lost their first shape, they have acquired one altogether irregular, and have in no instance even tended towards that girdle-like shape encircling the canal of the intestine which is so characteristic in the large coalesced tuberculous ulcers."

2060.—The rectum of a woman, aged thirty, affected by what was supposed to be tertiary syphilitic ulceration.

2061.—A portion of the large intestine, from the same patient, showing the alternation of a healthy with a diseased tract of mucous membrane.

2057b.—The rectum and sigmoid flexure of a patient upon whom the operation of colotomy was performed three days before death for the relief of a syphilitic stricture of the rectum. The bowel from the anus upwards is much thickened, and its cut edge almost resembles cartilage. The thickening gradually diminishes until it is imperceptible at the splenic flexure. There is hardly any epithelium covering the diseased portion of the intestine. A microscopic examination of a portion of the intestinal wall, taken about fourteen inches above the anus, shows that the epithelial lining is entirely absent. The submucous tissue is so infiltrated with round cells as to look like a section of lymphatic gland. The muscular coat is also invaded by lymph corpuscles and a dense fibrous meshwork, whilst the outer peritoneal coat is infiltrated with cells.

From a woman aged thirty-five, who had acquired syphilis about twelve years before her admission to the hospital. All round the margins of the anus and vagina, and extending for some distance up both, there was a mass of cicatricial tissue to be felt during life. The patient had suffered for several years from diarrhoea, and for some months before her death had been unable to retain her fæces. Left lumbar colotomy was performed three days before death. At the autopsy no other signs of syphilis were discovered. A microscopic section is preserved in Series *lv.*, No. 87i.

Dysenteric ulceration.

The following is an example of dysenteric ulceration of the rectum. The characters of the dysenteric ulcer, however, are better seen in several specimens of dysenteric ulceration of the colon, the common seat of the affection, Nos. 2016 and 2018a.

2057a.—A bladder, rectum and sigmoid flexure. The mucous membrane of the latter is much thickened and thrown into large transverse folds, one of which, being separated in part from its connections, forms a bridge across the gut. Between these folds are deep pits or depressions, the base of the deepest being mainly formed by the peritoneum covering the gut. At the seat of the greatest thickening, the sigmoid flexure is firmly adherent to the

bladder by very strong, but rather elongated, adhesions. Opposite this point a small pigmented depression in the vesical mucous membrane marks the seat of a former communication between the two contiguous viscera. The mucous membrane of the bladder is natural, but the prostate is somewhat hypertrophied.

From a gentleman who had suffered for several years with dysenteric symptoms. Some years before death he frequently passed flatus per urethram, but never any fæcal matter. After a time this ceased, and for the last two years of his life there were no signs of any communication existing between the intestine and the bladder.

Tubercular ulceration.

Tubercular ulceration is not of very unfrequent occurrence in the rectum, and it is the cause of the fistulæ which are found in persons suffering from pulmonary phthisis. The ulcer is generally ragged, with undermined edges; it allows of the escape of fæcal material, and so causes supuration around the bowel.

Cancerous ulceration.

For description and specimens of cancerous ulceration, see "Cancerous Stricture of the Rectum."

FISTULA IN ANO.

Fistula in ano may be defined as a fistulous tract by the side of the rectum, left by the contraction of the cavity of an ischio-rectal abscess.

The way in which an ischio-rectal abscess, and consequently a fistula, is produced was long a matter of controversy. Sir Benjamin Brodie held the opinion that all ischio-rectal abscesses were the result of ulceration of the mucous membrane and subsequent perforation of the walls of the rectum with escape of fæces into the ischio-rectal fossa, and, therefore, that all fistulæ communicated with the rectum. Others, however, maintained that an abscess might form in the ischio-rectal fossa from causes other than perforation of the rectum, such as various constitutional conditions of the patient, blows or kicks upon

the nates, etc., and, therefore, that should a fistula result from the imperfect healing of such an abscess it need not necessarily communicate with the bowel.

It is now universally recognised that an abscess, and consequently a fistula, may be produced in either way, and that an internal opening does not always exist. It is difficult, however, in the living to be quite sure that there is no internal opening. In the Museum there are two specimens in which its absence is clearly demonstrated.

A recognition of the fact that an ischio-rectal abscess may be the result of causes other than ulceration and perforation of the rectum is of importance, for should such an abscess be opened early it may be prevented from making its way into the rectum, and under appropriate treatment may completely and soundly heal without the production of any fistula; whereas should the opening be delayed until the abscess points externally it will certainly by that time have burst into the bowel, and a fistula will be the result.

The frequent termination of an ischio-rectal abscess in a fistula is due to the constant action of the sphincter and the contraction of the levator ani during defæcation, which prevent the walls of the contracted abscess-cavity from uniting. After the fistula has existed some time the smooth membrane with which it becomes lined is an additional hindrance to the healing process.

Fistulæ are divided into complete, blind external, and blind internal. A *complete fistula* is one which opens externally upon the cutaneous surface and internally into the bowel. A *blind external fistula* is one that opens on the cutaneous surface, but has no internal opening into the bowel. A *blind internal fistula* is one that opens into the bowel, but has no external opening upon the cutaneous surface.

As a fistula is the result of the contraction of an ischio-rectal abscess, it will be lined when first formed by granulations, but after it has existed some time its walls become hard, indurated, and lined by a smooth shining membrane.

In direction the fistula usually extends obliquely upwards

and inwards on one side of the rectum, and when complete generally opens into the gut immediately above the internal sphincter. Occasionally, however, it extends for some distance above the internal opening in the form of a cul-de-sac by the side of the rectum. Occasionally the internal opening has been found as high as three or more inches up the rectum, and occasionally two internal openings have existed. Secondary fistulæ frequently burrow beneath the skin of the perineum and buttock, forming angles, as it were, with the deep fistula. There is usually but one external opening, but occasionally there may be several. When single the opening is usually about half an inch from the verge of the anus, but it may be at some distance from the anus, or close to it, and so enveloped in the loose folds of integument that it is often difficult to discover it. It may be little more than a minute aperture, only discernible by the slight discharge which oozes from it, or it may appear as a minute hole slightly elevated on a papilla.

The internal opening is often difficult to find ; it generally lies hidden in the fold of mucous membrane immediately above the sphincter.

A fistula is often associated with a cancerous or other form of stricture of the rectum.

Complete fistula.

2052.—Portion of a rectum, with a fistula extending for two inches upwards on its exterior, and then suddenly opening into its cavity. The passage appears lined by a smooth membrane, like the mucous membrane of the rectum itself.

Blind external fistula.

2051.—Portion of a rectum, exhibiting a fistula which extends from the anus upwards between the fibres of the levator ani muscle and the longitudinal muscular fibres of the intestine. A bristle is passed through the fistulous passage ; it does not open into the rectum.

2053.—Portion of a rectum, with the anus. Irregular and branched fistulous passages, whose course is indicated by bristles,

extend in various directions around the exterior of the rectum; but none of them open into it. They appear lined by soft and smooth membrane.

Blind internal fistula.

2057.—Portion of a rectum. Its coats are generally and greatly thickened, indurated, and consolidated with each other and with the remaining parts. Just above the anus there are numerous ulcerated apertures with smooth edges, which lead into short fistulous canals in the surrounding indurated tissues. One of these canals extends beyond the tissue through the coats of the bladder into its cavity.

HÆMORRHOIDS OR PILES.

Hæmorrhoids or piles may be defined as swellings about the anus, the result of the dilatation or varicose state of the hæmorrhoidal veins. Before studying the specimens illustrating the anatomy of piles, the normal arrangement of the hæmorrhoidal veins should be noticed (see Physiological Series, No. 718). The hæmorrhoidal plexus is situated between the mucous and muscular coat of the lower part of the rectum, and extends from the inner margin of the external sphincter for about three-quarters of an inch up the gut. The veins are arranged in clusters, principally longitudinally, anastomosing with one another by transverse loops. Above, they communicate through the middle and superior hæmorrhoidal, the inferior mesenteric, and splenic veins with the portal vein, all of which are destitute of valves; below, branches perforate the internal sphincter, establishing a communication with the subcutaneous veins (the external hæmorrhoidal) around the margin of the anus, which terminate in the internal pudic. The peculiar anatomical arrangement of the hæmorrhoidal veins; the absence of valves in the veins through which they communicate with the portal vein, whereby they have to sustain the whole weight of the column of portal blood; and their situation between the muscular and mucous coats of the rectum, so that they receive but little support during defæ-

cation, should be noted, as these conditions constitute the chief predisposing causes of hæmorrhoids.

Hæmorrhoids consist at first of little more than dilated hæmorrhoidal veins, and appear as swellings situated around the margin of the anus external to the sphincter, or in the interior of the lower part of the rectum; but after they have existed some time the vein-walls become hypertrophied, and the connective-tissue surrounding the dilated veins becomes infiltrated and thickened. They then appear composed in great part of connective-tissue and a number of small blood-vessels. From the fact that hæmorrhoids are occasionally produced quite suddenly, it is probable that they may in some cases be due to rupture of a vein and extravasation of blood into the connective-tissue around. When situated without the sphincter they are covered in part by skin and in part by mucous membrane, and are called external hæmorrhoids; when situated in the interior of the rectum they are covered only by mucous membrane, and are called internal hæmorrhoids.

External hæmorrhoids occur in two forms—either as soft, globular, pinkish-blue swellings, or as moderately firm fleshy tumours; the former are composed of varicose and dilated veins containing fluid or clotted blood; the latter, which are the result of secondary changes occurring in the former, consist of thickened skin and infiltrated connective-tissue with small vessels ramifying in them.

2076.—Portion of a rectum with hæmorrhoids. The surface of the hæmorrhoids is formed partly by the mucous membrane of the rectum and partly by the external integuments, thickened and raised in irregular folds around the margin of the anus.

2076a.—The lower portion of the rectum and the anus, from a man aged thirty-eight. The mucous membrane in the neighbourhood of the anus is festooned with hæmorrhoids. The piles are for the most part of the external variety, since they are partially covered by skin and partially by mucous membrane. The central round mass is, however, entirely covered by mucous membrane, and is therefore an internal pile.

Internal hæmorrhoids (i.e., those occurring within the

sphincter) are identical in their nature with those situated externally; they present certain peculiarities in appearance, however, inasmuch as they are covered with mucous membrane and not with skin. They occur in many forms. They may consist merely of the smaller hæmorrhoidal veins dilated and varicose, giving to the mucous membrane a dark purplish colour, and rendering it liable to become prolapsed during defæcation; or they may form either slightly raised, flattened and oblong, or distinctly globular pedunculated swellings. These swellings may be very vascular, from the congested state of the mucous membrane covering them (bleeding piles); or if the mucous membrane has become thickened they appear firm and fleshy, of a reddish-brown colour, and do not easily bleed. The bleeding appears to take place from the small arteries in the mucous membrane, and not from the dilated veins. The globular kinds have often a distinct artery entering at their base, which may bleed freely if the pile is excised.

Internal hæmorrhoids are liable to be protruded during defæcation, and to become strangulated by the sphincter, causing much pain and irritation. If not soon reduced the constricted part may become gangrenous and separate.

Whether external or internal, hæmorrhoids may become inflamed and suppurate. They are also frequently associated with fissure, fistula, prolapse, or other affections of the rectum.

2045.—A prolapsed rectum. A section has been made through the anterior wall, in which numerous clots of blood are conspicuous and denote the situation of dilated hæmorrhoidal veins.

2074.—A rectum, around the lower part of which the veins, dilated into hæmorrhoidal tumours, have been filled with wax injected into the inferior mesenteric vein.

2075.—Portion of a rectum. At its lower border the mucous membrane is raised in folds and lobular tumours by the hæmorrhoidal enlargement of the subjacent veins.

2077.—A pyriform clot of blood, firm and dark, which was removed from a dilated portion of a hæmorrhoidal vein.

PROLAPSUS RECTI.

Prolapsus ani is the name given to the protrusion of the lower part of the rectum through the anus. It may result from a relaxed state of the sphincter ani, or from straining in consequence of constipation, diarrhœa, hæmorrhoids, stricture of the urethra, stone in the bladder, polypus or ascarides in the rectum, etc. It is most frequently met with in children.

The protrusion commonly appears as an irregular ring of mucous membrane, or, when much of the rectum is protruded, as an elongated cylindrical swelling slightly inclining to one side, with a central depression at its lowest part.

The lateral inclination and retraction of its lowest part is due to the dragging of the meso-rectum, which is, of course, drawn down when much of the rectum is protruded. This dragging of the meso-rectum also accounts for the slit-like appearance which the aperture at the bottom of the central depression (the entrance into the bowel) sometimes assumes. When recent, the protruded part has the colour of healthy mucous membrane, but if not soon reduced it becomes livid and congested in consequence of the constriction of its bloodvessels by the sphincter; in old-standing cases it becomes indurated and leathery from exposure, approaching in character to skin. The protruded portion in some cases is ulcerated. Prolapse of the rectum may be distinguished from a protruding polypus by the aperture in the centre of the prolapsed gut, and from an intussusception of the rectum or other part of the intestine protruding through the anus by the mucous membrane in the case of prolapse being continuous with that of the sphincter, whereas in intussusception a sulcus exists between the protruded part of the bowel and the sphincter.

2045.—A prolapsed rectum. The mucous lining of the most dependent portion is much thickened, forming the greater part of the fibro-cellular mass which protruded through the anus. A section has been made through the anterior wall, showing this thickened portion, in which numerous clots of blood are conspicuous, and denote the situation of dilated hæmorrhoidal veins.

POLYPI OF THE RECTUM.

Polypi occur as pear-shaped pedunculated growths springing from the submucous tissue of the rectum, and more commonly from that of the lower and posterior portion. They are covered with the mucous membrane, which they resemble in colour, and are generally very vascular, giving rise to frequent hæmorrhages, especially in children. They are usually single, and vary from the size of a pea to that of a large nut; in the rare cases in which they are multiple, their number may be very great (No. 2065a). Their peduncle, which is generally slender, is often more than an inch in length, allowing them to protrude externally during defæcation. In structure they differ, and have been divided into the soft or glandular, and the hard or fibrous, the former variety mostly occurring in children, the latter in adults.

Simple, or Glandular Polypi.

The soft or glandular approach the adenomata in structure, and are composed of a number of follicles lined by cylindrical epithelium (*Lieberkühn's crypts*) bound together by areolar connective-tissue. Their peduncle is generally soft and readily broken.

Single Polypi. 2062a.—A portion of the rectum, laid open to show a pedunculated rectal polypus. The polypus is attached to the mucous membrane of the intestine by a tapering stalk measuring an inch and a quarter in length. It is spongy in texture, and it contains small cavities filled with clear fluid. Under the microscope the tumour is found to be composed of areolar tissue containing a number of glands resembling those found in the rectal mucous membrane.

From a woman aged fifty, in whom it was accidentally discovered at the post-mortem examination. See also No. 2062.

2063.—A large polypus of the rectum from a man aged forty. Symptoms had existed for ten years, and for two or three years the fæces had never passed without much straining and discharge, occasionally of blood. Before removal the polypus could be felt in the rectum, nearly four inches from the anus, attached to the posterior wall of the bowel. When protruded, by long straining it

appeared as an irregular spheroidal mass, lobed, moderately firm but brittle, about two and a half inches in its chief diameter, and, like the adjacent mucous membrane, readily but not freely bleeding. Its base of attachment seemed to be rather more than an inch in diameter.

Under the microscope the tumour was seen to be composed of small cells like gland-cells and a small quantity of fibro-cellular tissue. Numerous papillæ were found with loops of capillaries in their interior, and covered with cylindrical epithelium. Upon a careful examination of the rectum a short time after the removal of the tumour no trace of it could be discovered.

Simple polypi may also result from the irritation caused by the ova of *Bilharzia hæmatobia*.

2065a.—A good instance of a polypus due to the irritation produced by the ova of the *Bilharzia hæmatobia*. Its substance is crowded with the ova of the parasite. It was removed from an Arab who protruded it whilst straining at stool.

Multiple Polypi. 2065a.—The rectum, with the anus and a portion of the sigmoid flexure, from a case of multiple polypi of the rectum. There is a considerable deposit of adenoid cancer at the junction of the sigmoid flexure with the rectum, surrounding the bowel and almost obliterating its canal. A glass rod has been passed through the stricture thus formed. The rectum below the constriction contains a large number of polypoid growths. The polypi are more or less globose in shape, having slender stalks, but here and there are ribbon-like, ragged, slender, and branched outgrowths, whilst some of the smaller growths are sessile. Above the seat of cancer there are but few to be found, and in the ascending and transverse colon there were not more than three or four, and these were small and rudimentary. The rectum, where it passed over the concavity of the sacrum, was adherent to the neighbouring parietal peritoneum. The large intestine above the stricture was enormously distended by fæces. The peritoneum over the anterior longitudinal muscular band of the cæcum had been split by the excessive stretching. Microscopical examination of the growth surrounding the intestine at the seat of stricture showed that it was an adenoid cancer. The polypi consist of simple glandular tissue, but their bases are continuous with the carcinomatous growth, which has infiltrated the whole thickness of the wall of the rectum.

From a man aged twenty. Ten years previously he was taken

to the London Hospital for hæmorrhage from the bowel, and was operated upon. For three or four months he remained well, but the bleeding returned, and recurred at intervals during four years. He was subsequently operated on several times with temporary relief. His appearance on admission was that of extreme anæmia. He complained of pain in the rectum, especially on defæcation. He had almost constant discharge of bloody mucus from the bowel, and frequent attacks of hæmorrhage. He could protrude from the anus at will a polypoid mass the size of a plover's egg. The polypi could be seen after the dilation of the rectum, and some were removed after passing a ligature round their pedicles. After being thrice discharged and readmitted, the patient was brought to the hospital moribund and with signs of peritonitis. A brother and sister of this patient presented themselves for treatment, and they were found to be suffering in exactly the same manner from multiple polypi of the lower bowel.

Sections of the growth are preserved in **Series lv., Nos. 87k and 87l.**

Fibrous Polypi.

The hard or fibrous polypi are composed almost entirely of fibrous tissue, and their peduncles are tough and not readily broken.

2065.—A fibrous polypus removed from the lower part of the rectum. It is covered with a structure resembling mucous membrane, which, however, over portions, has the character of common integument, and long silken hairs grow from its surface.

2064.—A fibro-myxomatous polypus removed from the rectum of a gentleman about forty years old.

2064a.—A very large fibro-cellular polypus from the rectum. Its surface is smooth, and presents a slight trace of lobulation; its base of attachment is about one inch and a half in diameter. On section, it appears to be composed of very loose gelatinous connective-tissue, the spaces of which immediately after removal contained a considerable amount of fluid. The weight of the tumour when fresh was nearly two pounds. The patient was a young woman aged twenty-four. She had suffered for some time with slight difficulty of defæcation, which, however, caused but little trouble. One day, while straining at stool, the tumour was extruded through the anus, where it was tightly gripped by the sphincter, and became irreducible. It was then removed by trans-

fixion of the base and ligature. Microscopic sections are preserved in **Series lv., No. 87d.**

VILLOUS TUMOURS.

Villous tumours of the rectum are rare; they resemble the villous growths in the bladder, and, like these, are of papillomatous structure. They spring from the mucous membrane, and give rise to frequent hæmorrhage. There is no specimen of them in the Museum.

STRICTURE OF THE RECTUM.

Stricture of the rectum is commonly divided into simple and malignant.

Simple stricture.

Simple stricture is caused either by the fibrous contraction of inflammatory products resulting from inflammation of the mucous and submucous coats, or by the contraction of cicatrices following ulceration or injury of the bowel. Syphilitic and dysenteric ulceration more frequently give rise to stricture than simple ulceration, as they involve the submucous coat, and in the case of dysenteric ulceration the muscular coat also; whereas simple ulceration is usually confined to the mucous membrane. There is a specimen in the Museum (**No. 2047**) exhibiting a permanent stricture without any visible change of structure, attributed to contraction of the muscular coat.

The stricture may involve a small portion only of the intestine, assuming a ring-like form, when it is called annular; or it may include an inch or more of the gut.

The strictured portion of the bowel is composed in great part of fibrous tissue.

Simple stricture is most commonly met with from one to two inches from the anus, but it may also occur at the junction of the first and second portions of the rectum, *i.e.*, from four to five inches from the anus, and at the junction of the sigmoid flexure with the rectum.

2047.—Portion of a rectum, the cavity of which, at its upper part, is contracted to a quarter of an inch in diameter, without any

visible change of structure. The contraction includes about an inch of the length of the intestine ; it was probably occasioned by the action of the muscular fibres.

2048. — Portion of a rectum exhibiting a very close annular stricture between two and three inches from the anus. See also Nos. 2025 and 2061.

2079. — The rectum, uterus, and vagina of a child five years old. Ten months before the death of the child, in the attempt to administer an enema, a clyster-pipe was forced through the adjacent walls of the rectum and vagina. At the part thus injured there is a small depression in the wall of the vagina, and a long, pale, and irregular cicatrix in that of the rectum. Just below the cicatrix, at a distance of about an inch from the margin of the anus, the canal of the rectum is reduced to an eighth of an inch in diameter, and the adjacent tissues are indurated. Above this stricture the intestine is greatly dilated ; below it is of natural size. See also No. 2048a.

2057b. — The rectum and sigmoid flexure of a patient upon whom the operation of colotomy was performed three days before death for the relief of a syphilitic stricture of the rectum. The bowel from the anus upwards is much thickened, and its cut edge almost resembles cartilage. The thickening gradually diminishes until it is imperceptible at the splenic flexure. There is hardly any epithelium covering the diseased portion of the intestine. A microscopic examination of a portion of the intestinal wall, taken about fourteen inches above the anus, shows that the epithelial lining is entirely absent. The submucous tissue is so infiltrated with round cells as to look like a section of lymphatic gland. The muscular coat is also invaded by lymph corpuscles and a dense fibrous meshwork, whilst the outer peritoneal coat is infiltrated with cells.

From a woman, aged thirty-five, who had acquired syphilis about twelve years before her admission to the hospital. All round the margins of the anus and vagina, and extending for some distance up both, there was a mass of cicatricial tissue to be felt during life. The patient had suffered for several years from diarrhoea, and for some months before her death had been unable to retain her fæces. Left lumbar colotomy was performed three days before death. At the autopsy no other signs of syphilis were discovered. A microscopic section is preserved in Series lv., No. 87i.

Fibrous stricture.

2048a.—The rectum, with the uterus and a portion of the vagina, from a patient who had a fibrous stricture of the rectum. The stricture is tubular, and commences three inches above the anus, extending upwards to a height of six or seven inches. It is so tight that the glass rod which is passed through the upper portion almost fills the lumen of the gut. The stricture seems to be produced by a thickening and contraction of the muscular coat. The muscular element appears to have disappeared, leaving only a greatly hypertrophied fibrous network. The upper part of the stricture ends abruptly, but the mucous membrane is superficially ulcerated for a distance of from one to two inches higher, the muscular coat corresponding to this portion being somewhat hypertrophied but not contracted. At the bottom of Douglas' pouch is a well-marked cicatrix, apparently indicating the site of an old abscess cavity in the fascia between the peritoneum and the rectum. The rectum opposite this point has been dragged upon, and drawn towards the cicatrix. From a woman, aged thirty-two, who was quite well till she was prematurely delivered of a still-born child six years before her death. This premature labour was followed by intense pain in the lower part of the belly, and she had other symptoms of pelvic cellulitis. A month later she had a discharge of blood and pus from the rectum, which continued for some weeks. Soon afterwards she noticed a slight difficulty in passing her motions, and she also had some discharge from her bowel. The trouble gradually increased, until a year before her death, after which it rapidly got worse.

Malignant stricture.

All forms of cancer occur in the rectum, and by encroaching upon the lumen of the gut may give rise to stricture. A special variety of epithelial cancer is the most common; it may begin as a cauliflower-excrescence, protruding into the rectum, or as a hard nodular ring-like induration of the mucous membrane. The surface of the growth after a time ulcerates, the ulcer having elevated edges and an indurated base covered with a sanious offensive discharge. It is most common round the anus and at a distance of from two to five inches up the rectum.

Columnar-celled epithelial cancer of the rectum is nearly always of that variety called *adenoid or glandular cancer*. "The growth proceeds almost exclusively from the glands of the rectum, which grow out in the form of elongated, and sometimes branched, saccules; the lumina of the glands are often preserved and filled with mucus; the cylindrical epithelium retains its form, and becomes very large. The interstitial connective-tissue becomes infiltrated with small round cells; it undergoes a partial mucoid softening, and is very vascular" (Billroth).

Should the patient soon succumb to intestinal obstruction the disease will seldom be found involving the neighbouring parts, but when the patient survives for some time, as after a successful colotomy, the cancer infiltrates the adjacent structures, causing them to become adherent to the rectum, converting the whole into a cancerous mass: death ensues from interference with their functions.

The *scirrhus form of cancer* generally occurs as an infiltration of the coats, converting the portion of the gut involved into a rigid tube, and afterwards, by its contraction, producing complete obstruction.

The *encephaloid form* is rare, but both the adenoid and encephaloid cancer may undergo colloid degeneration.

2067.—A portion of a rectum and of the sigmoid flexure of the colon. There is an annular constriction at the point of junction of these two portions of the large intestine, and the canal is still further obstructed by the projection of a cancerous growth into its interior. The rectum itself appears healthy, but the colon is greatly dilated, and its walls are much hypertrophied.

The patient, a middle-aged woman, died in the hospital after five weeks' suffering from complete obstruction of the intestinal canal. The cæcum gave way in several places before death, and peritonitis ensued, consequent upon the escape of fæcal matter.

2069.—A rectum and urinary bladder. A carcinomatous mass, arising from the mucous membrane of the rectum in its whole circumference, projects for about four inches upwards from the anus into the cavity of the intestine. The cellular tissue between the bladder and rectum is thickened and indurated.

The patient was a woman forty years old. She died extremely emaciated, with cancerous tumours in the liver and other parts. She had made no complaint leading to a suspicion of disease of the rectum.

2049.—A rectum exhibiting a contraction of its cavity, which commenced two inches above the anus, and is thence continued four or five inches upwards. The coats of the intestine are generally thickened and indurated, and the divided edges exhibit white bands intersecting a very firm mass of scirrhus cancer. The cellular and adipose tissue around the rectum is also thickened, and is converted into a hard brawny mass of cancer, in which the posterior surfaces of the uterus, vagina, and broad ligaments are involved. See also Nos. 2068, 2070, 2071. In No. 2065a, the cancer has undergone colloid degeneration.

EXCISION OF THE RECTUM AFFECTED WITH CANCER.

2066a.—The lower portion of the rectum, removed during life from a single lady, aged fifty-one, on account of the growth of an adenoid cancer. The growth, as is seen in the specimen, completely surrounded the bowel, its centre, which was ulcerated, being situated about two and a half inches from the anus; it has, however, been entirely removed, for the preparation is suspended by the healthy mucous membrane. The peritoneum was clearly seen during the operation, but it did not appear to be affected. The intestinal walls are not greatly thickened, nor is the lumen contracted.

The patient had suffered from troublesome diarrhoea for eight months, especially in the forenoon, her motions often being as many as a dozen in the twenty-four hours. The patient made a good recovery. See also Nos. 2080 and 2080a.

The effects upon the intestine above the seat of stricture.

Whatever the kind and position of the stricture, the intestine above the constriction becomes much distended by fæces, the muscular coat becomes hypertrophied, and the mucous membrane thickened and frequently ulcerated. Sometimes the distension is so great that the walls give way, and extravasation into the peritoneal cavity ensues.

Fistula and hæmorrhoids are frequent concomitants of stricture; their presence has occasionally caused the existence of stricture to be overlooked.

2048.—Portion of a rectum exhibiting a very close annular stricture between two and three inches from the anus. Above the stricture the intestine is dilated, and its muscular coat is thickened and hypertrophied ; below it there is diffuse superficial ulceration of the mucous membrane. A portion of quill is passed through the constricted part.

1952.—The large intestine, enormously distended, taken from a child with stricture of the rectum. It contained a large bucketful of fluid faecal matter, which had been gradually accumulating from the time of the formation of the stricture. [A dry specimen preserved in the wall-case on the right of the door.] The rectum is preserved in No. 2079.

CONGENITAL MALFORMATIONS OF THE RECTUM.

IMPERFORATE ANUS.

The intestinal canal in early foetal life terminates, as may be remembered, at some little distance from the cutaneous surface as a blind pouch or cloaca, common to it and the genito-urinary organs. As development advances, the cutaneous tissues (epiblast) at the spot corresponding to the future anus become invaginated towards the cloaca, the intervening tissues and walls of the cloaca become gradually thinned, and at length completely absorbed, and a connection is established between the cloaca and the surface of the body.

Subsequently the anterior or genito-urinary portion of the cloaca becomes cut off from the posterior or intestinal, the latter retaining its connection with the external opening, which is then called the anus. The invagination forming the anus is not, however, quite terminal, so that a small cæcum—the post-anal gut—is said to be occasionally found running backwards towards the coccyx. The various forms of imperforate anus may be explained by the failure of one or more of the above processes of development.

I. Should no invagination of the cutaneous tissues take place, the anus will be entirely wanting. The intestine in such a case may terminate in a blind pouch, a moderate thickness of tissue or a thin membrane alone intervening

between it and the outer surface; or it may communicate (should the process by which the intestine is normally cut off from the genito-urinary portion of the cloaca also have failed) with any of the genito-urinary organs, *i.e.*, with the bladder, urethra or vagina constituting a fæcal fistula (Nos. 3640a and 3640b); or, again, it may open externally in some abnormal situation such as the perineum or groin, a condition somewhat difficult of explanation. In some instances the rectum itself may be entirely absent.

II. Should invagination of the cutaneous tissue have taken place, but the communication between the cloaca and the surface not have been accomplished by the absorption of the intervening tissues, an anus, natural to all outward appearances and in a normal situation, will exist, but will terminate internally as a blind pouch; areolar tissue, varying in amount from a thin membrane to a layer of considerable thickness, intervening between the top of the pouch and the end of the intestine. In such a case the rectum itself, as when the anus is entirely absent, may terminate blindly, or in one of the forms of fæcal fistulæ.

3640.—The rectum, bladder, and other parts from a case of imperforate anus. The cutaneous and subcutaneous portions of the anus appear well formed, a conical depression from the perineum, with converging folds of skin and mucous membrane, existing as in the natural state. But the space between this depression and the closed termination of the rectum is filled with cellular tissue forming a layer measuring about a fifth of an inch in thickness. Directly above this layer the rectum is dilated in a large pouch. See also Nos. 3639 and 3646.

3641.—A similar malformation of the rectum and anus. A layer of cellular tissue, nearly an inch in depth, intervenes between the depression and the closed end of the intestine. A large rupture of the colon, about four inches from the cæcum, was occasioned by the accumulation of fæcal matter.

3642.—A similar malformation, in which the anal depression is well formed and more than half an inch deep, but between it and the dilated termination of the rectum an interval of nearly an inch deep is filled with cellular tissue. A bristle is placed in an aperture

in the end of the rectum made with a trocar in an attempt to give passage to the fæces. See also **No. 3643**, in which the trocar passed by the side of the rectum and did not enter it.

3647.—The rectum of a child fourteen months old, in which at birth the anus was imperforate. The rectum was punctured from the anus with a trocar, and the aperture remained open for the passage of fæces. Where the partition existed between the rectum and anus there is now an annular fold of mucous membrane projecting like a perforated diaphragm into the canal of the intestine about two-thirds of an inch from the anus. At this fold the mucous membrane is smooth and appears very dense; above and below it is deeply wrinkled. The muscular coat of the rectum above the fold is very thick.

3648a.—The dried rectum and sigmoid flexure from a girl aged ten years, who had an imperforate anus. Colotomy had been performed on the left side immediately after birth. The whole intestine is greatly dilated, but below the colotomy wound it is distended into an enormous cul de sac, which, in the fresh condition, held a quart of fluid. At the end of the cul de sac is a small shrivelled portion which represents the connective-tissue which intervened between the termination of the intestine and the anus. (In the wall-case in the north side of the top gallery.)

3648.—A similar specimen from a child who lived two years after the puncture of the rectum. The tissues punctured appear to have been torn or cut in making the preparation; but the insufficiency of the aperture is proved by the great distension, the thick muscular walls, and the large follicles of the rectum above it. See also **Nos. 3644 and 3645.**

Fæcal fistulæ. **3640a.**—The rectum and urino-genital organs of a male infant. The anus is imperforate. The rectum opens by a small aperture, through which a black bristle has been passed, into the prostatic portion of the urethra immediately upon the left side of the verumontanum. The situation of the anus is marked by a small papilla in front of the upper portion of the bristle. From a child aged twenty-three days. Lumbar colotomy was performed three weeks before death.

3640b.—The rectum and genito-urinary organs from a newly-born female child. The anus is imperforate; the rectum opens by a large aperture into the posterior wall of the vagina. Through this opening a glass rod has been passed. The other organs are natural.

SECTION XVI.

INJURIES AND DISEASES OF THE GENITO-URINARY ORGANS.

INJURIES AND DISEASES OF THE PENIS AND URETHRA.

WARTS ON THE PENIS.

WARTS on the glans and prepuce are very common as the result of gonorrhœa. When abundant, they somewhat resemble epithelioma, from which they may generally be distinguished by the absence of induration.

2888.—Portion of a penis with warts upon the prepuce and upon the surface of the glans. Previous to the growth of these the glans appears to have protruded through an ulcerated aperture in the lower part of the prepuce.

PRIMARY SYPHILITIC SORES ON THE PENIS.

Two specimens of phagedænic ulceration of the glans, the result of venereal inoculation, follow. The appearances and behaviour of primary venereal sores are not described, as they can be better studied clinically in the living patient.

2884.—A glans penis, exhibiting a large ulcer, with a ragged irregular surface extending from below into the urethra.

2900.—Section of a penis, in which the glans and part of the corpus cavernosum have been removed by ulceration. See also No. 2886a.

TUBERCLE OF THE PENIS.

2887.—Section of a penis, in which tuberculous matter is infiltrated through the whole of the interior of the corpus cavernosum. On a small separated portion the fibrous covering has been reflected to show that it is unaltered. The cavity of the dorsal vein is filled with tuberculous matter. The corpus spongiosum and the urethra are sound.

CARCINOMA OF THE PENIS.

Cancer of the penis is generally epithelial, very rarely scirrhus.

The epithelial variety begins usually as a warty excrescence on the inner surface of the prepuce, more rarely as a circumscribed nodular induration of the glans itself. As it increases in size it assumes the form of an indurated, irregular, cauliflower-like growth covered with an offensive sanious discharge.

The cancer is of the squamous-celled variety, and involves the whole of the organ, and thence spreads to the neighbouring parts. The inguinal glands are affected, but secondary deposits in distant organs do not as a rule occur. If amputation is performed sufficiently early the disease may not return, but if amputation be delayed until the glands have become implicated the cancer generally recurs in the glands, or more rarely in the cicatrix.

2893.—The greater part of a penis removed together with a very large warty growth, which covers all its upper and anterior part, and appears to have originated in the skin of the prepuce. The glans and body of the penis are healthy. See also No. 2899.

The scirrhus variety, which is extremely rare, begins either as an infiltration or as a distinct tubercle in the neighbourhood of the corona glandis. It rapidly invades the remainder of the organ, ulcerates, affects the neighbouring glands, and gives rise to secondary cancer in distant organs.

2895.—Portion of a penis, in which the corpus cavernosum is converted by cancerous disease into a firm substance. The glans

penis, with a part of the altered corpus cavernosum, is deeply ulcerated.

2898.—Sections of a penis which was removed in consequence of extensive cancerous disease. In the lower half of the prepuce is a mass of firm cancer. The part of this mass which is near the glans has ulcerated deeply, and the lower half of the glans itself is similarly destroyed. The remains of the glans and the anterior third of the corpus spongiosum appeared filled with cancer, and there is a nearly isolated mass of cancer in the corpus cavernosum, just behind the glans.

From a man seventy-five years old. The disease had been eighteen months in progress. The penis was cut off close to the pubes. A week after the operation the patient died of erysipelas. After death the inguinal and lumbar glands were found enlarged with cancerous disease, and there were several small, white, hard cancerous tumours in the lungs.

2901.—Scirrhus cancer of the penis and bladder.

STRICTURE OF THE URETHRA.

Anatomy of the urethra.

Before discussing the pathology of stricture, a few remarks on the anatomy of the urethra may not be out of place. The urethra is about eight inches long, and, when the penis is held straight, forms a single curve, with its concavity upwards, under the arch of the pubes. Anatomically it is divided into three portions, the prostatic, the membranous, and the spongy. The prostatic, surrounded by the prostate, measures a little more than an inch in length; the membranous, placed between the two layers of the triangular ligament and surrounded by the compressor urethræ muscle, measures a little less than an inch; and the spongy, surrounded by the corpus spongiosum, about six inches. It is narrowest at the meatus and at the junction of the spongy with the membranous portion—that is, where it passes through the anterior layer of the triangular ligament. Immediately external to the mucous membrane the urethra is surrounded by a layer of unstripped muscular fibres.

Anatomical and Physiological Series :

1133.—A penis, with the prostate and Cowper's glands. The urethra is laid open.

1135.—A cast in wax of the urethra, to show its average length and the proportionate sizes of its several parts.

1136.—A urethra, with the bloodvessels of the corpus spongiosum injected, and its canal laid open from below.

1146.—The anterior part of a pelvis, with the bulbous and membranous portions of the urethra shown in their relations to the triangular ligament.

Varieties of stricture.

Three forms of stricture are described : the spasmodic, the congestive, and the organic. The *spasmodic*, depending upon spasm of the unstriped muscular fibres surrounding the urethra, and the *congestive*, depending upon congestion of the capillaries of the mucous membrane, as they both disappear after death, will not be further referred to. They may be dismissed with the remark that they frequently occur as passing complications in patients suffering from organic stricture, and are seldom met with save when some amount of organic stricture exists.

ORGANIC STRICTURE OF THE URETHRA.

Organic stricture is a contraction of the canal of the urethra in consequence of organic change in the mucous and submucous tissues, the result of inflammation or injury. It is generally caused by a protracted gonorrhœa or gleet, the fibrous thickening and contraction of the inflammatory material reducing the lumen of the canal. It may also occur after syphilitic sores, abrasions from the careless passage of catheters, use of injections of too great strength, or after wounds and lacerations from external violence, such as a blow or fall upon the perineum, causing laceration of the urethra (*traumatic stricture*). In the latter cases it is produced by the contraction of cicatrices.

Seat of organic stricture.

Stricture may occur in any part of the urethra save the

prostatic. It is most common in the posterior part of the spongy portion immediately in front of the anterior layer of the triangular ligament. According to the statistics collected by Sir Henry Thompson, sixty-seven per cent. of strictures occur in that part of the urethra which extends from an inch in front of, to three-quarters of an inch behind the junction of the spongy and membranous portions, seventeen per cent. in that part which extends from the meatus to two inches and a half up the passage, and sixteen per cent. in that part which is between the two above mentioned.

Varieties of organic stricture.

Several varieties of organic stricture, such as the linear, the annular, the bridle or packthread, the cartilaginous, and the resilient or elastic, have been described.

Linear stricture. 2858.—Section of a urethra, in which there is a linear stricture about two inches anterior to the bulb. The stricture occupies only a small portion of the length of the urethra, the induration and contraction of the canal being marked merely by an opaque white line. See also No. 2860.

Annular stricture. 2859.—A lateral section of a bladder and urethra. There is an annular stricture, that is, a ring-like induration, immediately in front of the bulb.

2862.—The cast of a urethra in which there was a slight annular stricture immediately behind the bulb.

The annular differs from the linear variety merely in the greater width of the ring-like induration of the mucous membrane. The distinction is a refinement hardly worthy of mention.

Packthread or bridle stricture. 2865.—A penis, in which the canal of the urethra is traversed by eleven distinct cords or bands. These bands are flat and narrow, and attached at their extremities to the wall of the urethra. They lay close to the wall of the canal, but are now raised by portions of glass passing beneath them.

From a man in whom instruments had been passed very frequently for the cure of stricture.

Some have supposed the bands of a bridle stricture to be stretched inflammatory adhesions. More probably they are

portions of mucous membrane which have been separated from the urethral walls by an instrument, which after perforating the mucous membrane returned into the canal by a second perforation.

Cartilaginous or gristly stricture. 2882.—A penis, exhibiting a stricture of the urethra about an inch anterior to the bulb. The mucous membrane is thickened, indurated, and cartilaginous in the situation of the stricture.

THE CONSEQUENCES OF STRICTURE.

When a stricture has existed some time, serious structural changes occur in the urinary apparatus on the proximal side of the lesion, as the result of the mechanical obstruction to the outflow of urine. The urethra behind the stricture, the bladder, the ureters, and the kidneys, become affected in various ways, and as regards time generally in the above order. The changes liable to occur in the several parts are as follows :

A. *Changes in the urethra behind the seat of stricture.*

1. *Dilatation and thickening.*

2858.—Section of a urethra, in which there is a stricture in the spongy portion. The urethra behind the stricture is dilated, and its walls thickened.

See also Nos. 2859, 2867, 2873, and 2872a.

2. *Ulceration and its consequences.*

Ulceration of the walls of the urethra behind the seat of stricture is a common complication ; it may be only superficial (No. 2872b), or it may extend deeply, perforating the walls of the urethra (No. 2872c).

Under the latter circumstances the urine may be forced by the contraction of the bladder into the cellular tissue of the scrotum, perineum, and groin (*extravasation of urine*) ; or, as is more commonly the case, the first few drops of urine that escape set up inflammation, the tissues immediately around become sealed by plastic effusion, further

extravasation is prevented, and a urinary abscess is the result. The abscess makes its way to the surface, and, after bursting or being opened, the escape of urine may prevent its healing, and a fistulous passage is then left, extending from the cutaneous surface to the urethra (*urinary fistula*). [The various stages in the formation of a urinary fistula due to stricture of the urethra may be studied in Nos. 2872a, 2872b, and 2872c.] Although urinary abscesses and fistulæ are generally produced in the manner above described, it must not be forgotten that abscesses unconnected with the urethra may occasionally form around that passage, and by bursting, both internally into the urethra and externally upon the integument, may also be productive of urinary fistulæ. According as the fistulæ are situated in the perineum, scrotum, or the body of the penis, they are spoken of as perineal, scrotal, or penile.

Superficial ulceration. 2873.—A penis, exhibiting a stricture two inches and a half from the external orifice. The mucous membrane behind the stricture is in part superficially ulcerated.

Extravasation of urine. 2876.—A bladder and urethra, with a stricture at the bulbous part. A large opening exists in the urethra at the junction of the bulbous with the membranous portion; it was formed by ulceration, and through it urine was effused into the perineum.

2877.—A bladder and urethra. There is a stricture of the urethra at the bulb, and in the anterior part of its membranous portion. The mucous membrane has ulcerated in the situation of the stricture. Ulceration has also taken place through the prostate and the adjacent coats of the bladder at its lower and back part, and the aperture thus formed leads to a large irregular cavity resulting from the effusion of urine into the cellular tissue between the bladder and the rectum.

Extravasation of urine in this situation is rare; it usually occurs in front of the triangular ligament, which structure prevents the urine from making its way into the pelvis.

Urinary abscess. 2873.—A penis, exhibiting a stricture of the urethra. Behind the stricture the whole urethral canal is greatly dilated, its walls are thickened, and its mucous membrane is deeply

folded, and, in parts, superficially ulcerated. There are several small sacs, like the cavities of abscesses, close to the urethra ; two of these communicate with its canal close to the prostate. See also Nos. 2872a, 2872b, and 2872c.

Ulceration and fistulæ. 2866.—The anterior part of a penis, with a stricture in the spongy portion of the urethra, about two inches from the external orifice. Behind the stricture the canal is dilated ; its walls also are thickened and penetrated by an ulcerated aperture, which leads into a fistulous passage extending to the integuments.

2874.—Section of a penis, exhibiting a very close stricture in the spongy portion of the urethra, about three inches from the external orifice. Ulceration of the urethra has taken place at the seat of the stricture, and has extended through the indurated tissues around it, and into numerous fistulous passages in the parts between the stricture and the bladder.

2874a.—Part of a bladder and a penis, divided along its dorsum. The mucous surface of the membranous urethra is ragged and inflamed. Around the prostatic and spongy portions of the canal is an abscess cavity, communicating with the urethra and bladder by several openings, extending for some distance on the under surface of the penis, and surrounded by a mass of sloughy tissue. The bladder is thickened and the ureters dilated, glass rods being passed into their vesical orifices. On the right side of the bladder is a large sacculus, capable of holding nearly half a pint, and communicating with the bladder by an orifice about the size of a split pea. There was another and smaller sacculus in the anterior half of the viscus.

The patient was a man aged forty-nine, who had suffered from stricture of the urethra for about four years. The symptoms increased, and for three weeks he had incontinence of urine. He died with symptoms of pyæmia, and at the post-mortem examination abscesses were found in his kidneys.

See also Nos. 2869, 2871, 2875.

Sloughing of the urethra. 2878.—A bladder and urethra. Sloughing of the urethra has destroyed five inches of its walls, with the adjacent corpus spongiosum. Behind the part which has sloughed, the canal of the urethra is lost in a large irregular cavity, like that of an abscess.

3. *Rupture of the urethra.*

There is no specimen of rupture of the urethra in the Museum.

4. *Impaction of a calculus behind a stricture.*

2879.—Section of a bladder and urethra. A disc-shaped calculus, seven-tenths of an inch in diameter, is fixed in the bulbous portion of the urethra immediately behind a slight stricture.

2880.—Part of a penis and prostate, with the urethra laid open. An inch in front of the membranous part of the urethra a stricture exists, through which the continuity of the canal cannot now be traced, but it appears to have been extremely narrow. The urethra posteriorly to the stricture is dilated, and immediately behind it a calculus, half an inch in diameter, is lodged in the most dilated part projecting towards the perineum. The obstruction caused by the calculus, added to that of the stricture, appears to have completely closed the urethra. By the side of the stricture is a large cavity that was filled with foetid pus; it extends into the perineum, where it is laid open by a long incision.

The patient was about forty-five years old, and had had stricture for many years. Sudden retention of urine occurred, followed by rapid swelling and suppuration in the perineum. An incision was made into the perineum, and foetid pus let out, but the calculus was not felt, and the retention was only partially relieved.

B. *Changes in the bladder.*

1. *Thickening of the mucous membrane and hypertrophy of the muscular coat.*

2859.—A lateral section of a bladder and urethra. There is an annular stricture of the urethra immediately in front of the bulb. The bladder is large, and its muscular coat is hypertrophied; the fasciculi extending from the ureters to the prostate gland are remarkably developed.

This hypertrophy of the muscular coat is the result of the extra work which the bladder has to perform in order to overcome the obstruction to the outflow of urine.

2. *Ulceration of the mucous membrane.*

2868.—A bladder and urethra. There is a stricture of the urethra immediately anterior to the bulb. The bladder is thickened

and exceedingly contracted, and its mucous membrane, raised in projecting folds, is superficially ulcerated and nearly covered by calculous matter.

3. *Hernia of the mucous membrane.*

2402.—A bladder and part of the urethra, laid open from the front. The muscular wall of the bladder is hypertrophied. Its mucous membrane is thick and coarsely rugous. On the right side, just above the orifice of the ureter, a narrow, funnel-shaped opening leads to a large pouch, lined by mucous membrane, but devoid of muscular tissue. From the body of a man who had suffered from stricture of the urethra. See also Nos. 2874a and 2878.

The protrusion of the mucous membrane between the muscular fibres was the result of pressure upon the walls of the bladder, in consequence of the obstruction to the expulsion of the urine.

c. *Changes in the ureters.*

1. *Dilatation and hypertrophy of the muscular coat.*

2863.—The ureters in this specimen are dilated, and their muscular coat is hypertrophied.

2875.—A lateral section of the bladder and urethra, exhibiting a stricture of the urethra. One of the ureters is dilated into a small cyst at its termination.

2. *Prolapse of the ureters ; rare.*

2367.—The bladder and a portion of the ureters from an old case of stricture of the urethra, with a history of two years' duration. The specimen shows the ordinary effects of urinary obstruction, as well as an unusual prolapsed condition of the vesical ends of both ureters, with extreme hypertrophy and dilatation of the tubes themselves ; the vesical orifices of these tubes are reduced to mere pin-hole apertures. The prolapsed pouch of the right ureter contains a calculus. There is a sacculus of mucous membrane thrust out between the muscular fibres of the posterior wall of the bladder. The prolapse of the ureters seems to be due to the disproportion in size between the ureters themselves and their vesical orifices, as if, in the efforts to micturate, the urine being unable to escape

freely from the bladder, the abdominal walls had compressed and borne down the ureters.

D. *Changes in the kidneys.*

1. *Dilatation of the pelvis and infundibula; absorption of the substance of the organ.*

2374.—A kidney, exhibiting great dilatation and hypertrophy of the ureter, pelvis, and infundibula, with absorption of part of its substance.

2376.—A kidney, of which the pelvis and infundibula are dilated into a large sac. The greater part of the proper substance of the gland is absorbed; its remains form a thin layer covering a portion of the sac.

INJURIES OCCASIONALLY SUSTAINED IN THE INSTRUMENTAL TREATMENT OF STRICTURE.

False passages. 2881.—A penis, with a portion of the bladder. About two inches from its external orifice the canal is contracted, forming a close annular stricture, behind which it is dilated in its whole length. From the stricture, a false passage, formed by catheters, is continued in the corpus spongiosum, along the side of the urethra, and through the prostate into the bladder.

2882.—A penis, exhibiting a stricture of the urethra about an inch anterior to the bulb. The mucous membrane is thickened and indurated in the situation of the stricture, and the canal behind it is much dilated. A bristle is introduced into the stricture, and another into a false passage formed by a catheter, which extends from the front of the stricture for a short distance along the outer side of the urethra.

CONGENITAL MALFORMATIONS OF THE PENIS.

EPISPADIAS AND HYPOSPADIAS.

Epispadias is a congenital malformation of the penis, in which the urethra opens upon the dorsal surface; or is exposed in its whole length through a median cleft along the dorsum of the penis. It is frequently associated with the congenital malformation of the bladder called extroversion or ectopia vesicæ.

Hypospadias is a congenital malformation in which the urethra opens upon the under surface of the penis, commonly but a short distance behind the glans, but it may be as far back as the root of the organ. In conjunction with these malformations the scrotum may be cleft.

There is no specimen of hypospadias in the Museum, but there is a Drawing, **Series xxxviii**, Nos. 15 and 16. An example of epispadias follows.

3670.—The penis of an adult with epispadias. A median cleft along the dorsum of the penis extends into the urethra, from its orifice to the pubes. A loose fold of integument covered the fissure in its whole extent. The penis is short; but the other parts are well formed. See also drawing, **No. 39**.

DISEASES OF THE LABIUM, CLITORIS, AND FEMALE URETHRA.

LABIAL CYSTS.

Labial cysts are probably mucous glands dilated in consequence of obstruction to the exit of their products. They frequently attain a considerable size, and have been found attached to the labium by a pedicle. They generally contain a mucoid, dark-coloured fluid, or in some instances a sebaceous material.

3035a.—A cyst, which was attached to the right labium by a slender pedicle.

HYPERTROPHY OF THE LABIUM.

3020.—A nympha, removed from a middle-aged woman. It is enlarged so as to form a deeply lobed spheroidal mass, with a wrinkled and warty surface, between three and four inches in diameter. A section of it shows that it is composed of a firm, compact, and elastic tissue, like skin infiltrated with serous fluid. See also **No. 3021a**.

TUMOURS OF THE LABIUM.

Papilloma. 302. — Two large warty growths, which were removed from the labia pudendi.

Fibro-cellular tumours (soft fibromata). 3025.—A large fibro-cellular tumour, which was attached by a broad pedicle to the left labium of a woman aged thirty-five. It had existed for ten years.

3028.—A fibro-cellular tumour (*soft fibroma*). Its surface appears flocculent and soft from inflammation and sloughing. The tumour was flask-shaped and was pendulous from the right wall of the vagina and right nympha.

The patient was thirty-four years old, and had noticed the disease for three or four years. It began as a tumour projecting into the vagina from beneath its external wall, and in this situation acquired a large size before it protruded externally. Its protrusion occurred ten days before its removal, and was followed by very rapid enlargement, probably because of the inflammatory swelling. It was loosely connected with the surrounding tissues, and was easily removed. There was no return of the disease within two and a half years of the operation.

Fibrous tumours. 3026.—Section of a large fibrous tumour which formed within the labium pudendi. The tumour was removed from a lady twenty-eight years old. It had been observed four years; it had given no pain, and interrupted no function, though it was twice as large as an adult's head. It commenced its growth at the lower part of the left labium, and extended gradually along the buttock and over the os coccygis. It formed a pendulous mass rather broader than the two thighs. The patient completely recovered. She remained well for very many years after the operation.

Melanotic sarcoma. 3033.—The labia and part of the vagina, removed by operation on account of a large mass of melanotic sarcoma, which, arising at the front part of the vagina, encroaches equally upon each labium.

Carcinoma of the Labium. — Cancer of the labium is usually of the epitheliomatous variety, and bears a general resemblance to the epithelial, or sweep's cancer of the scrotum. In cases where one labium is invaded by an epithelioma, the labium of the other side is frequently found to be affected in a similar manner, so that it appears as if the disease might sometimes spread by direct contact.

3035.—A labium, on the surface of which is an oval, elevated, warty growth, of moderately firm texture, and with a finely granular surface.

3034.—The labia affected with cancer. They are both enlarged and indurated. In the left labium, which is most diseased, the cancer forms an elevated, circumscribed, and superficially ulcerated swelling. They were removed from a middle-aged woman.

HYPERTROPHY OF THE CLITORIS.

3016.—A large mass, very deeply lobed, which was removed from a clitoris. It probably had its origin in an enlargement of the preputium clitoridis.

3019.—The prepuce of a clitoris, enlarged by a spheroidal mass until it measures between five and six inches in diameter. The mass appears composed of a compact and elastic fibro-cellular tissue. Its surface is lobed, fissured, coarsely warty, and brownish. It is suspended by the nymphæ, which were similarly, but slightly enlarged.

The patient was twenty-six years old. The growth was removed four months after her first labour.

URETHRAL CARUNCLE.

Vascular growths are not infrequently found at the orifice of the female urethra; they are composed of villous tufts of the mucous membrane, containing loops of capillary blood-vessels and nerves. They are extremely sensitive, and bleed freely when touched.

3036.—A vascular tumour, which was removed by ligature from the margin of the orifice of a woman's urethra.

DISEASES OF THE SCROTUM.

HYPERTROPHY OF THE SCROTUM.

Hypertrophy of the scrotum is common in persons who have long suffered from irreducible scrotal hernia or hydrocele. It must be distinguished from elephantiasis scroti, which is sometimes spoken of as hypertrophy.

2817.—A scrotum, whose tissues have undergone simple hypertrophy, probably due to the long continuance of a large hydrocele or hernia.

ELEPHANTIASIS SCROTI.

This term is applied to a chronic induration and thickening of the skin and cellular tissue of the scrotum. It seldom occurs in this country, but is common in tropical climates, where it is known as elephantiasis arabum. The skin appears elevated into lobes and folds separated by deep fissures; the sebaceous glands are greatly enlarged, and exhibit wide, open orifices, surrounded by elevated rings; the cellular tissue is compact and filamentous; the whole scrotum often attains a great size. The integuments of the penis are generally involved in the disease. The affection appears to be dependent upon the presence in the blood of the *filaria sanguinis hominis*, a minute nematode worm, which is parasitic in man, having the mosquito for its intermediate host.

2818.—A scrotum affected by elephantiasis.

TUMOURS OF THE SCROTUM.

Various innocent tumours are occasionally found in connection with the tissues of the scrotum. Specimens of fatty and fibro-cellular growths follow.

Fibro-cellular tumour (soft fibroma). 2819.—A fibro-cellular tumour, which was removed from the scrotum, with a portion of the integument.

2819a.—A pedunculated tumour removed from the left side of the scrotum. It is about the size of a small orange, and when examined microscopically it was found to be a soft fibroma.

From a boy aged seventeen; the tumour had been noticed for a year before removal. It was painless, semi-translucent, tense and elastic. It did not appear to be adherent either to the testis or skin.

2820.—Part of a tumour from a scrotum, which weighed twenty-four pounds, and was about a foot in length. It is lobed, firm, elastic, white, and composed of compact, fibro-cellular tissue. In the recent state many parts of it were infiltrated with serum, making them quite sacculent, and in some there were extravasations of blood. At the lower part of the mass, the testicle and its

tunica vaginalis (which contained some ounces of serous fluid) are shown flattened by its pressure.

The patient was seventy-four years old, and the tumour was of five and a half years' growth. It was easily separable from the surrounding parts, into which many lobes extended far from its chief mass. It was complicated, not only by the hydrocele above mentioned, but by a large scrotal hernia that descended to its upper part, and by thickening and œdema of the scrotum.

Carcinoma of the Scrotum.

Cancer of the scrotum is nearly always of the epithelial variety. It generally begins as one or more warty growths, consisting of several hypertrophied papillæ of the skin of the scrotum. The warts are usually of an oval shape, with a smooth and convex surface, slightly elevated, and projecting a little over the surface of the adjacent skin. After a time they become more vascular, superficially ulcerated, and covered with a scab formed by the encrusting of the discharge. The scab separates or is rubbed off, and there results an ulcer with sinuous, raised, everted edges and a warty base; the ulcer rapidly spreads, involving the whole skin of the scrotum, and the inguinal glands become affected.

From the great frequency with which it occurs in chimney-sweepers, cancer of the scrotum is generally designated *the soot or sweep's cancer*. It appears to be due to the irritation caused by soot. The author has seen similar cases in operatives engaged in the manufacture of coal tar.

The following series of specimens illustrates the successive changes in the development of the cancer from the soot-wart.

A. *The soot-wart.* 2823.—Portion of a scrotum, on the surface of which is an elevated, oval, warty growth, of firm texture, with a slightly granular, smooth, convex surface, which was vascular but not ulcerated. The margins of the growth project a little over the surface of the adjacent skin. By the side of this growth is one of smaller size and superficially ulcerated. From a young chimney-sweeper.

2822.—These horny growths were removed from the scrotum of a chimney-sweeper, where they had existed some months. During the last nine years five similar growths had formed, and had been shed after attaining a certain age. The base became surrounded by a ring of ulceration, and at length the least violence sufficed to detach them.

On the skin in the neighbourhood small, dark, warty growths were scattered. These had appeared in the last twenty years. See also No. 2821.

B. *Increase in size and ulceration of the wart.* 2824.—Portion of the scrotum of a chimney-sweeper. A large part of the surface is covered by a very elevated warty growth of firm, compact substance, the surface of which is nodular, deeply fissured and ulcerated.

C. *Extension of the ulceration.* 2825.—Portion of the scrotum of a chimney-sweeper, in which, by the further progress of the disease as presented in the three preceding specimens, there is a deep ulcer with thickened sinuous margins. Along one margin of the ulcer there are several small warty growths like that in No. 2823, and superficially ulcerated.

D. *The fully developed cancer.* 2826.—Portions of skin affected with soot cancer; the larger portion from the scrotum, the smaller from the perineum. On the latter are two small cancerous warts, one prominent and branched, the other nearly subcutaneous. On the former the cancerous disease appears partly as a deep ulceration, partly in the form of large warty growths. The margins of the ulcer, shown especially on the right side, are, for the most part, sinuous, raised and everted; its base appears coarsely warty. The chief warty growth is at the lower part of the specimen. Its surface is nodular and fissured, and from many parts of it there arise conical, curved, sharp-pointed bodies, about one-third of an inch in length, firm and white, like the strong papillæ of a carnivore's tongue. The cancerous structures extend to a depth of from one-eighth to one-fourth of an inch. Their microscopic constituents are those of epithelial cancer.

The patient was a healthy-looking chimney-sweeper, twenty-five years old. He had observed one of the small warts in the perineum for four years. The disease in the scrotum had existed only one year, and its progress was so rapid, both by ulceration and by subcutaneous extension, that it was necessary to remove all the skin of the scrotum, except a small piece at its lower part, a

portion of the skin of the perineum, the prepuce, and all the skin of the penis, except a narrow ring round its middle, and nearly all the skin over the symphysis pubis. The right testicle also, to which the base of the ulcer adhered, was removed, and three enlarged inguinal glands. The patient recovered easily from the operation, and the wounds were healed in three months.

OSSEOUS GROWTH FROM THE SCROTUM.

2821.—An osseous growth removed from the scrotum. From the history of the case it was believed to have originated from an epithelial wart.

DISEASES OF THE TUNICA VAGINALIS.

HYDROCELE.

Hydrocele is a collection of fluid in connection with the testicle or spermatic cord. (Hydrocele of the spermatic cord will be found under the head of "Diseases of the Spermatic Cord.") Two varieties of hydrocele in connection with the testicles are described, the ordinary or vaginal hydrocele, and the encysted hydrocele.

ORDINARY OR VAGINAL HYDROCELE.

Ordinary hydrocele is a collection of serous fluid in the cavity of the tunica vaginalis.

The fluid is generally transparent and of a pale straw colour; it has a specific gravity of 1030, contains albumen, and is coagulable by heat. Occasionally, however, it is thick and dark coloured, owing to the presence of altered blood, and in old people it may contain shining crystals of cholesterin.

Ordinary hydrocele fluid. 2743.—A clear, straw-coloured fluid, from a hydrocele of the tunica vaginalis. Compare this fluid with that preserved in No. 2810, which was obtained from an encysted hydrocele of the testis. The latter is watery or slightly opalescent. It contains only a trace of albumin, but large quantities of sodium, chloride and spermatozoa.

The sac, formed by the distended tunica vaginalis, is gene-

rally pear-shaped, with the narrow end upwards ; or it may be oval, in which case there is often a slight transverse constriction at its upper or lower part, due to the unequal yielding of its walls, owing to the presence of bands of adhesions. In the case of large hydroceles, where the fluid has encroached upon the funicular portion of the tunica vaginalis, the constriction may be due to the narrowing which naturally exists between the tunica vaginalis and its funicular portion.

Pear-shaped. 2738.—A hydrocele in which the sac is somewhat pear-shaped.

Oval, with transverse constriction. 2735.—The tunica vaginalis and spermatic vessels from a case of hydrocele. In consequence of an unequal yielding of the tunica vaginalis, there is a distinct prominence of the swelling at its lower part.

The walls of the sac are commonly thin and translucent, but in old-standing cases they become greatly thickened and sometimes cartilaginous or even bony.

Ordinary condition of the walls. 2735.—A hydrocele. The walls are thin and translucent.

Thickening of the walls. 2739.—A hydrocele, with thickening of the enlarged tunica vaginalis and opacity of its internal surface.

2740.—A hydrocele, with thickening of the tunica vaginalis, and an irregular nodulated and tubercular condition of its internal surface.

2752.—A tunica vaginalis greatly enlarged and thickened ; its walls are from one to three lines in thickness, tough and laminated ; its internal surface is granular and very vascular : and its cavity was filled with pus.

Cartilaginous thickening of the walls. 2741.—A hydrocele, in which the enlarged tunica vaginalis is thickened and indurated, so that it is like cartilage in texture.

The testicle is usually situated behind and a little below the centre of the sac ; but it may be found in front, either from having descended with the epididymis transposed, or from having contracted adhesions to the anterior wall ; this latter condition gives the hydrocele a sacculated appearance.

The testicle is generally somewhat flattened, but seldom

atrophied. The constituents of the cord are spread out over the back of the sac, and the cremaster muscle is hypertrophied and well marked.

2736.—A hydrocele. The bloodvessels of the tunica vaginalis and testicle are injected. The testicle is divided, and appears healthy.

The testicle behind the sac. 2741.—A hydrocele of the tunica vaginalis; the testicle is situated at the middle of the posterior wall of the sac. The testicle itself is healthy.

Rarer conditions of Vaginal Hydrocele.

Division of the sac by an incomplete membranous septum. 2742.—A very large hydrocele, with thickening of the tunica vaginalis. The testicle is situated near the middle of the posterior wall of the sac, and a thick and broad membranous partition extends from it transversely across the middle of the sac, which it separates into two cavities only communicating in front of the partition. The vas deferens is exposed running vertically along the back part of the tumour.

Adhesions between the layers of the tunica vaginalis. 2751.—Two testicles. Upon the upper part of each there is a cyst of globular form, which was filled by a watery fluid. It is probable that this cyst was formed between the layers of the tunica vaginalis, which in the rest of their extent are adherent. The structure of the testicles themselves is healthy.

CONGENITAL HYDROCELE.

When, as frequently happens, a hydrocele forms in the sac of the tunica vaginalis, the funicular portion of which has not been obliterated, a free communication necessarily exists between the interior of the hydrocele and the general peritoneal cavity. This variety is called congenital.

There is no specimen in the Museum.

ENCYSTED HYDROCELE OF THE TESTICLE.

The encysted hydrocele of the testicle is a collection of fluid in one or more cysts which have no communication with the cavity of the tunica vaginalis.

The cysts may occur either between the tunica vaginalis and the tunica albuginea, or in connection with the epididymis. In the former situation encysted hydroceles are rare; they consist of single thick-walled cysts containing a brownish-green fluid, developed in front of the testicle in the connective-tissue between the above-mentioned tunics.

Those in connection with the epididymis are more common, and are composed of one or several cysts filled with a watery or milky-whitish fluid which often contains an abundance of spermatozoa; their walls are thin, membranous, and lined with tessellated epithelium. If carefully examined they are generally found to communicate with the ducts of the epididymis. Their true origin is still doubtful, the general opinion being that they are developed from some of the foetal remains (Wolffian body, Müllerian duct), so abundant in the situation of the epididymis.

2805.—A hydrocele of the testicle, consisting of a single cyst immediately above the testicle. See also No. 2772a.

2806.—A testicle, with part of the spermatic cord. Along the epididymis there is a series of thin and delicate membranous cysts communicating together, and having for their boundary the tunica vaginalis at its reflection between the testicle and epididymis. They contained a transparent and colourless fluid. A bristle is passed beneath the vas deferens near its connection with the epididymis.

Fluid from an encysted hydrocele. 2810.—Slightly opalescent fluid, containing an abundance of spermatozoa, from an encysted hydrocele of the testis.

Compare this with the specimen of fluid from an ordinary hydrocele, No. 2743.

Suppuration after Injection of a Hydrocele with Iodine.

2753a.—The tunica vaginalis and testis of a man on whom the operation for radical cure of a hydrocele had been performed ten years previous to its removal. The sac of the tunica vaginalis is converted into an abscess cavity with walls about a quarter of an inch in thickness, tough and firm, and lined by a smooth membrane. It forms a cavity capable of holding an ounce of fluid, and in the recent state contained some thin oily pus in which were innu-

merable cholesterin crystals, but no cells. Behind this is the testis in a perfectly normal state, but closely adherent to the contiguous structures. The epididymis and cord are normal. Immediately beneath the skin, in front of, but not in connection with, the sac of the tunica vaginalis, is some broken-down inflammatory material, marking the site of a superficial abscess. From a man aged twenty-seven years, who said that there had been a swelling of the testis ever since the operation for radical cure. It had never caused him any pain until quite recently, when it had begun to increase in size. At the time he came under treatment there was evident suppuration in the subcutaneous structures, and this was supposed to be in connection with a chronically enlarged and inflamed testis, the latter being simulated by the thickened tunica vaginalis. The testicle was therefore removed.

HÆMATOCELE.

A hæmatocele is an effusion of blood into the cavity of the tunica vaginalis, or into a cyst connected with the testicle or spermatic cord. The former of these conditions, being by far the most common, is that which is usually understood by the term hæmatocele. For the sake of distinction, however, it will be here spoken of as common hæmatocele, and the two rarer forms will be spoken of as encysted hæmatocele of the testis and cord respectively.

Common hæmatocele is generally the result of a blow or kick on the testicle; it may also occur from similar injuries to a hydrocele, or it may follow the operation of tapping a hydrocele, either in consequence of the puncture of a vessel or of the testicle itself, or in consequence of the sudden reduction of pressure in the bloodvessels of the tunica vaginalis by the withdrawal of the fluid. The blood may under favourable circumstances be absorbed, leaving the tunica vaginalis healthy. More commonly, however, secondary changes occur both in the sac and its contents. The walls become inflamed and thickened, and the blood coagulates in the interior of the sac and adheres to the roughened surface of the walls, so that the hæmatocele when cut open has somewhat of the laminated appearance of an aneurysm.

The centre of the clot may break down into a chocolate-coloured fluid, which, under the microscope, is seen to consist of broken-down blood-corpuscles, hæmatoidin and cholesterin crystals. Suppuration is also liable to occur, and the hæmatocele may thus become an abscess.

The source of the blood is doubtful. It has been attributed to the rupture of some of the large veins on the surface of the testicle or external to the parietal layers of the tunica vaginalis. In a few cases it has been traced to a wound of the spermatic artery.

Encysted hæmatocele of the testis is exceeding rare. It is the result of injury to an encysted hydrocele, and undergoes changes similar to those described under common hæmatocele.

Encysted hæmatocele of the cord will be found described under affections of the spermatic cord (see p. 530).

2744.—A testicle, with the cavity of the tunica vaginalis, enlarged and filled with masses of soft fibrinous substance derived from coagulated blood. The tunica vaginalis is thick and hard; the testicle is healthy.

2745.—A testicle and tunica vaginalis; the tunica vaginalis laid open by a section carried through the testicle from behind, is thickened and enlarged. Its cavity was filled with fluid blood, and irregular masses of solid blood-stained fibrous substance adhere to its internal surface. The testicle appears healthy.

2753.—A testicle and tunica vaginalis divided and laid open. The tunica vaginalis, which had probably been the seat of an old hæmatocele, was found filled with pus. Its walls are dense and thickened by layers of fibrous tissue, which in one place presents the appearance of fibro-cartilage. The testicle appears normal.

The specimen was taken from the body of an old man, who died of senile gangrene of the leg, with bronchitis. He only complained of pain in the testicle a few days before death.

See also Nos. 2745a and 2796a.

DISEASES OF THE TESTICLE.

ACUTE INFLAMMATION.

Acute inflammation is spoken of as orchitis or epididy-

mitis, according as it begins in or affects chiefly the body of the testicle or the epididymis.

Orchitis or inflammation of the body of the testis is usually the result of injury, such as a blow, kick, or squeeze of the testicle. It may be due to metastasis, as in mumps, occasionally too it occurs in gout and rheumatism.

Epididymitis or inflammation of the epididymis, which is far more common, is generally caused by the extension of inflammation from the urethra (consequent upon gonorrhœa, impacted calculus, or the passage of instruments) along the vas deferens to the epididymis.

The body of the testis or the epididymis, according as the disease begins in the one or the other, appears tense and swollen. On section the intertubular connective-tissue is seen injected and infiltrated with inflammatory material and the tubules filled with mucoid and purulent fluid. The tunica vaginalis is distended with a small quantity of turbid inflammatory effusion (*acute hydrocele*): a condition, however, more frequently observed in epididymitis than in orchitis. The inflammation in the majority of cases terminates in resolution, leaving the testicle little if at all functionally deteriorated. At other times it may pass into the chronic condition, or again, when very acute, it may end in suppuration and abscess.

2760.—A testicle, exhibiting the effects of acute inflammation in its interior. Several irregular cavities extend through the interior of the testicle, which were filled by pus and inflammatory material. The pus has escaped, but portions of the inflammatory material remain. The glandular tissue around these cavities is consolidated. A small quantity of transparent fluid was found in the sac of the tunica vaginalis, and there were partial adhesions between its opposite surfaces. At one part the tunica albuginea is thin and irregular on its surface, as if yielding to the enlargement of the testicle.

From a man in whom the operation of lithotripsy had been performed. The disease of the testicle commenced a week after the operation, and nearly a week before the death of the patient. A

portion of the broken calculus had previously become fixed in the urethra. The bladder, No. 2398, was taken from the same patient.

CHRONIC INFLAMMATION.

Chronic inflammation of the testicle may be a sequel to the acute disease, or it may begin as a chronic affection, when it is generally the result of slight injury in a debilitated, gouty, or rheumatic subject. As a sequel to acute inflammation, the disease may affect either the body or the epididymis, according as one or other of these parts is the seat of the primary inflammation. When the disease occurs in the body of the gland the inflammatory material, infiltrating the intertubular connective-tissue, may either become absorbed, leaving the testicle little if at all functionally deteriorated, or it may undergo a fibroid change, and, like all newly-formed fibrous tissue, contract, pressing upon and obliterating the tubules, and finally converting the affected part into a mass of fibrous tissue. When the disease is confined to the epididymis, should absorption not take place, the ducts of this organ are pressed upon and obliterated by the contraction of the inflammatory material in a similar manner, and the epididymis appears as a small nodular mass of fibrous tissue. From the inability of the secretion of the testicle to escape through the obliterated ducts, the tubuli seminiferi become dilated and subsequently more or less destroyed by the pressure of the retained secretion, and atrophy of the testicle sometimes, but not invariably, follows.

When the disease is chronic from its commencement, it generally begins in the body of the testicle, occasionally, though rarely, in the epididymis, and then more often in the lower part or "tail" than in the "head" (Curling). As the disease progresses all distinction between the body and the epididymis is lost, the testicle appearing enlarged, smooth, and indurated, and on section infiltrated with distinct yellowish-white masses of cheesy-looking material somewhat resembling tubercle. The tunica vaginalis is usually adherent and thickened. On microscopical examination

both the tubules themselves and the intertubular connective-tissue appear infiltrated with inflammatory material.

It is generally believed that the inflammation begins outside the tubules, and that the inflammatory products within are merely the result of the external irritation.

The inflammatory material may become completely absorbed, or it may undergo a fibroid change like that already described as following the acute form of inflammation. In some cases the tunica albuginea, together with the adherent tunica vaginalis and skin, may give way, and the inflammatory material and what remains of the tubular structure of the testicle may protrude as a fungating mass covered with granulations. This benign protrusion, sometimes called *hernia testis*, may be distinguished from a malignant fungus by the healthy, non-adherent condition of the skin around, by the absence of blood coagula on its surface, and by the absence of other signs of cancerous disease.

Inflammatory infiltration. 2761.—A testicle with its coverings divided by a longitudinal section. The testicle which is seen above was easily turned out from its membranes. Its structure appears to be but slightly altered, beyond being infiltrated with inflammatory products. The membranes are altogether much thickened and have undergone other changes, which are apparently the result of chronic inflammation. From a man aged thirty-one. The disease has existed about five months.

Induration and abscess. 2762a.—A section of the left testicle with a portion of the cord. The body of the testis presents a large oval abscess cavity partially filled with caseating material. The abscess has a very thick wall, and has destroyed almost the whole of the glandular substance. The globus major has also a small abscess in its substance. From a man, aged thirty-six, who noticed a swelling in his left testis for two years. The right testis began to swell eighteen months after he first observed the enlargement of the left. Before removal, the left testis was of the size of a lemon, and felt hard and uneven. There was no pain on pressure; the epididymis was hard and thickened, and the spermatic cord was thickened. See also No. 2762.

"Hernia testis." 2765.—A testicle with a portion of the scrotum. The testicle, covered on its anterior part by a layer of granulations,

is protruded through an ulcerated aperture in its tunics and in the scrotum. A section of the protruded testicle shows that its glandular tissue is but little altered; but the epididymis appears indurated and consolidated with the adjacent tissues.

Fibroid degeneration. 2763.—A testicle removed from a man, aged fifty-two. It had been enlarged for nine years. The bulk of its substance has disappeared, its place being supplied by a dense, firm though friable mass of fibrous tissue. The tunica vaginalis has been converted into a thick-walled cyst, the interior of which was covered with lymph and apparently old blood-clots. Above the main swelling was a smaller though similar cyst.

TUBERCULAR DISEASE OF THE TESTICLE.

Tubercular or strumous disease of the testicle is characterized by the presence of yellowish-white masses of tubercular-looking material in the body and epididymis. It generally first affects the epididymis, and in some instances may remain entirely confined to it. Usually, however, the body of the testis becomes subsequently involved. The vas deferens and vesiculæ seminales are also frequently found infiltrated with tubercle; indeed, the local affection of the testicle is often but a part of a general tuberculosis of the genito-urinary tract.

Tuberculous disease begin outside the tubules as a deposit of true miliary tubercles in the lymphatic tissue, especially in the neighbourhood of the rete testis. These miliary tubercles afterwards become caseous, and are then indistinguishable from the caseous masses resulting from the degeneration of the inflammatory products formed within the tubules.

A tuberculous testicle is enlarged and nodular, and the epididymis forms a distinct prominence at its upper and posterior part. On section circumscribed masses of yellowish, caseous-looking material are found scattered throughout the tubular structure, or even occupying the whole interior of the organ.

If the disease is not arrested, ulceration of the skin and of the tunics of the testicle takes place, allowing the morbid

substance with the remains of the proper tissue of the testicle to protrude through the skin of the scrotum; the fungus thus protruded is covered with granulations and a purulent discharge. In other instances the tuberculous matter, intermingled with much of the gland-substance, breaks down and is discharged through the ulcerated aperture in the scrotum, leaving unhealthy fistulous tracts in the substance of the testicle; or, again, the caseous material may dry up and undergo calcification. By the use of appropriate remedies the remains of the secreting structure, both within the tunics and even in the fungating mass, may be restored and regain their functional activity.

Tubercle of the testicle, although a disease of early life, is uncommon before puberty.

The epididymis chiefly affected. 2780a.—The right testicle and epididymis laid open to show tubercular deposits. The epididymis is enlarged and infiltrated with caseous material, which has broken down into an abscess in the globus minor. The testis is not enlarged, but it contains several nodules of recent tubercle. The vas deferens has been dissected out. It is blocked with caseous material, but it is not greatly thickened.

2780b.—The left testicle from the same case as the preceding. The tunica vaginalis has been laid open to show the position of a hydrocele which existed during life. The epididymis is very greatly enlarged, but the testis is not affected, so far as can be seen without laying it open. The vas deferens is slightly thickened, and is blocked by caseated material.

From a man aged forty-one, a valet by occupation, who died of general tuberculosis. Ten months before his death he observed a swelling on the inner side of his right knee. The swelling was said to have attained its maximum size in two or three days, and the patient was certain that it was not the result of an injury. The cyst in connection with the knee was aspirated on two occasions, and synovial fluid containing flakes of mucus was removed.

The knee is preserved in **Series vi., No. 1205f.** See also **No. 2782.**

Affecting the epididymis and the body. 2775.—Two testicles enlarged, and having circumscribed deposits of tuberculous matter in their interior and in that of each epididymis.

2777.—The left testicle removed from a man aged forty. It is divided by a longitudinal section. The whole interior is filled by a deposit of caseous tubercle; scarcely a trace of the natural structure of the testis is visible. The testis had been enlarged for eight months. The right epididymis was also considerably increased in size.

Affecting both testicles. 2779.—A testicle, exhibiting a circumscribed mass of tuberculous substance in its centre. The adjacent part of the testicle appears healthy, and the morbid deposit has produced no enlargement. The other testicle was similarly diseased.

2412d.—The bladder and testis from a case of tuberculosis of the genito-urinary tract. The mucous membrane of the bladder is ulcerated, whilst the prostate is converted into a large abscess. The vesiculæ seminales are greatly enlarged, and the vas deferens is thickened and cord-like. The epididymis of each testicle is also enlarged, and is converted into a caseating mass, and the body of either testis presents numerous patches of tubercle. From a man aged forty-eight, who suffered for two years before his death from tubercular disease of his genito-urinary tract. After eighteen months he presented symptoms of general tuberculosis. At the autopsy the lungs were found to be a mass of tubercle.

The left kidney with its ureter is preserved in **Series xxviii., No. 2341b.** See also Nos. 2773, 2774.

Fungating protrusion through the scrotum. 2766.—A testicle with a portion of the scrotum. The testicle enlarged and indurated, and exhibiting appearances of tuberculous matter deposited in it, is protruded through an ulcerated aperture in its tunics and the scrotum. Its protruded surface is thinly covered with granulations; its posterior part appears healthy.

2778.—Section of two testicles. In one testicle the place of the natural structure is entirely occupied by large masses of tuberculous substance. In the other testicle, a small portion of the natural structure remains surrounding a mass of tuberculous substance. Ulceration of the skin and of the tunics of one testicle had taken place, allowing the protrusion of the morbid substance through the scrotum. Both testicles were removed at the same time from a man forty years old.

SYPHILITIC DISEASE.

The testicle may be affected both in the early and the later stages of syphilis.

In its early (or secondary) *stages* syphilis attacks the testicle in the form of a chronic inflammation of the intertubular connective-tissue. Under appropriate treatment the inflammatory material may undergo complete absorption, leaving the organ apparently healthy. Otherwise it is apt to degenerate into fibrous tissue, which by its subsequent contraction destroys the tubules, and therefore leads to atrophy of the testicle. The body of the testicle, to which the disease is usually confined, is slightly enlarged, hard, heavy, smooth, egg-shaped, and flattened laterally, and on section the intertubular connective-tissue appears uniformly infiltrated by a dense, tough, yellowish-white material. The disease is occasionally associated with a small hydrocele of the tunica vaginalis. Suppuration seldom ensues. Usually one testicle only is affected.

In its later (or tertiary) *stages* syphilis attacks the testicle in the form of distinct gummatous growths situated in the connective-tissue between the tubules, producing an irregular uneven enlargement of the body of the testicle. The gummata appear on section as yellowish-white, tough, and fibrous-looking masses, surrounded by loose fibrous tissue which separates one mass from another. The gummatous growths, although they may yield to treatment and become absorbed, frequently soften and suppurate, the tunics and skin ulcerate, and there result fistulous passages in the body of the testicle. In rare instances a fungus may protrude through the ulcerated aperture in the tunics and skin. Both testicles are frequently affected.

2772.—Sections of a testicle. The organ is but little altered either in shape or size. Its external surface is uniformly smooth, firm, and inelastic to the touch. The epididymis is scarcely if at all affected. The glandular structure of the body of the testicle has been completely replaced by a dense, tough, yellowish-white material, like old inflammatory lymph. This under the microscope is seen to consist of fine granules and of oil globules of various sizes, with no trace of fibrillation, and only faint vestiges here and there of cell formation.

The specimen was taken from the body of a middle-aged man

brought to the hospital for dissection. No history of the case could be obtained, but numerous scars like those the result of syphilitic ulceration were seen on various parts of the body. The other testis was similarly affected, but to a somewhat less extent.

2772a.—A testis which contains a degenerating gumma in its substance. On the left side is a small testicular hydrocele.

Sections are preserved in **Series lv., No. 119c.**

MALIGNANT DISEASE OF THE TESTIS.

SARCOMA OF THE TESTICLE.

Round-celled sarcoma is the most common form of malignant disease invading the testicle. It begins in the intertubular connective-tissue of the posterior portion of the body of the testis, and occurs most frequently in young persons. The lumbar glands are first affected; though it is not unusual to find that the glands are not infiltrated even in an advanced stage of the disease. The swelling is elastic, tense and uniformly smooth, and no distinction can be made between the body of the testis and the epididymis. The skin ultimately becomes involved and a fungating mass protrudes through the scrotum. On section the tumour appears like a mass of brain substance, blotched in places with blood. Masses of cartilage are often found in the growths, and cysts containing intra-cystic growths are not uncommon. Spindle and mixed celled sarcomata are not very rare.

Round-celled Sarcoma.

2796a.—Sarcoma of a testis with a hæmatocele. From a man aged thirty-nine. The patient received a blow from a cricket-ball upon his testes four and a half years before his death. One testis swelled, but subsequently appeared to get well. Six months later the organ again swelled and slowly increased in size, but without pain or any impairment of the general health. Three and a half years after the injury the testis began to grow rapidly. It was tapped, and some chocolate-coloured blood was removed, leaving behind a solid mass. Four years after the injury the testis was removed; at the time of the operation the neighbouring lymphatic glands did not

appear to be infiltrated and the cord was not thickened. Two months later the left leg swelled and the iliac glands became enlarged. A mass subsequently formed in the pelvis, and after exhibiting signs of intestinal obstruction for ten days, the patient died. Sections are preserved in **Series lv., No 121b.**

Fibro-Sarcoma.

2797a.—Sarcoma of the epididymis. A testis and epididymis from a child, aged four years. The epididymis is occupied by a tumour of an oval shape, about two inches in length and one inch in width; the cord is continuous with the tumour above, and the testis, which has been cut across, is in no way affected by the new growth. The cut section of the tumour is firm, white, and homogeneous, but in places shows a faint fibrillation. A microscopic examination shows the structure to be a spindle-celled fibro-sarcoma. From a boy, aged four years, in whom a swelling had been observed for a fortnight before he came under the notice of the surgeons. During the next six weeks the tumour increased in size, by about one-third of its bulk. It did not cause pain, and the glands in the groin were not enlarged. There was no family history of syphilis or cancer. The patient made a good recovery after castration.

Microscopic sections are preserved in **Series lv., No. 121a.**

Cystic Sarcoma.

2797c.—A testis infiltrated with a round-celled sarcomatous growth. In many parts the sarcoma has undergone cystic degeneration. It has been partially injected.

2797d.—A testicle affected with cystic sarcoma. The new growth apparently proceeds from the rete testis, and extends upwards and anteriorly so as to involve a considerable part of the body of the organ. The lower and anterior portion of the testis, together with the greater part of the epididymis, is free from new growth. The section shows that the tumour consists of soft sarcomatous tissue, containing numerous cysts, one of which is large enough to hold three ounces of fluid. Microscopically the growth is a loose fibrous matrix containing numerous round cells. Many of the cysts are lined by columnar epithelium; the cysts contained a dark blood-stained fluid.

From a man aged sixty-one, in whom the tumour had been growing for twelve months. There was no history of injury.

Cystic Sarcoma containing Cartilage.

2797e.—A testicle with its epididymis infiltrated with a chondro-cystic sarcoma. The gland is greatly enlarged, measuring four inches in length by two and three quarter inches in breadth. The testicular substance is replaced by cysts and nodules of cartilage. Externally the tumour is hard and lobulated. Microscopically, the nodules consist of hyaline cartilage with a slightly fibrillated matrix, whilst the softer parts consist of a fibrous and homogeneous stroma containing numerous round and oval connective-tissue cells. The cysts are formed from the glandular substance of the testis; they are lined by a layer of columnar epithelial cells.

From a clerk aged twenty-eight, who first noticed a swelling in his left testicle five years before his admission to the hospital. The swelling was painless and only caused inconvenience by its weight. It was densely hard. There was no enlargement of the spermatic cord nor of the glands, and the skin over it was not adherent. The patient died ten months after the operation from a recurrence of the growth in the abdominal viscera. See also Nos. 2795 and 2797.

CARCINOMA OF THE TESTICLE.

Carcinoma of the testicle is a fairly common affection. It is nearly always of the medullary type; scirrhus, sometimes, though rarely, occurs. Medullary cancer generally begins in the body of the organ in the form of one or more distinct nodules; more rarely as a general infiltration. The tubular structure of the gland is encroached upon and destroyed by the advancing disease, or merely, as when the cancer begins in the rete testis, dispersed and spread over and around the growth. The epididymis, in the early stages unaffected, later becomes invaded and is rendered indistinguishable from the rest of the gland.

The tunica albuginea becomes thickened and the tunica vaginalis inflamed by the irritation of the new growth. The cavity of the latter is either distended by a small quantity of inflammatory effusion or is obliterated by the adhesion of the visceral to the parietal layers.

The skin then becomes adherent and ulcerates, and a

fungating mass of cancer protrudes; the cancer likewise spreads up the lymphatics of the cord to the lumbar glands, and is thence deposited in various organs of the body.

A testicle affected with medullary cancer enlarges with great rapidity, and often attains a large size; it is at first smooth, afterwards nodular, tense, yet elastic, and semi-fluctuating in places, and of a globular or pyriform shape; the epididymis is indistinguishable from the rest of the gland. On section it is seen to consist of yellowish-white brainlike material, intersected by numerous fibrous septa, which are the remains of the trabeculæ and of the mediastinum testis. The surface of the section is frequently blotched by patches of red, due to extravasation of blood from rupture of the capillary vessels, and here and there by patches of yellow, the result of fatty degeneration of the cancer elements. The cord is usually infiltrated with similar growths of cancer, and its vessels are enlarged; but in some cases it may remain free from the disease even when the lymphatic glands are markedly affected. The skin of the scrotum is traversed by large tortuous veins; it is not at first adherent to the testicle, but afterwards becomes so, and finally ulcerates, allowing the cancerous fungus to protrude. After the skin is involved in the disease the inguinal glands, which receive the lymphatics from the superficial part of the scrotum, become affected as well as the lumbar gland, which receive those of the testicle. The cancerous fungus is characterized by its sloughy, blood-stained surface, its sanious foul-smelling discharge, and by the adherent and infiltrated condition of the skin around.

Medullary cancer. 2799.—A medullary cancer of the testicle injected. The organ measures five inches long by four broad. The two layers of the tunica vaginalis are adherent to each other. On the surface of the section the outline of the testicle proper is still distinguishable. It is marked by the intermixture of brownish-red masses with the white medullary substance. The injection has not penetrated into this part of the tumour. Above and below the infiltrated epididymis is cut across. Its numerous vessels are

impacted. The growth is here softer and more brainlike. Microscopic examination showed that the irregularly dilated ducts of the testicle are in places distinguishable. They are filled with small granular cells intermingled with much granular debris. There is no alveolar arrangement except that produced by the dilated ducts. In some parts of the tumour there is a large quantity of connective-tissue almost destitute of cells.

From a man aged thirty-five years, whose right testicle began to enlarge six or eight months before his admission to the hospital, without evident cause. It increased in size very rapidly. The testicle was oval, smooth, soft and semi-fluctuating.

2801.—Section of a testicle, in which the place of the natural structure is filled by a large oval mass of soft, and apparently very vascular, medullary substance, like that in No. 2802. The morbid growth extends from the upper part of the testicle into the cellular tissue of the spermatic cord. The opposite surfaces of the tunica vaginalis are adherent.

2802.—A testicle, of which the natural structure cannot be discerned, its place being occupied by a large oval mass of soft medullary cancer traversed by partitions which divide it into many round masses. The tunica albuginea is thickened, and the opposite surfaces of the tunica vaginalis are adherent.

Scirrhus cancer. 2804a.—Section of a testis infiltrated with a firm, white, dense tumour, occupying about equally the gland itself and the epididymis. The cord is much thickened and the tunica vaginalis adherent. From a man aged fifty-four, who had noticed a swelling of the testis for one year. A microscopical examination shows that the growth is a scirrhus cancer.

Microscopic sections are preserved in Series lv., No. 122a.

CARTILAGINOUS TUMOURS.

Cartilaginous tumours of the testicle must be distinguished from the secondary growths of cartilage so frequently occurring in sarcomatous, carcinomatous, and cystic disease of the testicle. Primary cartilaginous tumours generally involve the whole organ, which they render exceedingly firm and hard, so that when handled they give the sensation of bone to the touch. On section they are seen to consist of tortuous, cylindrical, and knotted pieces of carti-

lage closely packed and embedded in a tough fibrous tissue. The tubules are in general completely involved in the mass of cartilage, but some of them are occasionally pressed aside by the growth and spread out, unaltered in structure, between it and the tunica albuginea.

The character of the cartilage varies with the rate of growth. When the growth is rapid the cartilage partakes of the hyaline form, when less so it partakes of the fibrous. It is liable to undergo ossification. The cartilage usually has its origin in the tubes, sometimes, as in Sir James Paget's case (No. 2784), in dilated lymphatics. The disease may secondarily affect distant organs.

2783.—Cartilaginous tumour of the testicle.

2784.—Section of a cartilaginous tumour, from a man aged thirty-seven. Cf. p. 346.

FIBROUS TUMOURS.

Fibrous tumours of the testicle are rare. They generally appear as hard, firm, encapsulated growths, having the ordinary microscopic characters of the fibromata. They spring from the intertubular connective-tissue, and as they increase in size displace and spread out the tubular substance around them. They are innocent growths.

2788.—Section of a tumour which has grown within the tunica albuginea of the testicle. It is of nearly regular, oval shape, and about six inches in its chief diameter; it is lobed, and now close-textured, pure white, like a lump of firm connective-tissue. In the recent state it was succulent and translucent, its substance being infiltrated with a clear, yellow, serous and synovia-like fluid. Part of the tunica albuginea is reflected from its surface, and within this part seminal tubes are found spread out.

The patient was thirty years old, and the growth of the tumour was observed for seven years. In microscopic structure it showed scarcely anything but fibro-cellular tissue, in bundles of well-formed filaments mingled with elongated fibre-cells.

CYSTIC DISEASE.

Two forms of cystic disease of the testicle are commonly

described, the malignant and non-malignant. The malignant [which has already been described, p. 522] appears to be merely a cystic degeneration of sarcomatous growths. The non-malignant form or the true cystic disease consists of a collection of multilocular and proliferating cysts, bound together by fibro-myxomatous tissue, in the body of the testicle. The cysts appear to be formed by the dilatation of the ducts of the rete testis, and may occupy nearly the whole of the organ, displacing the tubuli seminiferi, which, little altered in structure, are commonly spread out over them. The ducts of the epididymis are at first unaffected, but afterwards become atrophied. The cysts, which may be few or many, vary in size from microscopical minuteness to half an inch or more in diameter, and are lined with tessellated epithelium like that lining the tubes of the rete testis. They generally contain a serous or mucoid fluid, frequently tinged with blood. When large they may also contain growths springing from their walls, and composed of epithelial-like cells. Sometimes little masses of cartilage are found filling the cysts. The fibrous tissue surrounding the cysts is probably, in great part, intertubular connective-tissue hypertrophied from irritation. A testicle affected with cystic disease is generally of large size, smooth, uniform, semi-fluctuating in places, non-translucent, and of a pyriform or globular shape. The vessels of the cord are frequently enlarged and varicose.

2789.—A testicle, removed by operation. Its interior is occupied by a tumour developed among the tubuli seminiferi, and still surrounded by a thin layer of them. The lower part of the tumour is formed by a homogeneous compact yellow substance; but its chief mass is composed of a firm tissue, traversed by white fibres, in which there are numerous cysts. The walls of the cysts are closely connected with the surrounding tissue, and they are lined by a polished membrane. Most of them were filled by a fluid resembling mucus; others contained a fluid like serum, and in one a small lobulated growth has arisen from the interior of the wall, and nearly fills the cavity.

From a gentleman of middle age, in whom the tumour had

grown slowly. Four years after the operation he was in perfect health.

2792.—A testicle, in which there is a large firm tumour, in parts appearing fibrous, in parts spongy, and having numerous cysts with distinct membranous walls embedded in its substance. In some of the larger cysts there are growths of soft substance. The opposite surfaces of the tunica vaginalis are partially adherent.

ATROPHY.

Atrophy of the testicle may be simply the result of old age; or it may be induced by pressure, by interference with the blood-supply of the testicle, or by disease of the testicle itself. An undescended testicle is frequently atrophied, especially when retained in the inguinal canal, where it is subject to pressure by the action of the abdominal muscles or by the use of a truss.

In atrophy from old age, from pressure, or from interference with the blood-supply, the testicle becomes smaller, softer, and loses its elasticity; but it retains its shape, except in the case of atrophy from pressure, when it is slightly flattened. The tubules are wasted, indistinct, and contain no spermatozoa. The epididymis is reduced to a few fibrous threads, and the constituents of the cord are shrunk and wasted. The atrophy is generally accompanied by fatty degeneration.

In atrophy from disease the testicle not only decreases in size, but also loses its shape, becoming irregular, nodular, and uneven. The tunica vaginalis is adherent, and the whole organ is converted into a mass of firm fibrous tissue.

From old age. 2755.—The atrophied testicle of an old man.

From pressure. 2756.—A testicle, reduced to half its natural size, in consequence of the pressure of a hydrocele in the opposite side of the scrotum. The body of the testicle is much more atrophied than the epididymis.

DISEASES OF THE UNDESCENDED TESTICLE.

Atrophy sarcoma and medullary cancer are the principal affections of the undescended testicle.

Sarcoma. 2797i.—A section through a sarcoma which has infiltrated an undescended testis. The new growth has a firm white appearance, and has completely surrounded and infiltrated the testis, whose outline as an oval spongy mass is visible at the upper part and right-hand side of the preparation. Microscopical examination showed the tumour to be a round-celled sarcoma. It was removed from the right ilio-lumbar region of a man aged 49. The testicle had never fully descended into the scrotum, but until eight months before its removal it could be distinctly felt in the canal. See also No. 2797h.

Medullary carcinoma. 2800.—Encephaloid cancer of the left testicle, which had only descended through the inguinal canal, not reaching the scrotum. In the operation for its removal, the diseased testicle was found lying immediately beneath the integuments and outside the aponeurosis of the external oblique muscle. The right testicle was healthy and in the proper situation. From a man aged twenty-five.

2803.—A testicle, with a portion of the abdominal walls. The place of the testicle is occupied by a medullary cancer. The tunica vaginalis communicated with the cavity of the abdomen.

The liver and mesenteric glands were secondarily affected by the cancer. See Nos. 2219, 2291.

UNDEVELOPED TESTICLE.

2758.—The right testicle, undeveloped, of a man, aged twenty-two, who during his life was of a feeble intellect, and subject to epileptic fits.

CONGENITAL TUMOURS OF THE TESTIS.

2811a.—A testicle, with a cartilaginous body the size of a pea attached to its surface near the tail of the epididymis.

2813a.—A tumour of the spermatic cord, situated immediately above the testicle, and connected at its lower part with the globus minor of the epididymis. The vas deferens passed through its posterior portion. On examination with the microscope, the tumour appeared to be composed of a number of tubules, and it was thought that it might have originated in the remains of some of the foetal ducts of the part. It was removed, with the testicle, from a child aged four years.

Dermoid cyst of the testis. 2810a.—The right testicle containing a dermoid cyst. The testicle measures two and a quarter inches

in length by one and three-quarters inches in thickness. The spermatic cord is a little thickened. A black bristle has been passed into the cut end of the healthy vas deferens. The epididymis is present as a flattened band lying between the testis and the spermatic cord. The dermoid tumour occupies the whole of the body of the testis, and is inclosed by the smooth and somewhat thickened tunica vaginalis. The tumour consists of a number of cysts filled with a substance of gelatinous consistence: the cysts vary in size, from a small pin's head to one which occupies the whole of the posterior border of the organ. In the recent state this large cyst contained a number of long and delicate hairs, which sprang from the membrane lining the cyst. The rest of the tumour consists of masses of dense fibrous tissue with fat, and in some cases specks of calcified cartilage. Microscopical examination shows that the gland tissue has entirely disappeared from the body of the testis. The wall of the largest cyst consists of an epidermis and corium. The free edge of the epidermis is turned towards the interior of the cyst. The epidermis consists of a thick layer of stratified epithelium lying above a well-marked rete malpighii. The corium consists of dense connective-tissue containing in its deeper layers a quantity of fat and a large number of hair follicles. Each follicle has well-developed sebaceous glands in connection with it, and each contains a non-medullated hair.

From a healthy child aged four, in whom the tumour had been noticed for three years. When first observed it was growing slowly, but during the eighteen months preceding removal it increased rapidly in size.

Sections are preserved in Series lv., No. 122b.

DISEASES OF THE SPERMATIC CORD.

HYDROCELE OF THE CORD.

Hydrocele of the cord may be either diffused or encysted.

Diffused hydrocele is simply a dropsy of the cellular spaces of the cord. As it is very rare, and as there is no specimen of it in the Museum, it will not receive further notice.

Encysted hydrocele of the cord is a collection of fluid in a cyst or cysts in connection with the spermatic cord. The cysts are generally formed of portions of the funicular pro-

cess of the tunica vaginalis, which have remained unobliterated and have become distended with serous fluid.

The cyst, or cysts, when there are more than one, are frequently found connected with the peritoneum above and with the tunica vaginalis below by a white, shining, fibrous cord, the remains of the obliterated funicular process.

Although the cysts are commonly produced in the manner above described, it is probable that they may be occasionally developed from some of the foetal remains, so abundant in the neighbourhood of the epididymis and at the commencement of the cord, *e.g.*, the organ of Giraldès or the hydatid of Morgagni.

The walls of the cyst are generally thin and membranous and lined with squamous epithelium, but they may be found thickened and granular on their internal surface as the result of irritation or inflammation. They usually contain a clear, transparent, straw-coloured fluid, like that of ordinary hydrocele; but in rare instances a watery fluid containing spermatozoa and resembling that of encysted hydrocele of the testis, hence it is probable that in these instances the cysts are developed from foetal remains. The fluid, like the walls, may undergo secondary changes and become dark and turbid.

The coverings of an encysted hydrocele are the same as those of the cord, namely, in addition to the skin and superficial fascia, the inter-columnar, cremasteric, and infundibuliform fasciæ. The vessels, nerves, and vas deferens are behind the hydrocele.

2809.—A hydrocele of the spermatic cord. There are several very thin-walled cysts of different sizes communicating with each other, and nearly surrounding the upper and anterior part of the testicle; but none of them appear to communicate with the cavity of the tunica vaginalis.

2814.—A hydrocele of the spermatic cord. There is a large membranous cyst immediately above and behind the testicle. Its inner surface is fasciculated, but lined with a smooth polished membrane. The opposite surfaces of the tunica vaginalis, which

were adherent throughout, have been partially separated. The testicle is healthy.

2815.—A hydrocele of the spermatic cord. There are three large cysts, which do not communicate with each other; two of them are situate above the testicle, and the third behind it.

HÆMATOCELE OF THE CORD.

Hæmatocele of the cord is very rare. Like hydrocele of the cord it may be either diffused or encysted. *Diffused hæmatocele* is merely an effusion of blood in the cellular tissue of the cord; *encysted hæmatocele* is a collection of blood in the cavity of a former hydrocele. The following is one of the very few specimens, if not the only one, of this rare form of disease in the pathological Museums of London.

2816.—A large cyst in the spermatic cord, which contained blood. The cyst is situated just above the testicle, and the tissues around it are thickened, indurated, and consolidated. Part of the tunica vaginalis has been removed; the opposite surfaces are completely adherent.

FATTY TUMOUR OF THE CORD.

2812.—An elongated, lobed, fatty tumour, removed after death from the loose connective-tissue of a spermatic cord.

2812a.—Two specimens of lipomata of the spermatic cord. The tumours are lobulated masses of fat, apparently derived from the subperitoneal tissue; they extend along the upper third of the cord in close relation with the spermatic artery.

Both specimens were obtained from an old subject brought in for dissection.

2812b.—A good example of a fatty tumour of the spermatic cord. A lobulated mass of fat has passed through the inguinal canal, and extends along the whole length of the cord to the testis.

From a subject brought for dissection.

VARICOCELE OF THE CORD.

Varicocele consists in a varicose condition of the veins forming the pampiniform plexus. It is more frequently seen upon the left than the right side, in consequence, it is

said, of the greater length of the left vein, the pressure of the sigmoid flexure upon that vein, and from the left vein opening into the renal at right angles; whereas, on the right side, the spermatic veins open obliquely in the vena cava inferior. If the varicose condition is well marked the veins may be felt through the scrotum to form a soft irregular knotted mass, to which an impulse is given on coughing. The swelling disappears to a great extent when the patient is placed in the recumbent posture.

2816a.—A spermatic cord in which the veins of the pampiniform plexus have been dissected out after having been partially injected. Many of the veins are enlarged and tortuous, exhibiting the condition found in an early stage of varicocele. From a man aged about thirty years.

2816b.—A spermatic cord which has been treated in the same way as the previous one. The spermatic veins are less numerous and tortuous.

2816c. A spermatic cord in which the veins of the spermatic plexus have been dissected out and painted blue. It will be seen that they are large, numerous, and tortuous.

DISEASES AND INJURIES OF THE PROSTATE.

INFLAMMATION.

Inflammation of the prostate is commonly the result of the extension of inflammation from the urethra or bladder, of injury received in the passage of an instrument or of the impaction of a calculus. It also occasionally occurs as an idiopathic affection in gouty and rheumatic subjects.

The inflammation may terminate in resolution, ulceration, suppuration and abscess, or in chronic enlargement.

The following specimens of ulceration are examples of such inflammatory affections of the prostate.

2836.—A bladder and prostate. The middle lobe, which projects into the bladder, presents an ulcerated surface.

2837.—A bladder and prostate. The prostate is greatly enlarged; its middle portion, projecting into the bladder, has been deeply

torn by catheters which were arrested by it in the attempt to relieve retention of urine.

2845.—A prostate in each lateral lobe of which there is a large irregular cavity, formed by ulceration, and communicating with the urethra by the side of the caput gallinaginis. Calculi have been formed in these cavities. The mucous membrane at the neck of the bladder and in the prostatic part of the urethra is diffusively ulcerated.

2842b.—A bladder in which senile enlargement of the prostate was treated by electrolysis. The bladder is hypertrophied and a little sacculated. The whole thickness of the bladder wall, and of the contiguous rectum in the region of the trigone, has completely sloughed, and a ragged opening of the size of a shilling unites the cavities of the rectum and bladder. The prostate gland is enlarged to about three times its natural size. The middle lobe is as large as a hazel-nut ; it is detached on its left side, and is only united to the rest of the gland by a thin pedicle. It was sloughing.

From a man aged seventy, who had suffered for two years from symptoms of enlarged prostate. After the performance of median cystotomy a current from ten cells of a Stöhrer's battery was applied for half an hour to the middle lobe of the prostate. The patient died twelve days after the operation.

CHRONIC ENLARGEMENT.

Chronic enlargement of the prostate, though a common affection of advanced life, is not, as has been stated, a constant concomitant of old age ; it must be distinguished from the chronic inflammatory enlargement, which may occur at any period of life. The disease under consideration may be due to a uniform hypertrophy of the normal tissues of the prostate generally, or of the muscular and fibrous tissues only ; or to the presence of one or more distinct tumours embedded in, or of one or more distinct outgrowths springing from, the substance of the organ. Such tumours may resemble the normal prostate in structure ; or the muscular, the fibrous, or the glandular elements may predominate.

The enlargement may uniformly affect the whole organ, except that portion which forms the floor of the urethra, or it may be confined to one or both of the lateral lobes or to

the "posterior median portion" (the so-called middle lobe). Sometimes limited portions become pedunculated and project into the bladder.

When the enlargement is general the prostatic portion of the urethra is flattened laterally and increased in length, in extreme cases often measuring several inches. When only one of the lateral lobes is enlarged the urethra is deflected to the opposite side; when the posterior median portion is chiefly affected, the urethra turns suddenly upwards into the bladder at a right angle to the rest of the canal, the enlarged median portion standing up as an obstruction at the mouth of the bladder.

When the enlargement has existed some time the bladder becomes dilated, and its muscular coat hypertrophied, from its endeavours to overcome the obstruction to the outflow of urine. As the vesical orifice of the urethra, in consequence of the enlargement of the prostate, is no longer at the most dependent part of the bladder, the urine cannot be completely voided, but collects in the fundus behind the prostate, and, becoming ammoniacal from admixture with the alkaline mucus, deposits phosphates, in the form either of a calculus or of an incrustation upon the walls of the bladder.

The effects of the enlargement upon the urinary organs behind the seat of obstruction are similar to those that occur after stricture of the urethra. Thus the mucous membrane of the bladder may become chronically inflamed, and in some cases ulcerated; the ureters may become dilated, and the kidneys more or less disorganized.

I. *General enlargement.*

Affecting the entire organ. 2400a.—A bladder and prostate gland. The central as well as each lateral lobe of the prostate is enlarged. The bladder is dilated and its muscular coat is somewhat hypertrophied. The mucous membrane is healthy, but it is depressed into numerous small pits between the muscular fibres. At the upper part of the bladder are two well-defined pouches communicating by separate small openings with the general vesical cavity.

They appear to be formed by protrusions of the mucous membrane between the muscular fibres.

2830.—A bladder, with the prostate greatly and uniformly enlarged. The urethra within the prostate is deepened and laterally compressed. The muscular coat of the bladder is hypertrophied; bristles are passed beneath strong fasciculi of muscular fibres extending from the ureters to the neck of the bladder.

2833.—A greatly dilated bladder and the prostate gland. The three lobes of the prostate are enlarged, especially the third, which projects upwards almost at a right angle, and forms a valve over the vesical orifice. A piece of glass rod is placed in a false passage at the base of the middle lobe. The ureters and pelvis of the kidneys are not dilated.

From a man aged sixty-two years, who never had any difficulty in micturition until eight days before his admission to the hospital with retention. An elastic catheter was easily passed into the bladder.

Affecting chiefly the "posterior median portion" (middle lobe).
2842.—A bladder, with the prostate, exhibiting a general enlargement of the prostate, with predominant enlargement of its "posterior median portion" (middle lobe). The enlarged middle lobe, and the portions of the prostate and of mucous membrane which connect it with the enlarged lateral lobes, form a ridge across the neck of the bladder, behind the orifice of the urethra. Through the middle of this ridge a passage was formed by a catheter.

2834.—A bladder, with the prostate. The prostate is generally enlarged, but its posterior portion, or middle lobe, is enlarged much more than any other portion of it, and projects in the form of a round tumour into the cavity of the bladder, immediately behind the orifice of the urethra. The muscular coat of the bladder is hypertrophied. The ureters are dilated and thickened. Immediately above one of the ureters is a small cyst communicating with the bladder.

2835. A similar specimen; but the prostate, not being divided as it is in the preceding specimen, exhibits more plainly the manner in which, when enlarged, it projects into the neck of the bladder, and especially the manner in which the enlarged middle lobe projects behind and above, and partially overhangs the orifice of the urethra.

Affecting chiefly the lateral lobes. 2829.—A prostate, with parts

of the bladder and rectum. The prostate is greatly enlarged. The principal enlargement has taken place at the sides of the prostate and in the portion which is above and in front of the urethra. This portion is increased to upwards of an inch and a half in thickness, while the portion behind and below the urethra is scarcely thicker than is natural. The urethra within the prostate is flattened laterally, and contracted. A portion of glass is introduced into a passage made by a trocar during life, from the rectum through the prostate into the urethra. The orifices of the ureters are much dilated.

2831.—A bladder and prostate. The prostate is much enlarged and round circumscribed portions of it project into the neck of the bladder, both behind and in front of the urethra. A piece of coloured glass is passed through the urethra, the prostatic portion of which takes a very oblique course, in consequence, apparently, of the left lobe of the prostate being more enlarged than the right.

II. *Limited enlargements in the form of tumours or out-growths.*

In the form of tumours. 2849.—The lower part of a bladder, with the prostate laid open from the front. The right lobe of the prostate is enlarged by the growth within it of a tumour over which its substance and capsule are thinly spread out. The tumour is oval in shape, measuring about one and a half and two inches in its diameters, closely invested by the prostate, yet easily enucleated from it. A portion of it thus separated is suspended above the bladder. Its cut surfaces show a very firm, dense texture, like that of a prostate, with numerous small cysts. The microscopic structures had the same likeness to those of a natural prostate. The prostatic part of the urethra is flattened by a projection of the side of the tumour, and curved towards the left side. A piece of glass marks a passage made with a catheter through the right lobe of the prostate, by the side of the tumour. The left lobe of the prostate appears of natural size.

From a man fifty-one years old, who, for two years before his death, had increasing difficulty in passing urine. Complete retention at length ensued, and was relieved with catheters, some or all of which passed through the prostate in the tract indicated in the specimen. After seven days acute peritonitis, commencing apparently at the bladder, proved quickly fatal.

In the form of outgrowths. 2839.—Section of a bladder, prostate, and urethra. The prostate is enlarged, and some tumours growing from it project into the bladder. There was a calculus in the bladder, which was removed by the lateral operation a fortnight before death; and in the progress of the operation one of the tumours arising from the prostate was completely detached. This tumour is suspended in the lower part of the bottle; it is of oval form, about three-quarters of an inch in diameter, and appears to have been attached by a small pedicle.

2842a.—The urinary bladder, with great enlargement of all the lobes of the prostate gland. The bladder itself is hypertrophied and fasciculated, the mucous membrane being inflamed and slightly ulcerated around the prostate. Each lateral lobe of the prostate contains a small fibrous tumour, that in the left lobe being contained in a definite capsule. The middle lobe is pedunculated and tunnelled through its centre from the urethra. A glass rod has been passed along the channel.

From a man aged seventy-eight, who was admitted on account of retention of urine resulting from an enlarged prostate. He was sent out of the hospital in charge of a nephew, who had instructions to pass a soft rubber catheter; but he was shortly afterwards admitted with severe hæmaturia, to which he quickly succumbed.

2850.—A portion of a tumour, which was removed from the interior of a urinary bladder. It was attached just behind the orifice of the urethra, over the middle lobe of the prostate, by a band or pedicle, composed of mucous membrane and muscular fibres, and measuring about half an inch in width, and one-eighth of an inch in depth and thickness. The tumour (cut from the pedicle) is thinly invested with mucous membrane, like that of the bladder. It is of somewhat oval form, and measures from one and a half to two and a half inches in its several diameters. On its cut surfaces the tumour appears formed of very firm, tough, whitish substance, like that of a prostate. It is intersected by shining white circling bands of fibres, which divide it into closely packed lobes, and it contains many small round and oval cysts, lined with smooth membrane. The microscopic textures of the mass were exactly similar to those of prostate, including both gland-structures and well-formed smooth muscular fibres. The tumour may, therefore, be regarded as having grown, not within, but external to the prostate, and as having projected into the bladder till it became pedunculated.

The patient, sixty-four years old, was, for the last four years of his life, unable to pass urine without the help of the catheter. The tumour, as first seen after death, was described as "lying loose in the bladder, only connected to it by a pedicle, moving on this like a hinge, and when pressed forwards, obstructing the orifice of the urethra." See also **No. 2840**.

Specimens illustrating some of the methods of treating retention of urine from enlargement of the prostate.

By puncture of the bladder above the pubes. **2445a**.—A bladder, with an enlarged prostate, from a man in whom the bladder had been punctured above the pubes eight years before death. The fistulous passage through which the urine was discharged is about four inches in length, and extends from the front of the bladder immediately above the prostate, through the abdominal walls. A piece of glass is introduced into this passage. The lateral lobes of the prostate is enlarged, and a distinct portion of the prostate, flattened and triangular, projects into the bladder immediately behind the orifice of the urethra.

By puncture through the rectum. **2829**.—A prostate, with part of the bladder and rectum. A portion of glass is introduced into a passage made by a trocar during life, from the rectum through the prostate into the urethra.

Puncture of the bladder through the rectum for the relief of retention of urine is objectionable if the prostate is much enlarged; for either the instrument must be passed so high up the rectum to enable it to enter the bladder behind the large prostate that the recto-vesical pouch of the peritoneum will run grave risks of being wounded, or the trocar must be thrust through the prostate, a proceeding not only inflicting much injury upon the prostate, but also often failing in its object, as the point of the trocar (as seen in the above specimen) may enter the elongated prostatic urethra in front of the seat of obstruction, instead of entering the bladder.

By "tunnelling" the prostate. **2842**.—A bladder and prostate. The enlarged middle lobe, and the portions of the prostate and of the mucous membrane which connect it with the enlarged lateral

lobes, form a ridge across the neck of the bladder behind the orifice of the urethra. Through the middle of this ridge a passage was formed by a catheter. See also No. 2842a.

2849.—In this specimen a piece of glass marks a passage made by a catheter through the enlarged right lobe of the prostate for the relief of retention of urine. After seven days from the puncture acute peritonitis, commencing apparently in the neighbourhood of the bladder, proved quickly fatal.

By excision of portions of the prostate. 2848a —A bladder with the membranous urethra, from which large portions of the prostate were removed by operation ten months before death. The patient had been four times cut for stone. The urethra opens into a pouch, which in the fresh state was capable of containing two or three ounces of fluid. The walls of the pouch are formed anteriorly of condensed fibrous tissue, and nearer to the bladder of the remains of prostatic tissue. The pouch appears to have been formed within the prostate, and to represent the part from which the prostatic tissue had been removed. It communicates by a large opening with the bladder, which is thickened and contracted in the places where it is pouched.

From a man aged sixty-six. During the performance of lithotomy for the second time it was found that the middle lobe of the prostate was enlarged and had been perforated by the previous use of instruments. The hypertrophied portion was, therefore, removed through a median incision. A fortnight later the lithotomy wound was dilated, and a growth was removed from the right side of the prostate.

2848b.—The calculi and portions of the prostate removed from the patient mentioned in the preceding case. The total weight of the calculi is forty grains, whilst the portions of the prostate weigh one and a half ounces.

MALIGNANT DISEASE.

Sarcoma of the Prostate.

Sarcoma of the prostate is rare. It is usually found in young persons.

2854a.—A bladder and prostate. Occupying the whole of the latter is a large, soft sarcomatous tumour, parts of which project into the cavity of the bladder in the form of pedunculated growths of varying size. The bladder is somewhat hypertrophied.

From a man aged twenty-one years, who was admitted to the Royal Free Hospital for retention of urine. No tumour could at that time be felt per rectum, and his previous health had been good. He died in three weeks after much hæmaturia. A post-mortem examination showed greatly dilated ureters, with numerous small abscesses in the kidneys, but no secondary growths. On microscopical examination the tumour was found to consist of round and spindle cells.

Carcinoma of the Prostate.

Cancer of the prostate is also rare. When it occurs it is nearly always of the medullary type. It has been observed only in childhood and advanced age. Its characters are well seen in the following specimens. Scirrhus has also been observed, and more rarely colloid cancer.

2854.—The bladder and prostate of a child four years old. None of the natural structure of the prostate can be discerned; in its place there is a mass of soft, white, obscurely fibrous and shreddy medullary substance, nearly spheroidal in form, and measuring four inches in diameter. This mass projects backwards between the bladder and the rectum, covering the pouch of peritoneum between them to the level of the upper part of the bladder; it must nearly have filled the pelvis. The posterior and lower part is either superficially ulcerated or it has been broken. The peritoneum covering its upper part is extremely congested.

2853.—A bladder and prostate from a child five years old. The prostate is considerably enlarged both in its lateral and middle lobes. The natural structure of the prostate has entirely disappeared, and its place is occupied by medullary substance, a portion of which is of dark-grayish colour, perhaps from the deposit of melanotic matter. There are also similar dark-gray deposits in the cellular tissue around the prostate and neck of the bladder.

The child had been subject for four months to irritability of the bladder. Ten days before death it had retention of urine, which was succeeded by paralysis of the bladder.

TUBERCLE.

Tubercle in the prostate is rare, and is always associated

with a general tubercular affection of the genito-urinary mucous tract.

Miliary tubercles are deposited in the connective-tissue around the prostatic ducts and their terminal vesicles, and by undergoing caseous degeneration lead to the formation of distinct circumscribed patches of yellow caseous material. These ultimately coalesce, soften, and break down into pus, leaving, after the pus has made its way by ulceration into the bladder, urethra, or rectum, large irregular cavities, indistinguishable, except in being surrounded by tuberculous deposit, from those produced by ordinary inflammation and suppuration.

2412c.—The left kidney and the bladder, from a case of tubercular disease of the genito-urinary tract. The pelvis of the kidney is dilated and is partially absorbed. The glandular substance appears fatty. In the cortical portion are two or three large cavities which in the recent condition were filled with thin pus. The bladder is much hypertrophied and inflamed, and there is some diffuse inflammation about its neck. The prostate is the seat of a tubercular deposit; it is surrounded by an abscess of about the size of a large walnut, which opened into the membranous portion of the urethra. From a man aged forty-three, who had suffered from stricture for twenty-four years. He died of general tuberculosis. (See also **No. 2412d.**)

2846.—Sections of a prostate from a young man, with round circumscribed masses of tuberculous matter deposited in it.

There were tubercles in the lungs and other organs. The bladder of the same patient is preserved in **No. 2413**.

2848.—A prostate, of which nearly the whole substance has been destroyed by tuberculous ulceration. Only a thin shell of the prostate remains around a cavity with irregular walls. The cavity was traversed by some cords of the indurated tissue of the prostate infiltrated with tuberculous matter. It contained pus and detached portions of the organ, and it communicates by a wide orifice with the urethra. The patient was an old man, who had tuberculous disease of the lungs, kidneys, testicles, and other organs. He died with inflammation of the bladder.

FATTY DEGENERATION.

2843.—Portion of a prostate, which appears to have undergone a

complete fatty degeneration of all its structures. Its cut surfaces have the aspect of a firm, minutely-lobed, adipose tissue. The patient was upwards of seventy years old. He had old stricture of the urethra, diseased bladder, and granular degeneration of the kidneys.

CONCRETIONS AND CALCULI.

Prostatic concretions are small, brownish or blackish, seed-like bodies, often found in abundance in the ducts and follicles of the prostate of elderly people. They may be seen, on microscopical examination, in the prostate at early periods of life as soft, pale yellow bodies, but it is only in later years that they become visible as dark specks to the naked eye. They appear to be formed of inspissated prostatic secretion intermingled with phosphates of lime. As they increase in size the follicles in which they have been formed become dilated around them into small cysts.

In some instances one or more may become abundantly coated with phosphate and carbonate of lime, when they are generally spoken of as prostatic calculi.

Prostatic calculi assume various forms and sizes; they are hard in consistence, and vary in colour from white to pale brown. When large they may project into the urethra, causing retention of urine, and they have been known to protrude from the urethra into the bladder. They may give rise to abscess of the prostate or make their way by ulceration into the rectum or bladder.

2855.—A prostate, in which numerous small cysts are filled by brown calculi.

2856.—A similar specimen, but with smaller cysts and calculi.

2883.—Part of a penis and prostate. A small calculus is fixed in the dilated orifice of one of the prostatic ducts. See also **Series lii**, No. 219.

DISEASES OF THE VAS DEFERENS AND VESICULÆ SEMINALES.

HYDATIDS OF THE VAS DEFERENS.

2828.—A bladder, to the posterior part of which a cyst is

attached, which contained acephalocyst hydatids. The vesiculæ seminales and vasa deferentia are closely connected with the cyst, and the lower part of the right vas deferens communicates with it by two orifices, into which a bristle is passed. A portion of this vas deferens is wanting, and it appeared that the cyst might have originated in the dilatation of the deficient portion of the tube. The walls of the cyst are thin, but tough and firm; the hydatids found within it are at the bottom of the bottle.

TUBERCLE OF THE VESICULÆ SEMINALES.

Tubercle of the vesiculæ seminales hardly ever occurs except in connection with tuberculous disease of the genito-urinary tract. Three good specimens follow.

2412d.—The bladder and testes from a case of tuberculosis of the genito-urinary tract. The mucous membrane of the bladder is ulcerated, whilst the prostate is converted into a large abscess. The vesiculæ seminales are greatly enlarged, and the vas deferens is thickened and cord-like. The epididymis of each testicle is also enlarged and is converted into a caseating mass, and the body of either testis presents numerous patches of tubercle.

From a man aged forty-eight, who suffered for two years before his death from tubercular disease of his genito-urinary tract. After eighteen months he presented symptoms of general tuberculosis. At the autopsy the lungs were found to be a mass of tubercle.

The left kidney with its ureter is preserved in **Series xxviii., No. 2341b.**

2327.—Two specimens of vesiculæ seminales enlarged, indurated, and having deposits of tuberculous matter upon their lining membranes.

2347.—Vesiculæ seminales, prostate gland, and part of the bladder. Sections of the prostate and left vesicula seminalis exhibit tuberculous matter deposited in the interior of each. In the vesicula seminalis the tuberculous matter forms a uniform lining to the mucous membrane, the reticular arrangement of the surface of which remains distinct. In the prostate it is almost uniformly infiltrated through its left half, and some of it is softened. The right side of the prostate is nearly healthy. From a young man in whom there were tubercles of the lungs and other organs. His left kidney is preserved in **No. 2340**; the right

kidney was healthy. The left testicle had tuberculous deposits in its interior ; the right was healthy.

INJURIES AND DISEASES OF THE BLADDER.

RUPTURE.

Rupture of the bladder is commonly the result of external violence, such as a fall or blow upon the abdomen when the bladder is distended. It is a frequent complication of fracture of the pelvis. Simple over-distension, such as occurs in consequence of stricture of the urethra, seldom, if ever, leads to rupture, because the walls of the viscus, as already explained, become hypertrophied during the formation of a stricture, and are therefore rendered capable of resisting the pressure of the retained urine ; in such a case it is nearly always the urethra behind the stricture which gives way.

When the peritoneum is ruptured, as is most commonly the case, the urine necessarily escapes into the peritoneal cavity and sets up acute peritonitis, which is almost invariably followed by death. When the anterior wall alone is ruptured the peritoneum is not involved, and the urine is extravasated into the loose cellular tissue of the pelvis.

The direction of the rupture is generally vertical, and the edges of the rent are usually ragged and flocculent.

Extra-peritoneal rupture. 2440c.—A bladder which has undergone extensive extra-peritoneal laceration. A large rent is situated on either side of the organ, about three-quarters of an inch above the vesical orifice of the urethra. They communicate with a cavity large enough to hold a small orange, which existed between the back of the pubes and the front of the bladder. The membranous portion of the urethra is also torn transversely. The peritoneum was not ruptured, but there was extensive extravasation of urine into the cellular tissue of the pelvis and the back of the abdomen.

From a boy aged fourteen, who fell between the railway platform and a moving train. There was a fracture through both horizontal rami of the pubes as well as through the descending

ramus of the ischium. The patient survived the injury for thirty-three hours.

Intra-peritoneal rupture. 2440.—The bladder of a man, aged forty-five; the upper and back part of the fundus has been ruptured. The hole is large enough to admit a quill on the outside, but is of greater extent on the inside. The lining membrane of the bladder is ecchymosed in patches. The whole viscus is thickened, and large fasciculi appear on the inner surface. The membranous portion of the urethra is contracted, and beaded with small nodules of inflammatory material. The pelvis contained much blood and urine. The rupture was the result of severe injury to the abdomen. The patient died four days afterwards of peritonitis. He had suffered from stricture for years.

2440a.—A bladder exhibiting an intra-peritoneal rupture, situated at its upper and back part. The rupture is longitudinal in direction, and extends through the whole thickness of the viscus; a blue glass rod has been placed in it. The organ is greatly contracted.

From a boy aged twelve, who was run over by a van. On admission he was found to have a fractured pelvis; he was collapsed, and was passing blood by his rectum and urethra. The patient gradually developed signs of peritonitis, and died four days after the injury. At the autopsy no urine was found in the peritoneum, although it must have escaped freely from the bladder.

2440b.—A traumatic rupture of the bladder. A long rent extends through the whole length and thickness of the organ, and two smaller irregular rents, into which glass rods have been passed are situated on either side of the central laceration. The larger rupture involves the peritoneum.

From a man aged forty-nine, who was run over by an omnibus. He stated that he had not passed water for five or six hours before the accident. He died of shock, and at the autopsy the small intestine was found to be ruptured, the mesentery was torn, and there was a comminuted fracture of the pelvis.

2441.—A bladder, exhibiting a rupture of its anterior wall in a line from the prostate to the fundus. The rupture was produced by a blow on the abdomen.

SPECIMENS ILLUSTRATING THE CONDITION OF THE BLADDER
AND NEIGHBOURING PARTS AFTER THE OPERATIONS OF
LITHOTOMY, LITHOTRITY, AND PUNCTURE.

After Lithotomy.

The following specimens well illustrate the condition of the wound in the prostate and neck of the bladder at different periods after the operation of lithotomy.

Twenty-four hours after the operation. 2837a.—A sagittal section through a bladder and prostate gland, to show the hypertrophy of the muscular fibres which lie between the orifices of the ureter. The third lobe of the prostate is much enlarged, and projects upwards into the bladder. The hypertrophy of the muscular fibres seems to be the result of this chronic prostatic enlargement. It has taken place secondarily to the elevation of the prostate, apparently for the purpose of doing away with the vesical pouch, which would otherwise be formed. The black rod is passed along the urethra; below the rod is seen the track of a lithotomy wound made the day before the death of the patient.

A few days after the operation. 2396.—A bladder, showing the incision in the neck made in the performance of lithotomy.

2442.—The bladder, ureters, and kidney of a child, showing the incision made in the performance of lithotomy a few days before death.

A fortnight after the operation. 2443.—The bladder and rectum of a child, upon whom the operation of lithotomy was performed about a fortnight before death. A bristle is passed through the track of the wound.

Five years after the operation. 2444.—The bladder and kidneys of a man, upon whom the operation of lithotomy was performed five years before death. The cicatrix in the mucous membrane between the prostate and neck of the bladder is distinctly visible.

Ulceration of the bladder. 2434.—The bladder, urethra, and a portion of the os pubis of a man upon whom the operation of lithotomy had been performed. A portion of the front of the bladder is destroyed by ulceration; the remaining part is thickened and diffusely ulcerated.

After Lithotrity.

2398.—A bladder, with part of the urethra of a man on whom

the operation of lithotrity was performed. There were two calculi in the bladder; one of moderate size, which was broken by the instrument; the other, of larger size, was not detected, being lodged in a deep recess formed by the dilatation of all the coats of the bladder at its lower and back part, immediately behind the prostate. See also No. 2404.

2444a.—The bladder and kidneys of a patient upon whom lithotrity had been ineffectually performed shortly before death. The left kidney is much enlarged, and contains numerous small miliary abscesses in its cortex. The right kidney is small, its pyramids are absorbed, and its pelvis is much dilated. The bladder is contracted and thickened; there is a small pouch behind the prostate. It contains three pieces of a recently broken uric acid calculus. In the dilated prostatic urethra is another portion of the same calculus. The fragments together weigh seventeen drachms. From a patient aged fifty-nine, who was admitted to the hospital in a dying condition.

After Puncture.

Through the rectum. **2401.**—A bladder behind which is a sac nearly as large as itself. Above the communication of the sac with the bladder is an orifice which was made by a trocar introduced from the rectum for the relief of retention of urine.

2829.—A prostate with part of the bladder and rectum. The prostate is greatly enlarged. A portion of glass is introduced into a passage made by a trocar during life from the rectum, through the prostate into the urethra.

The better treatment in both the above cases would have been to have punctured the bladder above the pubes.

Above the pubes. **2445.**—The bladder and urethra of a man in whom the bladder was punctured twelve years before death. Connected with the front of the bladder is a fistulous tract extending through the parietes of the abdomen by which the patient discharged his urine from the time of the puncture of the bladder until his death; it is lined by a membrane similar to and connected with the mucous membrane of the bladder.

2445a.—A bladder, with an enlarged prostate, from a man in whom the bladder had been punctured above the pubes eight years before death. The fistulous passage through which the urine was discharged is about four inches in length, and extends from the

front of the bladder immediately above the prostate through the abdominal walls. A piece of glass is introduced into this passage.

CYSTITIS.

Cystitis or inflammation of the mucous membrane of the bladder may be either acute or chronic.

Acute Cystitis.

Acute cystitis is rare. It is generally the result of direct irritation or injury of the mucous membrane; hence it is occasionally met with after lithotrity, or the retention of a catheter in the bladder. It may also occur in the course of chronic cystitis, or rarely as an idiopathic affection.

The mucous membrane appears vividly injected, swelled, roughened on its surface and covered with the products of inflammation. In severe forms it assumes a dark red or purple colour. The inflammation may terminate in suppuration, ulceration, or gangrene, all of which may exist at the same time in different parts of the bladder. In rare instances the mucous membrane may die and be cast off in one piece, leaving the muscular coat exposed. The detached mucous membrane has occasionally been passed by the urethra. In the less severe forms the inflammation may either terminate in resolution or may pass into the chronic condition.

2404.—A bladder with portion of the urethra, from a man, aged seventy-three, on whom the operation of lithotrity had been performed, and who died twelve days after the last crushing. The bladder, which is somewhat thickened, presents the usual appearances of acute ulcerative cystitis; a few fragments of calculus were found loose in its cavity, but the greater portion was found impacted in two small pouches of about the size and shape, each of them, of a cob-nut. The fragments had evidently become impacted after the operation. The pouches are in the more dependent part of the bladder, near the orifices of the ureters, of which, however, they formed no part.

2408.—The urinary bladder from a woman aged thirty-four. Except for an inch in breadth around the orifice of the urethra, where

the mucous membrane still exists, the muscular coat of the bladder is everywhere exposed, and the lining membrane is everywhere destroyed. The bladder is rather large, the urethra natural. The ureters were dilated to the size of the little finger, and their orifices in the bladder would admit a goose-quill; their lining membrane is natural. The kidneys were affected with diffused suppurative nephritis, and their pelves were dilated.

2408a.—A bladder from which the whole of the mucous lining, preserved in specimen No. 2408b, has sloughed. The bladder wall is soft and easily lacerated, and its inner surface is rough and ulcerated. The prostate is natural, but the urethra has sloughed round an aperture in the perineum. The cæcum was found to be adherent to the upper surface of the bladder; but on separating the two surfaces, the whole of the fundus came away as a slough, leaving the aperture seen in the specimen. The edges of the bladder after the separation of the slough presented a ragged border. The kidneys were in a condition of tubal nephritis. There was no stricture of the urethra.

2408b.—The whole of the mucous membrane of the urinary bladder, with a portion of the muscular coat, which was found as a slough in the bladder, preserved as specimen No. 2408a. The surface of the slough is covered with a rough phosphatic deposit.

From a man aged thirty-six, who was admitted with retention of urine of three days' duration. A small catgut was passed along a railroad catheter and retained, three or four pints of urine draining away. Much blood passed, and it was conjectured that the bladder contained blood-clot. Though the urethra admitted a No. 10 English catheter five days after admission, the patient was unable to void urine spontaneously, and in spite of antiseptic precautions, the urine became foul and ammoniacal. A month after admission perineal cystotomy was performed, but was followed by only temporary improvement; suppuration continued, and he died two months after admission.

2409.—This specimen is apparently nearly the whole of the mucous membrane of the urinary bladder with a portion of the muscular coat, which was passed during life, by a woman aged twenty-six, from the urethra. A month previously she was admitted into the hospital on account of retention with incontinence of urine, and retroversion of the uterus, being about four months pregnant. Soon after her admission ninety-six ounces of urine were drawn off with a catheter, and the urine was subsequently drawn off regularly every few hours.

The expulsion of the specimen from the bladder was preceded by retention and acute pain in the hypogastrium, and on examination, the urethra being found blocked by some white-looking substance, the membrane here preserved was removed. For some months afterwards the patient was unable to hold her urine for more than from five to twenty minutes at a time. When last seen (about eight months afterwards) she was in much the same condition. Her general health was good. She was delivered of a healthy child, at about the full time.

Chronic Cystitis.

This is usually due to the extension of inflammation from the urethra to the bladder, the irritation of calculi, the presence of unhealthy urine, or the too frequent passage of catheters. The mucous membrane appears thickened, velvety, congested, of a dark red colour, and covered with an abnormal secretion of mucus, or with muco-pus, or, when the disease has lasted some time, with a deposit of phosphates. The mucous membrane is easily detached, and is often found destroyed in places by ulceration or by suppuration. The muscular coat thus exposed becomes hypertrophied from irritation, or may even, in severe cases, participate in the inflammation.

2406.—A bladder, in which nearly the whole of the mucous membrane has been removed by ulceration.

2407.—A similar specimen, showing more plainly the enlarged fasciculi of the muscular coat exposed by the ulceration.

Abscess. 2405.—A bladder, in the posterior wall of which two abscesses have formed. The cavities of the abscesses are exposed by the removal of the peritoneum; they occupied circumscribed spaces between the peritoneal and mucous membranes, in which spaces the muscular fasciculi alone remain, the cellular tissue between them having been destroyed in the suppuration. In several places also the mucous membrane lining the intermuscular spaces has been destroyed, so that the abscesses communicated with the cavity of the bladder.

HYPERTROPHY AND SACCULATION.

Hypertrophy of the bladder is generally associated with

some obstruction to the urinary outlet, or with the presence of a foreign body in the bladder; and is the result of the constant action of the muscular fibres to overcome the obstruction, or to expel the foreign body. The hypertrophied muscular fibres give to the interior of the bladder a columnar and rugose appearance, somewhat resembling the interior of the ventricles of the heart. The mucous membrane may be thickened, or ulcerated and in great part destroyed. In conjunction with the hypertrophy the bladder may be either contracted or dilated. The dilatation may be general, or confined to certain portions of the walls. The partial dilatations, called *sacculi*, consist either of all the coats, or, as is more commonly the case, of the mucous membrane only, protruded between the fasciculi of the hypertrophied muscular fibres from the pressure of the retained urine. Such a pouch, often spoken of as a hernia of the mucous membrane, when once formed may go on enlarging until it nearly, or quite, equals the bladder in size and becomes a receptacle for urine, or even for calculi.

Sacculi, formed by protrusions of the mucous membrane, are often seen in different stages of formation in the same bladder.

Simple hypertrophy.

From stricture. 2361a.—The kidneys, ureters, and bladder. The kidneys are enlarged and sacculated, and their pelves are dilated. The right ureter immediately beyond the pelvis of the kidney presents a very tight and tortuous stricture about an inch in length. The stricture is so tight that it was barely possible to inject water through it. Two inches lower down this ureter is again constricted, but the second stricture is not so narrow, and is annular in form. The left ureter is also constricted in two places, about two inches apart. The upper stricture is situated two inches from the kidney, and the ureter above it is dilated into a pouch. The strictures will admit of the passage of a No. 7 catheter. All the strictures are tough and fibrous, and appear to be of long standing. The bladder is very much hypertrophied.

From a man aged forty-four, upon whom urethrotomy was performed for the relief of an impassable stricture of the urethra.

From enlarged prostate. 2830.—A bladder, with the prostate greatly and uniformly enlarged. The urethra within the prostate is deepened and laterally compressed. The muscular coat of the bladder is hypertrophied; bristles are passed beneath strong fasciculi of muscular fibres, extending from the ureters to the neck of the bladder.

From the irritation of a calculus. 2396.—A bladder, the coats of which are much thickened and indurated in consequence of the lodgment of a calculus in its cavity. The muscular coat is in some parts nearly half an inch thick, and the mucous membrane forms a tough white layer, from one-tenth to three-tenths of an inch in thickness, and raised in prominent folds in the cavity of the contracted bladder.

From the irritation of a tumour in its interior. 2417.—The muscular coat of the bladder in this specimen is hypertrophied in consequence of the irritation of a villous tumour growing from its mucous membrane.

From phimosis. 2370.—The bladder, ureters, and kidneys of a boy, thirteen years old; the bladder is contracted, its muscular coat hypertrophied, and its mucous coat is ulcerated. The ureters are very tortuous and widely dilated, and their walls are thickened. The mucous membrane of each is rough, and pus is in some parts deposited upon it. The pelves and infundibula of both kidneys are also widely dilated, thickened, and rough on their internal surfaces from a similar deposit. The kidneys appear enlarged by the dilatation of their pelves and infundibula, but their glandular substance forms only a thin layer on their surfaces.

The patient had phimosis, and had suffered for four years with incontinence of urine. For three months before death he had severe symptoms like those of stone in the bladder. Circumcision was performed, but he died exhausted.

2370a.—The bladder, ureters, and kidneys of a boy aged seventeen. The bladder is enlarged and greatly hypertrophied, and its mucous coat is ulcerated. The ureters are enormously distended and thickened, except at their vesical orifices, which retain their normal size. The pelvis and infundibula of the kidneys are widely dilated, thickened, and rough, from a deposit of lymph upon their inner surfaces. The glandular substance has entirely disappeared. From a railway porter who had phimosis. The contraction of the prepuce was so great that the point of a hairpin could not be passed through it into the meatus urinarius. The patient was at

work until the day of his circumcision. He died of uræmia three days after the operation.

Phimosis, *i.e.*, an elongated and contracted condition of the prepuce, in consequence of the impediment which it offers to the outflow of urine, may produce the same effects upon the urinary organs (well seen in the above specimens) as those already described as occurring after stricture. Phimosis is, moreover, often productive, as in the case of the child from whom the specimen **No. 2370** was taken, of symptoms similar to those of stone in the bladder.

Without any evident cause. **2395.**—The bladder of a child in which the muscular coat is exceedingly hypertrophied. Its other tissues appear healthy.

The child was four years old, and suffered intensely with signs of stone in the bladder; but no stone existed, nor was any disease found in the urethra or other part of the urinary system.

Hypertrophy with sacculation—the sacculation consequent upon the partial dilatation of all the coats of the bladder.

2397.—A bladder with an enlarged prostate. The bladder is much thickened. At the upper and back part, immediately above the orifice of the left ureter, a portion of the bladder is distended into a sac of considerable size, of which the walls are thinner than those of the rest of the bladder, although all the coats appear to be comprised in the dilatation.

2398.—A bladder with part of the urethra of a man, on whom the operation of lithotripsy was performed. There were two calculi in the bladder; one of moderate size, which was broken by the instrument; the other, of larger size, was not detected by the instrument, being lodged in a deep recess formed by the dilatation of all the coats of the bladder at its lower and back part, immediately behind the prostate.

2399.—Sections of a dried bladder, of very large size, and with numerous cysts communicating with the posterior and lateral parts of its cavity. Within two of these cysts calculi are lodged.

Hypertrophy with sacculation—the sacculation consequent upon the protrusion of the mucous membrane between the fasciculi of the muscular coat. (*Hernia of the mucous membrane.*)

2401.—A bladder, behind which is a sac nearly as large as itself. The sac, which probably had its origin in the protrusion of the mucous membrane of the bladder between its muscular fibres, communicates with the cavity of the bladder by a small round opening just above the orifice of the right ureter. The muscular coat of the bladder is much thickened; its mucous membrane is healthy, but depressed into small pits between the muscular fibres. Above the communication of the sac with the bladder is an orifice, which was made by a trocar introduced from the rectum, for the relief of retention of urine. There is a smaller sac communicating with the bladder above the termination of the left ureter.

2403.—The bladder of an old man, who had long suffered with stricture of the urethra. Its muscular coat is thick, but weak and flaccid, and the mucous membrane is depressed into pits between the muscular fasciculi. On the right side are two large thick-walled sacs, each between three and four inches in diameter, communicating with the bladder by two small round apertures, and separated from each other by a partition formed by the union of their adjacent walls. They appear to have been formed by portions of the mucous membrane protruded, like herniæ, between fasciculi of the muscular coat, and growing and thickening as they were gradually dilated.

2400a.—A bladder and prostate gland. The central as well as each lateral lobe of the prostate is enlarged. The bladder is dilated and its muscular coat is somewhat hypertrophied. The mucous membrane is healthy, but it is depressed into numerous small pits between the muscular fibres. At the upper part of the bladder are two well-defined pouches communicating by separate small openings with the general vesical cavity. They appear to be formed by protrusions of the mucous membrane between the muscular fibres. See also No. 2402.

DILATATION OF THE BLADDER.

Dilatation of the bladder may, as already seen, be associated with hypertrophy of the muscular coat. It is said to exist, however, without any hypertrophy of the walls,

in some cases of enlarged prostate. There is no specimen resembling this condition in the Museum.

TUBERCULAR DISEASE.

Tubercular disease of the bladder is characterized by the presence in the mucous membrane of numerous small, circular, distinct ulcers with thickened edges. It begins by the formation of miliary tubercles in the lymphatic tissue of the submucous coat. The tubercles here, as in other situations, undergo caseous degeneration and softening; and this change is followed by ulceration of the mucous membrane covering them, producing the characteristic appearance above described. Fresh tubercles form around and undergo similar changes, leading to the formation of fresh ulcers, which by encroaching upon and coalescing with those previously formed, give rise to a deep, irregular ulcer with thickened edges.

The disease is frequently associated with a general tubercular condition of the genito-urinary mucous tract.

2413.—A bladder, exhibiting numerous distinct circular ulcers in its mucous membrane. At the bases of some of these ulcers there are small tubercular deposits. The portions of the mucous membrane intervening between the ulcers are healthy. There were tubercles in the lungs and other organs.

2412b.—The urinary organs of a child aged nine years, in an advanced stage of tuberculous disease. The mucous membrane of the bladder is rough and thickened; it has lost its natural polish and is thickly set with small circular ulcers. The ulceration has in many places been succeeded by caseous degeneration, and close to the orifice of the left ureter the mucous membrane has been extensively destroyed. The kidney contains several large caseating masses, which are mostly situated in the neighbourhood of the pyramids, the cortical portion of the gland being nearly free. The right ureter, which is laid open, presents several ulcers similar to those found in the bladder.

2414.—Part of a bladder and its ureters. The entire mucous surface of the former is converted into a rough villous texture, being part of a layer of considerable thickness which has taken the place of the natural lining. In the recent state it was soft and of

a pale yellow colour, and was formed by a deposit of tubercular matter in the mucous and submucous tissues. This condition extends up to the left ureter, and involved the calyces and tubuli of the corresponding kidney. The right ureter remains unaffected.

Part of the penis, including the glans, is suspended in front, and the urethra is laid open, to show that the diseased condition prevails to its very extremity.

From the body of a boy, who had long suffered from symptoms of vesical disease, which at first simulated those of a calculus in the bladder. Large quantities of broken-down tuberculous material were constantly passed with the urine.

TUMOURS OF THE BLADDER.

Fibrous or polypoid growths.

These growths, generally known as polypi, occur as sessile or as pedunculated tumours projecting into the interior of the bladder. They are usually perfectly innocent, being composed of fibrous or of fibro-myxomatous tissue. At times, however, sarcomatous and epitheliomatous elements have been found entering into their composition.

Springing from the submucous tissue, they protrude the mucous membrane before them, and appear, when viewed from the inside of the bladder, as flattened elevations; as they increase in size they assume a polypoid form, becoming irregular and warty on the surface. All varieties, from a simple flattened elevation to a complete polypoid mass, are often seen in the same specimen. They may be multiple, although they are usually single. Their common seat is the lower and back part of the bladder; they generally occur in young subjects, and are more common in girls than in boys. Obstruction to the escape of urine is the common cause of death.

There are no purely fibrous polypi of the bladder in the Museum.

Mucous polypi (myxomata). 2417a.—A bladder containing multiple mucous polypi. The organ is much hypertrophied and somewhat dilated. The trigone and the whole wall over an area which extends in all directions from the urethral orifice for the

distance of about an inch, is occupied by polypoid growths. The polypi are numerous, and their stalks are, in the majority of cases, slender. In many places the growths are compound, one stalk bearing several tumours. The growths vary in size ; some are no larger than a pea, and closely resemble the small hypertrophied synovial fringes met with in osteo-arthritis, whilst others are as large as the top of the finger or thumb. The two largest polypi (which are suspended below the preparation) were found loose in the bladder. On the left side of the bladder wall, and to a less extent upon its posterior surface, are some sessile growths which closely resemble the polypi. In the parts where the sessile growths are found the mucous membrane is ulcerated. The polypi on section are soft, fleshy, and gelatinous. Microscopical examination showed that they consist of myxomatous tissue, in which are numerous oval connective-tissue corpuscles. The muscular coat of the bladder is inflamed, but not ulcerated.

From a boy aged nine years, who had incontinence of urine for four months before his death, and who suffered great pain in his hypogastrium and loins. The pain was worse on defecation and when he passed his water voluntarily. It was also increased by exercise and jolting. The urine, which passed in a full stream, was very foetid, and contained albumen, urates, and pus. No stone was discovered on sounding, but a soft mass was felt in the region of the trigone. He passed blood in his water on only one occasion. At the autopsy, the kidneys were found to be much enlarged and the pelves and calyces were dilated. The glandular substance was dark red, with numerous patches of suppuration. The capsule was thickened and easily separated, whilst the ureters were dilated to the size of the little finger.

Villous or papillomatous growths.

These tumours, called villous from their appearance and papillomatous from their microscopic structure, are soft, flocculent, fringe-like bodies, resembling the villi of the chorion, attached by a narrow stem to the mucous membrane of the bladder. They are innocent, and must be distinguished from a villous form of epithelioma, which they greatly resemble, and with which they were formerly confounded. They consist of numerous branching processes composed of a basis of fibrous tissue supporting numerous

dilated and tortuous bloodvessels, and covered with layers of epithelium resembling those of the mucous membrane of the bladder. They seldom attain a large size, rarely exceeding that of a small chestnut, and are generally multiple, many smaller growths being scattered over the mucous membrane around the larger tumour. They are attended by slight but constant bleeding. Exhaustion from continual loss of blood is the common cause of death.

2417. — A bladder, with a uniformly enlarged prostate. The muscular coat of the bladder is hypertrophied. A soft, flocculent, and very vascular growth is attached by a narrow base to the mucous membrane at the lower and posterior part of the bladder immediately behind the orifice of the urethra. The morbid growth was the source of frequent and profuse hæmorrhage.

2418. — A bladder, with a soft and shreddy villous tumour growing from the mucous membrane near the centre of its posterior wall.

2421a. — Portions of a papillomatous growth removed from the bladder during life by an opening made through the abdominal walls. The growth, which was of about the size of a small walnut, was attached to the side of the bladder, a little above and behind the left ureter. Microscopically, the growth consists of branching processes of fibrous tissue covered by one or more layers of oval epithelial cells.

From a man aged forty-six, who had observed blood in his urine for five years before his death. The urine sometimes stopped whilst he was micturating. There was much pain after micturition and during defecation, as well as when pressure was made over the pubes. The patient died two days after the bladder was opened. At the autopsy the bladder was found to contain much blood. See also Nos. 2417b, and 2417c.

MALIGNANT DISEASE.

Sarcoma of the bladder.

Sarcomata are common in the urinary bladder, although they have hitherto been to a large extent overlooked or confounded for want of careful microscopical examination with the different varieties of carcinoma, or have been mistaken

for polypoid tumours. Sarcoma of the bladder appears to occur most commonly in patients under five and over fifty years of age ; in males more frequently than in females. The commonest position for the growth is the posterior wall of the bladder, near or between the orifices of the ureters. In children the tumours may be multiple or polypoid, and pedunculated or sessile ; whilst in adults the sarcoma is generally single and sessile. All varieties of sarcoma tissue are found.

2419a.—A bladder containing a large sarcomatous tumour. The organ has been laid open along its anterior wall, and its cavity is seen to be obliterated, except at its upper part, by a large new growth, which has infiltrated its anterior and lateral walls as well as the fundus. The portion of the growth which occupies the cavity of the bladder is a cauliflower-like and tuberos mass. By the extension of the growth posteriorly the rectum has become involved, and close to the anus the growth actually projects into the cavity of the bowel. The projecting portion, however, has broken down, and in this way a fistulous passage has been established between the bladder and rectum ; along it a rod has been passed. At the upper part of the specimen a portion of a catheter has been passed through a supra-pubic puncture which was made a fortnight before the death of the patient.

From a man aged fifty-four, who first suffered from hæmaturia eighteen months before his death. The sarcoma was partially removed by median lithotomy and dilatation of the prostate ; but as the tumour continued to grow and micturition was difficult and painful, the bladder was punctured above the pubes. See also **2419b.**

2428.—The bladder of a woman, with its cavity nearly filled by a large tumour which apparently originated within the coats of its posterior part. Portions of glass are passed into the ureters, which open on the front surface of the tumour. The tumour is pale, soft, and spongy. Microscopically it consists of round cells with little or no matrix. The growth infiltrates the vesical wall.

A section is preserved in **Series lv., No. 95dd.**

2429.—Sarcoma of the urinary bladder from a man aged fifty-seven, who had had symptoms of disease for about six months before death. Two large masses of disease are to be seen which affect the muscular as well as the mucous coat of the bladder,

whilst the lesser raised patches are limited to the mucous membrane, and even to its more superficial layers. Whether their mode of origin is by direct extension from the larger masses, or by transplantation of sarcoma cells from the surface of these upon different portions of the surface of the mucous membrane during an empty state of the bladder, is uncertain. Around the opening of the right ureter is a mass of sarcoma infiltrating the muscular coat. Microscopically the growth was found to be a mixed-celled sarcoma undergoing colloid degeneration.

2419.—A bladder laid open by a vertical incision through its anterior wall. A pedunculated growth is attached to its inner surface, stretching transversely across the fundus of the bladder immediately behind the aperture of the ureters. The mass is attached at either side, but free in the centre, and was so situated that it might lie over the urethral orifice or be propelled in that direction when attempts were made to void urine. Microscopically the tumour appears to be an alveolar sarcoma.

From a child who had suffered for eight weeks from extreme pain during micturition, frequently followed by severe pain in the abdomen. See also No. 2430.

Carcinoma of the bladder.

Cancer of the bladder may be a primary affection or an affection secondary to cancer of neighbouring tissues.

Primary cancer.—Primary cancer is generally epitheliomatous, rarely medullary, hardly ever scirrhus.

The epitheliomatous form appears as a warty or villous excrescence of the mucous membrane, having the usual characters of epitheliomata of other parts. It may occur in more than one spot in the same bladder. The villous appearance seems to be due to the fact that the masses of cells are discharged into the bladder during the process of ulceration, leaving the fibrous septa attached to the cancerous mass to float freely in the bladder, and must be distinguished, as has already been remarked, from the simple papilloma.

The medullary variety begins within the walls, and as it increases in size projects as a distinct tumour into the cavity of the bladder, which, in some instances, it may at length

almost or entirely fill. The surface of the cancer may be ragged and flocculent; it may be irregularly broken down by ulceration, or, again, it may be smooth but nodular.

All the forms of cancer spread to the neighbouring parts, and the medullary, as in other situations, affects distant organs.

Secondary cancer.—When extending from the uterus the cancer is commonly epitheliomatous or scirrhus; when from the prostate, medullary; and when from the rectum, adenoid or scirrhus.

Primary cancer.

Epithelioma. 2420a.—A bladder affected with epithelioma. The mucous membrane is everywhere thickened and ulcerated. There are deposits of phosphates about the trigone. The wound made during the operation of cystotomy is seen in front of the orifice of the urethra.

From a man aged sixty-two. Perineal section was performed upon the patient seven days before his death.

2426a.—A bladder which is symmetrically ulcerated in two places. The ulceration is situated upon either side of the trigone. There is also extensive ulceration at the upper and back of the bladder, where a small perforation has taken place into the peritoneal cavity. Through the perforation a glass rod has been passed.

From a man aged sixty, who had several attacks of hæmaturia during the years 1883 and 1884. From Christmas, 1885, until his death in August, 1886, the hæmaturia was constant but painless. At the post-mortem examination general peritonitis was found. There were no secondary growths or enlarged glands.

2426b.—The bladder and left kidney, showing an epithelioma of the bladder leading to occlusion of the ureter. The bladder is ulcerated over the whole extent of the trigone, and presents in this region a slightly raised epitheliomatous appearance. The left ureter is completely blocked for about half an inch by the extension of the growth into it, and as a result of this occlusion it is greatly distended, and was filled with thick creamy pus. The kidney is converted into a large sacculated cyst, the renal substance being completely absorbed. Microscopical examination of the

ulcerated portion of the bladder showed that it is infiltrated by a typical epithelioma. From a man aged forty-four, who had suffered for eighteen months from hæmaturia and difficulty in passing water.

2427.—The bladder of a man aged fifty-nine, on the lower portion of the anterior wall of which is a considerable growth of cancer. Portions of the disease project into the adjacent parts of the cavity. The prostatic portion of the urethra is distorted. The growth consists of numerous round and short oval cells, which are embedded in a matrix of fibrous tissue. The fibrillated surface is produced by the cell masses discharging into the bladder, leaving the fibrous septa to float freely.

Medullary cancer. 2423.—A bladder, exhibiting a general thickening of its coats and a large mass of soft medullary cancer attached to the mucous membrane of its posterior wall, just above the prostate. A sac, as large as the bladder itself, and filled by a similar medullary growth, communicates with the lower and posterior part of the bladder. This sac was situated between the muscular coat of the bladder and the peritoneum covering its posterior wall; one of the ureters terminates in it by an opening through which a quill is passed. A passage has been formed through the prostate by a silver catheter.

The man from whom the specimen was taken had had difficulty in passing urine and occasional retention for two years. In the last attack of retention the prostate as shown in this specimen was pierced; but the withdrawal of the urine did not reduce a swelling which could be felt above the pubes, and which was produced by the bladder pressed forward by the cyst full of medullary substance. It is uncertain whether this cyst be formed by dilatation of the ureter or by mucous membrane protruded from the bladder between its muscular fibres; the latter supposition is the more probable.

2420.—A bladder, in which there is a mass of soft, broken, medullary substance occupying the whole thickness of the coats of its fundus.

2424.—A bladder, half the cavity of which is filled by a broken, soft, and flocculent growth proceeding from its mucous membrane. The rest of its internal surface is superficially ulcerated.

2426.—The bladder of a man aged forty-five, who for two or three years before his death had suffered from hæmaturia and other symptoms of a foreign body in the bladder. The bladder is

laid open by a vertical incision through its front wall. This is much thickened and indurated; and springing from the region of the neck, and so extending as to involve the orifices of the ureters and urethra, is a large lobulated cancerous tumour which occupies a considerable portion of the cavity. The lower surface is ulcerated.

Scirrhus cancer. 2424a.—A urinary bladder whose walls and trigone are infiltrated with a dense growth, which is quite smooth on the surface and white on section. Similar growths infiltrated the fundus of the organ above the level of the ureters, and one large mass is situated immediately above the left ureter. The tissues were not shreddy or villous, and there were no enlarged glands. The bladder wall is hypertrophied. Microscopically the growth was found to be a scirrhus carcinoma.

From a man aged sixty-two years, who for twelve years had difficulty in passing his water. Twelve months before death his urine became foul, and he subsequently had very great pain in the region of his bladder, but until the post-mortem examination there was no reason to suspect the presence of a new growth.

HÆMATURIA RESULTING FROM BILHARZIA.

The *bilharzia hæmatobia* is a parasitic worm whose eggs are found in the submucous and unstriated muscular tissue of nearly all the organs of the body. The adult female worm (No. 2393d) is found in the portal vein. It appears to be endemic in Egypt.

2393b.—The urinary organs from a case of *bilharzia hæmatobia*. The bladder is contracted, and its mucous membrane is thickened by a number of papillomatous masses which are found microscopically to contain enormous numbers of *bilharzia* ova. The ureters are dilated and thickened. Their mucous membrane is covered with a slate-coloured membrane also containing large numbers of ova. The pelves of the kidney are lined with the same membrane and ova.

From an old Arab who came to the hospital at Alexandria suffering from dreadful and continuous pain, and passing almost pure blood mixed with enormous quantities of débris, containing the ova of *bilharzia*. Perineal lithotomy was performed in the

hope of relieving the pain, but the man died a week later. See also No. 2393c.

Microscopical sections of the bladder, showing the encysted ova, are preserved in **Series lv., No. 92f.**

CALCULUS IN THE BLADDER.

VARIETIES OF CALCULI.

The calculi most frequently met with in the bladder are the uric acid, the oxalate of lime, and the fusible or mixed phosphates. The rarer forms are the urate of ammonium, the cystic oxide or cystine, the phosphate of lime, the phosphate of ammonium and magnesium or triple phosphate, the carbonate of lime, the xanthic or uric oxide, the fibrinous, the blood, the uro-stealith, and the silicious. The seven latter are exceedingly rare.

Uric acid calculi.

Uric acid, or lithic acid, calculi, as they were formerly called, are usually small, but may attain a considerable size; they are oval, smooth, or finely granular, hard, give a clear, ringing sound when struck, are of a nut-brown colour, and laminated on section. The harder forms have a conchoidal fracture. The nucleus is usually composed of uric acid, sometimes of oxalate of lime, and is generally formed in the kidney by the aggregation of urinary deposits. They are most frequent in youth and middle age. See **Series lii. Nos. 2, 3, 5, 6** and many others.

Urate of ammonium calculi.

Urate of ammonium calculi are usually small, oval, smooth, earthy, brittle, of a pale fawn or clay colour, and homogeneous or indistinctly laminated on section; their fracture is earthy. They are less frequently met with than uric acid calculi on account of the greater solubility of urate of ammonium. They are most common in children. See **Series lii., Nos. 60 and 61.**

Oxalate of lime calculi.

Oxalate of lime, or mulberry calculi, as they are often called from their resemblance (when first removed, covered with blood, from the bladder) to a mulberry, are generally of moderate size, globular, uneven, tuberculated, of a reddish-brown colour, very hard, and crystalline on section. The nucleus is generally oxalate of lime, but it may be uric acid or urate of ammonium; it is usually formed in the kidney. Oxalate of lime calculi are most frequently met with in the middle periods of life. See **Nos. 37, 38a**, and many others.

Several varieties of oxalate of lime calculi are described. The following are contained in the Museum:

The hemp-seed calculus, so called by Dr. Wollaston, from its resemblance to a hemp-seed, is small, smooth, globular, and pale in colour.

Series lii., No. 38.—Section of a calculus of the kind commonly called "hemp-seed calculus;" nucleus uric acid, covered by a smooth layer of oxalate of lime.

The pure white oxalate of lime. **Series lii., No. 132.**—A calculus of oxalate of lime. Pure white oxalate of lime deposited upon brown oxalate of lime.

Phosphatic calculi.

Three forms of phosphatic calculi occur: (1) The phosphate of lime or earthy phosphate; (2) the phosphate of ammonium and magnesium, or triple phosphate; and (3) the phosphate of lime with phosphate of ammonium and magnesium, the mixed or fusible calculus. The first two are rare, the last is common.

1. *Phosphate of lime or earthy phosphate.*—Calculi composed of phosphate of lime uncombined with other salts are rare. The following specimen consists of thirty-one calculi of this description, which were removed from one bladder. **Series lii., No. 214**, is a calculus of pure phosphate of lime removed from the kidney, and **Series lii., Nos. 215 and 216**, are calculi composed of phosphate of lime combined with other salts.

Series lii., No. 170.—Thirty-one calculi removed from a Hindu peasant, aged thirty-five. They are composed of phosphate of lime.

2. *Phosphate of ammonium and magnesium (triple phosphate).*—Calculi composed entirely of the triple phosphates are rare; there are no specimens in the Museum. **Series lii., No. 174** is a calculus composed in great part of triple phosphates, probably deposited upon a nucleus of uric acid.

3. *Phosphate of lime with phosphate of ammonium and magnesium, the mixed or fusible calculus.*—The “mixed calculi,” consisting of phosphate of lime with phosphate of ammonium and magnesium, or fusible calculi as they are called, because they are readily fusible before the blowpipe, are by far the most common of the phosphatic calculi. They are especially the calculi of the later periods of life. They vary in shape and size, and are usually smooth, soft, friable, earthy, and laminated on section.

They are commonly formed in the bladder, their nucleus consisting of one of the other forms of calculi or of some foreign body other than a calculus, as a piece of catheter, a hair-pin, blood, fibrin, etc.

They are produced as follows:—The calculus or other foreign body causes irritation of the mucous membrane and consequently the secretion of mucus; the mucus, owing to its alkaline reaction, causes the resolution of urea contained in the urine into carbonate of ammonium, the carbonate of ammonium unites with the acid phosphates, and an insoluble mixed phosphate of ammonium, magnesium, and lime is thrown down and deposited upon the foreign body. See **Series lii., Nos. 175, 176, 178,** and several others.

Cystin or cystic oxide calculi.

The cystin or cystic oxide calculi are rare. They are usually globular, smooth, or smoothly tubercular, soft, semi-transparent, waxy-looking, yellowish-brown when recent, greenish-blue when preserved for some time, and not

laminated on section. They contain a large percentage of sulphur, and are of renal origin.

Series lii., No. 169a.—Section of a cystic oxide calculus recently removed, and showing a yellowish brown, waxy appearance.

Series lii., No. 168.—The half of a large cystic oxide calculus, with a nodular and apparently crystallized surface.

Series lii., No. 167.—The half of a large cystic oxide calculus. It is kidney-shaped, and its surface is beaded, and presents the usual waxy appearance. It is of a greenish-blue colour. It was removed from a girl aged seventeen.

Carbonate of lime calculi.

Carbonate of lime calculi are very rare. There are several calculi in the Museum containing small quantities of carbonate of lime (**Series lii., Nos. 185, 187, and 188**), but none composed chiefly of this salt, excepting one from the bladder of a horse (**Series lii., No. 238**).

Xanthic or uric oxide, blood, uro-stealith, fibrinous, and silicious calculi are very rare. There are no specimens in the Museum.

STRUCTURE OF CALCULI.

Although, as we have seen, calculi may be chiefly composed of one constituent, they are more often composed of several, which may be arranged in alternate layers around a nucleus (*alternating calculus*). The nucleus usually consists of uric acid, urate of ammonium, or oxalate of lime, in which cases it is commonly formed in the kidney by the aggregation of urinary deposits, becoming coated by the same or by other deposits upon its descent into the bladder. After the calculus has existed some time in the bladder it generally becomes encrusted by a layer of phosphates, as described under phosphatic stone, in consequence of the irritation of the mucous membrane. But the nucleus may consist of a foreign body introduced into the bladder, such as a portion of a gum-elastic catheter or of a bougie, or fibrin or blood, etc.; in such cases the calculus commonly consists of phosphates throughout. In rare instances no nucleus can be

discovered ; it is probable that in such cases the calculus was formed around some animal matter, such as blood or fibrin, which afterwards broke down, giving rise to the appearance of a cavity in the centre of the calculus. The formation of layers of different composition in a calculus is due to the varying state of the health of the patient and the condition of the mucous membrane of the bladder.

Calculi of various composition, in two layers.

Nucleus, uric acid. **Series lii., No. 32.**—Section of a calculus ; nucleus, uric acid, surrounded by a thin layer of urate of ammonium.

Series lii., No. 40.—Section of a calculus ; nucleus, uric acid, with a coating of the phosphates. See also **Series lii., Nos. 29 and 31.**

Nucleus, urate of ammonium. **Series lii., No. 69.**—Section of a calculus ; nucleus, urate of ammonium, outer portion nearly pure uric acid.

Series lii., No. 77. Calculi ; nucleus, urate of ammonium ; remainder, oxalate of lime and urate of ammonium in alternate layers.

Series lii., No. 85.—Calculus ; nucleus, urate of ammonium ; exterior fusible. See also **Series lii., No. 90.**

Nucleus, oxalate of lime. **Series lii., No. 137.**—Sections of a calculus ; nucleus, oxalate of lime, surrounded by uric acid. See also **Series lii., Nos. 135, 139, and 140.**

Series lii., No. 147.—Section of a calculus ; nucleus, oxalate of lime, with a crust of fusible calculus. See also **Series lii., Nos. 146, and 148.**

Series lii., No. 153.—Calculus ; nucleus, oxalate of lime, covered by crystals of phosphate of magnesium and ammonium (triple phosphate).

Series lii., No. 158a.—A large calculus ; nucleus, oxalate of lime ; the circumference, phosphate of lime, with small portions of urate of ammonium and carbonate of lime.

Calculi of various composition, in three layers.

Nucleus, uric acid. **Series lii., No. 53.**—Section of a large calculus ; nucleus, uric acid ; around it a thin layer of oxalate of lime ; the outer white layer, fusible phosphates. See also **Series lii., No. 54a.**

Series lii., No. 52.—Calculus ; nucleus, uric acid, surrounded by a

layer of uric acid, urate of ammonium, and earthy phosphates ; external layer, triple phosphates.

Nucleus, urate of ammonium. **Series lii., No. 95.**—Section of a calculus ; nucleus, urate of ammonium, surrounded by oxalate of lime nearly pure ; remainder, uric acid with a little oxalate of lime.

Series lii., No. 96.—Section of a calculus ; nucleus, urate of ammonium ; the greater portion of oxalate of lime coated by the fusible phosphates. See also **Series lii., Nos. 97, 98, 100.**

Nucleus, oxalate of lime. **Series lii., No. 159.**—Section of a calculus ; nucleus, oxalate of lime surrounded by impure uric acid, a thin layer of urate of ammonium with oxalate of lime coating the whole.

Calculi consisting of more than three various layers.

Series lii., No. 56.—Sections of a calculus ; nucleus, uric acid surrounded by a thin layer of oxalate of lime ; around this, uric acid nearly pure ; the remainder, uric acid and oxalate of lime in alternate layers.

Series lii., No. 111.—Section of a calculus ; nucleus, urate of ammonium with oxalate of lime, surrounded by oxalate of lime ; the remainder may be divided into three portions, the inner one consisting of phosphate of lime with phosphate of ammonium and magnesium, and a little carbonate of lime ; the middle, which is much harder in texture and more compact, of phosphate of lime and carbonate of lime ; and the outer of phosphate of ammonium and magnesium and phosphate of lime.

Nucleus formed of a foreign body introduced from without.

Series, lii., No. 189.—Parts of a gutta-percha bougie, about five inches in length, encrusted with deposits of urate of ammonium, ejected from a man's urinary bladder after being broken into several pieces by a lithotrite. When the bougie was being passed, twenty-seven days prior to its removal, it broke between four and five inches from the distal extremity, the fragment being left in the urethra. Its removal was at once attempted by cutting into the urethra through the perinæum, but a spasmodic action of the membranous portion ensued, and the whole fragment was drawn into the bladder. It there lay across the neck, where it was readily reached by the lithotrite, turned, and an unsuccessful effort made to withdraw it. It was subsequently broken into several pieces, portions removed between the blades of the instru-

ment, and the remainder expelled on two separate occasions with a violent rush of urine.

Series lii., No. 190.—Sections of a calculus; triple phosphate, with phosphate of lime deposited around a piece of the stilet of a catheter, which is bent into the form of a hook.

Series lii., No. 192.—Fusible calculous matter deposited around a piece of paper which had been passed into the urethra of a female.

Series lii., No. 194.—Portion of sealing wax which had been introduced into the bladder three years prior to its extraction, It is almost entirely encrusted with calculous matter.

2438.—Three pieces of indiarubber tubing found, thickly encrusted with phosphates, in the bladder of a man aged thirty-five, who was admitted into the hospital with symptoms of stone. He stated that a few months back he had fallen astride a board and struck the perinæum; that after the accident he passed bloody urine some days, and that ever since he had had much difficulty in holding his water, which was always thick. He persistently denied that an instrument had ever been passed into his bladder. Lithotomy was performed four times, as his bladder was thought to contain a soft calculus. He died from acute inflammation of the whole genito-urinary tract.

Series lii., No. 195.—A hairpin, which became the nucleus of a phosphatic calculus, removed from the bladder of a girl, aged seventeen. She had passed it into the bladder two months previously.

SHAPE OF CALCULI.

Calculi vary in shape according to their composition and the circumstances of their formation: thus, the uric acid and urate of ammonium are generally oval, the oxalate of lime globular; the phosphatic are generally oval or globular; but they may be of the same shape as their nucleus, or, when large variously moulded by the contraction of the muscular coats of the bladder upon them.

When several calculi are present in the same bladder they usually present smooth flattened surfaces, in consequence of the attrition of one calculus upon another.

When a calculus becomes lodged at the entrance to the prostatic portion of the urethra it often assumes a dumb-bell

shape in consequence of fresh depositions of phosphates upon the part projecting backwards into the bladder.

A calculus impacted in the ureter is generally elongated ; a calculus in the kidney is generally branched (see "Calculus in the Kidney").

The following specimens exhibit some of the irregular forms which calculi may assume.

Series lii., No. 22.—Calculi from a bladder. The two larger, chiefly composed of uric acid, were removed by the operation of lithotomy. The first was crushed in the extraction. The second, extracted entire, is in the shape of a three-sided pyramid, the base and sides of which are all smoothly flattened. The fragments of the first stone indicate that it may have had nearly the same shape. At the operation it was thought that such a shape would not be acquired unless more than two calculi were present, and subject to mutual contact and friction. Long search was, therefore, made for others ; but none existed except two minute rough portions which could have had no share in shaping the larger calculi that were extracted.

Series lii., No. 20.—Twenty-eight small calculi from the bladder of a gentleman sixty-eight years old. Their surfaces are smooth and flat.

Series lii., No. 178.—Twelve polyhedral calculi from the bladder.

Series lii., No. 175.—Sections of a calculus consisting of mixed phosphates ; the dark veins in it are probably due to urate of ammonium. The form of the calculus and the arrangement of its veins appear to indicate that it is composed of two calculi united at their borders.

2433.—A bladder and ureters. A small calculus is lodged in each ureter.

Series lii., No. 214.—Two lobed calculi from the kidney. Phosphate of lime with a large proportion of animal matter.

Series lii., No. 217.—A large lobed and branched calculus from a kidney. It is a fusible calculus coated with triple phosphates.

COLOUR OF CALCULI.

The colour of a calculus cannot always be depended upon as indicating its chemical composition.

As a rule, however, uric acid calculi are of a nut-brown colour (**Series lii., No. 10**), urate of ammonium of a pipe-clay

or ash-gray (**Series lii., Nos. 54a and 56**), oxalate of lime of a mahogany-brown (**Series lii., No. 122**), phosphatic white (**Series lii., No. 81**), cystic oxide yellowish-brown when fresh (**Series lii., No. 169a**), greenish-blue when preserved (**Series lii., Nos. 167 and 168**), carbonate of lime white (**Series lii., No. 238**), xanthic oxide, cinnamon-brown (no specimen).

SPONTANEOUS FRACTURE OF CALCULI.

Calculi sometimes undergo spontaneous fracture; this has been attributed, when there are several calculi in the bladder, to the calculi coming into violent collision with one another. When there is but one, it is supposed that the fracture of the stone may be due to the contraction of the hypertrophied muscular coat of the bladder, or to some chemical change taking place in the cement substance between the various layers; or perhaps to the infiltration of urine which causes the cement substance to swell and so disintegrate the calculus.

The edges of the fragments are generally smooth and rounded off by the action of the urine and the friction of the fragments upon one another.

Series lii., No. 198.—Calculi, broken into several portions, which were found after death in the bladder of an old man. They had broken spontaneously, and appear to have been parts of several large calculi. The edges of many of the fragments are rounded by mutual friction. They consist of uric acid with a few layers of urate of ammonium.

The patient was eighty-one years old, and had suffered for more than a year with signs of stone in the bladder. He would not allow an instrument to be passed; but on two occasions in the nine months previous to his death he obtained relief from the use of alkaline medicines.

Series lii., No. 199.—Fragments of calculi, chiefly impure uric acid. They were passed from the bladder of an old man, and appear to be portions of one or more calculi broken up spontaneously.

Series lii., No. 200.—Calculi, consisting of urate of ammonium and oxalate of lime in alternate layers, from the bladder of a boy

ten years old. The smaller portion was found loose in the bladder, and from the smoothness of its surface it may be presumed to have been spontaneously separated a considerable time before the operation from that part of the larger calculus in which an excavation is now visible.

SITUATION OF THE CALCULI.

The calculus is usually found immediately behind the prostate in the lower fundus of the bladder; but it may be situated in the upper fundus behind the pubes, or lodged in a cyst formed by a pouch-like dilatation of the coats of the bladder or by the protrusion of the mucous membrane between the fasciculi of the muscular coat, or impacted in one of the ureters at its entrance into the bladder, or adherent to the walls of the bladder. Calculous matter is frequently found encrusting morbid growths in the bladder or deposited upon the walls of the bladder when roughened by ulceration of its mucous membrane.

Free, behind prostate. 2432.—A bladder containing three large calculi situated in the lower fundus, immediately behind the prostate.

In some cases the lower fundus becomes converted into a deep recess behind the prostate by the dilatation of the coats of the bladder [No. 2837a]. A calculus lodged in such a recess may escape detection, as happened in the case of the man from whom the following specimen was taken.

Lodged in a deep recess immediately behind the prostate. 2398.—A bladder, with part of the urethra, of a man on whom the operation of lithotomy was performed. There were two calculi in the bladder, one of moderate size, which was broken by the instrument; the other, of larger size, was not detected by the instrument, being lodged in a deep recess formed by the dilatation of all the coats of the bladder at its lower and back part immediately behind the prostate. See also No. 2398b.

Encysted in a pouch formed by the dilatation of the coats. 2399.—Section of a dried bladder, of very large size, and with numerous cysts communicating with the posterior and lateral parts of its cavity. Within two of these cysts calculi are lodged. Fifteen calculi were found in the cavity of the bladder: those which are

arranged by the sides of the sections appear to be composed of uric acid. See also No. 2398a and No. 2433a.

Adherent to the walls of the bladder. Series lii., No. 119.—Section of an oxalate of lime calculus that was found at the operation for its removal attached by the end that is placed uppermost in the bottle to the lining membrane of the bladder.

Impacted in the ureters immediately before their entrance into the bladder. 2433.—A bladder and ureters. The ureters are dilated, and there is a small calculus in each just before its termination in the bladder.

Calculous matter deposited upon the roughened walls of the bladder. 2437.—The bladder of a girl thirteen years old. Its muscular coat is very thick, strong and fasciculated. Its mucous membrane also is thickened and corrugated, whilst the summits of many of the wrinkles are coated with grains of calculous matter.

Calculi impacted in the urethra in cases when there has been no stricture. 2433a.—The urinary organs of a patient who had numerous calculi. The left kidney contains a branched phosphatic calculus in its pelvis. The bladder is pouched, a glass rod being passed through the aperture of communication. The portion which is in direct connection with the urethra contains a uric acid calculus, whilst the pouch contains two smaller stones of the same nature. The prostatic urethra is blocked by a long round calculus, which appears to be moulded to its shape, consisting chiefly of urates and phosphates.

From a man aged twenty-four years, who for five years had difficulty in passing water. A catheter was first passed two years since. Admitted with retention of urine; a No. 7 silver catheter was passed. Death from uræmia.

Calculi impacted in the urethra behind a stricture. See Nos. 2879 and 2880, described under "Injuries and Diseases of the Penis and Urethra," p. 499.

EFFECTS OF CALCULI (OR OTHER FOREIGN BODIES) IN THE BLADDER.

The long-continued presence of a calculus or other foreign body in the bladder induces serious pathological changes in the urinary organs. Thus, the bladder generally becomes contracted, its mucous membrane thickened, inflamed or ulcerated, and its muscular coat hypertrophied; the ureters

become dilated, and their muscular coat hypertrophied; the pelves of the kidneys become dilated, often inflamed (*pyelitis*), and the kidneys become congested and inflamed, whilst their secreting structure becomes destroyed and excavated into a number of cysts.

2431.—A bladder containing a calculus, with the ureters and kidneys. The coats of the bladder are thickened, contracted, hypertrophied, and superficially ulcerated. The ureters, pelves and infundibula of the kidneys are widely dilated.

2432.—A bladder, exhibiting hypertrophy of its muscular coat, with enlargement of the prostate, and three large calculi nearly filling the lower half of its cavity, and resting on the enlarged prostate. The ureters open in the narrow interspaces between the calculi.

The walls of the bladder in some cases (as described under “Hypertrophy and Sacculation,” p. 551) become dilated into cysts in which foetid urine collects and in which other calculi are often formed (*encysted calculi*). See Nos. 2399 and 2433a.

Ulceration and perforation of the walls of the bladder may occasionally ensue and the calculus may then escape into the peritoneum, the vagina, the perineum, or into the rectum, as in the following specimen.

2433.—A bladder, contracted, indurated, and thickened, with ulceration extending through the middle of its posterior wall, and forming a passage from its cavity into the rectum. This passage is laid open for the purpose of showing a calculus which is lodged within it. The ureters are dilated, and there is a small calculus in each just before its termination in the bladder. The mucous membrane of the rectum is raised into thick and hard folds. The three calculi at the bottom of the bottle were found in the bladder.

CONGENITAL MALFORMATIONS OF THE BLADDER.

EXTROVERSION OF THE BLADDER.

Extroversion of the bladder (*ectopia vesicæ, congenital hiatus of the bladder*) is a congenital malformation in which the posterior wall of the bladder is exposed or protruded

through an aperture in the lower part of the anterior abdominal walls and front wall of the bladder, the result of the non-union of the ventral laminæ in that situation.

The deficiency in the walls of the abdomen and bladder generally reaches as high as the umbilicus, which, in such cases, is absent, and is generally associated with a like deficiency of the upper wall of the urethra, which then appears as little more than a groove along the dorsum of the penis, while the latter organ itself is usually shorter and smaller than natural. The mucous membrane of the bladder appears bright red and villous, and is apt to bleed in consequence of the chafing of the clothes. The orifices of the ureters, and the urine as it leaves them drop by drop, are visible. A rudimentary prostate, the anterior wall of which is deficient, is generally present, and upon its floor the opening of the common ejaculatory ducts may be seen. The symphysis of the pubis is often absent, the pubic bones being merely bound together by fibrous tissue, while the recti muscles diverge on each side of the bladder to their insertion into the separated pubic bones. The scrotum is generally cleft. The testicles may be found in the cleft scrotum, or they may remain undescended. A congenital scrotal hernia on one or both sides is common. On opening the abdomen the hypogastric artery can be traced over the back of the bladder to the situation of the umbilicus. The urachus is usually absent, or rather the bladder in these cases includes the urachus. The vesiculæ seminales and vasa deferentia are usually well formed.

3667.—The pelvis of a female infant, with the kidneys, exhibiting an extroversion of the urinary bladder. A small piece of glass rod is inserted into the mouth of each ureter. At a point corresponding to the orifice of the urethra are two duct-like apertures leading into a normal vagina, posterior to which a piece of blue glass is placed in a cul de sac which corresponds to the normal vaginal orifice; the uterus and ovaries are natural. The posterior wall of the bladder, and the openings of the ureters are bulged forwards; the kidneys are normal. During life the rectum was

prolapsed. Drawings of the case are preserved in **Series xxxviii.**, Nos. 15 and 16.

3104b.—A model in plaster of a pelvis, with wide separation of the symphysis pubis. The original was taken from a woman aged forty-four, who had ectopia vesicæ. [In the last case in the top gallery.]

3668.—A specimen of extroversion of the bladder, from a male child, aged eighteen months. An operation for its relief was performed some weeks before death; it failed, but the line of incision still remains. The portion of integument raised up on the left side of the bladder is much contracted.

Two black rods are placed in the ureters, two bristles in the vasa deferentia, and a third bristle in the sinus pocularis; there is no symphysis pubis, the two pubic bones being separated by an interval of an inch and a quarter. The recti muscles are separated by the bladder. Nevertheless the ossa innominata present a normal appearance, all the parts being present. The ilia, however, seem to be articulated at a more obtuse angle than usual with the sacrum. The obliterated hypogastric arteries can be seen crossing the pelvis. The umbilicus is well marked, but no distinct urachus was made out. The skin of the scrotum is left. The testes, which were normal in appearance and position, have been removed. The vesiculæ seminales are present, and of normal size. See also casts of congenital malformations in Nos. 91, 92, 93, and 94, and drawings in **Series xxxviii.**, No. 15a.

SECTION XVII.

DISEASES AND INJURIES OF THE GENITO- URINARY ORGANS—(*continued*).

INJURIES AND SURGICAL DISEASES OF THE KIDNEYS AND URETERS.

Rupture of the Kidney.

2394a.—A right kidney which has undergone extensive laceration upon its outer and anterior surface. From a patient who was brought into the hospital dead

2394b.—A section of a kidney which has a laceration extending from the hilum for a distance of an inch and a half into the cortex. The rupture is simple and linear in character, its edges are united at the upper part by blood clots, whilst the whole is covered with a thick layer of condensed fat.

From a man aged twenty-seven, who fell a distance of twenty-six feet. He survived the accident for eighteen days, during which he made no complaint of abdominal pain. On admission his urine contained a little blood, but three days after the accident it was acid, and had a specific gravity of 1020, containing neither sugar, albumin, nor blood.

SURGICAL DISEASES OF THE KIDNEYS.

CALCULUS IN THE KIDNEY.

Renal calculi generally consist of uric acid or of oxalate of lime. They may pass down the ureter into the bladder, forming the nucleus of a vesical calculus, or they may

remain in the kidney and gradually increase in size. In the latter case they may be found in the glandular substance or in the pelvis of the organ. They may be single or multiple, rounded or branched. The kidney may be hardly affected by their presence, or it may become inflamed, leading to pyelitis or suppurative nephritis, see p. 584. The oxalate of lime, or *mulberry* calculi as they are often called from their irregular shape, appear to cause the greatest amount of renal irritation. In many cases the calculi become impacted in the ureter.

2345.—A kidney, the pelvis and infundibula of which are dilated and filled with calculi. One large calculus fills the pelvis, and branches from it are continued into many of the infundibula. Smaller calculi fill the other infundibula. The glandular substance of the kidney is nearly absorbed.

2358.—A kidney, with a large calculus impacted in the commencement of the ureter. The kidney is much increased in size, and its substance appears indurated, and in parts infiltrated with pus. The pelvis and infundibula are greatly dilated, and their mucous membrane is thickened and made rough by the copious deposit of inflammatory material upon its surface. See also Nos. 2345a, 2345b, and 2346.

Lodgment of a calculus at the commencement of the ureter. Ulceration extending from the pelvis of the kidney into the colon. 2355.—A kidney, which is much enlarged in consequence of the lodgment of a calculus at the commencement of the ureter. The infundibula are dilated; their mucous lining and the proper substance of the organ are indurated, and appear to be the seat of purulent deposits. Portions of glass are introduced through the ulcerated apertures leading directly from the kidney to the descending colon. The portion of the colon which thus communicates with the interior of the kidney exhibits numerous small ulcers of its mucous membrane. The capsule of the kidney, a part of which is reflected, is thickened, indurated, and consolidated with the surrounding tissues.

The patient was a young man who had suffered from attacks of pain in the loins, which were always relieved by discharges of pus from the rectum. A quantity of pus was found also to have passed from the lower part of the kidney to the back of the psoas muscle.

2344a.—A kidney having a good-sized rough calculus embedded in its cortex. The substance of the kidney does not appear to be inflamed, and except in the immediate neighbourhood of the stone, where the parenchyma has been absorbed by pressure, the gland is uninjured. The calculus does not seem to have given rise to any symptoms during life.

2351.—A kidney, in the pelvis of which are large and irregular calculi. The inflammation and suppuration which ensued were followed by adhesion of the kidney to the adjacent portion of the descending colon, and the discharge of the contents of the pelvis into the intestinal canal through an ulcer.

2358a.—The right kidney in a condition of acute inflammation, resulting from the presence of calculi in its substance and the obstruction of its duct by the impaction of a calculus. The organ is greatly dilated, so that it forms a lobulated cyst; and its parenchyma has undergone absorption until there remains only a thin tough coating of the consistence of leather. In the fresh state the interior of the cyst was of a bright inflammatory colour, spotted with flakes of pus, and it still appears shaggy from the deposit of lymph upon its inner surface. The calculus, blocking up the ureter near its commencement, is oval and dark-coloured. Several small dark-coloured calculi of oxalate of lime lay in the infundibula of the kidney.

From a woman aged thirty-one, who suffered long-standing and severe pain of a wearing character in the right side, which she dated from her last confinement, two years previously. She never had any attack of renal colic, hæmaturia, or vesical irritability. A swelling below the liver, noticed for six months, gradually increased until it was as large as a foetal head. The urine contained pus. An exploratory puncture into the tumour let out thick greenish pus. Nephrectomy was performed, and the patient made a good recovery.

A drawing is preserved in **Series lvii., No. 324a.**

Blocking up the pelvis of the kidney with soft calculous material.

2337.—Section of a kidney, in which nearly the whole of the glandular structure is absorbed. In its place, and in the pelvis and ureter, there is a soft and white substance like mortar, consisting of phosphate of lime, with small proportions of carbonate of lime, and of animal matter. From a woman, sixty-two years old, who for twelve years before her death had no sign of renal disease.

Renal calculi.

Series lii., 210.—A renal calculus taken from the body of a middle-aged lady. The calculus consists of pure oxalate of lime of the crystalline and dumb-bell varieties.

Series lii., 213.—A renal calculus, composed of cystic oxide, from a man. The bright shining particles on its surface consist of small flakes of cholesterin. See also **Series lii., Nos. 201 to 218.**

209.—An oxalate of lime calculus removed by the operation of nephro-lithotomy. It presents the extremely rough and spiculated surface characteristic of such calculi. The specimen is interesting, as it was the first calculus successfully removed in the hospital by this operation.

Series lii., No. 212.—Renal calculi from a man aged thirty-eight years. In the right kidney were (1) the great calculus, which weighs no less than $36\frac{1}{2}$ ounces; (2) about a thousand smaller calculi, weighing together nearly three ounces; (3) a large quantity of calculous dust. In the left kidney were (1) a large calculus, weighing $9\frac{3}{4}$ ounces; (2) a quantity of calculous dust. The stones and gravel consisted chiefly of the phosphate of magnesium and ammonium. The patient was gouty, and from childhood had been liable to attacks of pain in the right loin. Five months before his death the pain in the right loin became continual. He died suddenly, but his death was not preceded by any symptoms of suppression of urine. The kidneys from this case are preserved in **Series xxviii., No. 2349**; they are entirely converted into cyst-like sacs.

HYDRONEPHROSIS.

Hydronephrosis is that condition of the kidneys in which the pelvis and calyces become distended with urine. The distension may be so great as to lead to absorption of the glandular substance, and the consequent conversion of the organ into a mere membranous sac. Hydronephrosis may be produced by anything which prevents the free outflow of urine, such as impaction of a calculus in the ureter, enlarged prostate, stricture of the urethra, or, even, simple phimosis.

2347b.—A dilated, sacculated kidney. The orifice of the ureter is entirely occluded by a stone about the size of a small bean. The calyces are destroyed, and only a very thin piece of the cortex remains.

2357.—A large sac caused by dilatation of the pelvis of a kidney, in consequence of the impaction of a calculus in the ureter. It formed a movable abdominal tumour, the nature of which was doubtful during life.

2364.—The kidneys from a girl aged fourteen years. The left kidney shows an advanced condition of hydronephrosis; the pelvis is distended and the parenchyma of the organ is destroyed, with the exception of a few flattened disc-like portions. The pelvis of the right kidney is also dilated, but the parenchyma appears to be increased in quantity, and is swollen, pale, and opaque. The right ureter is dilated to the size of a quill; the left ureter is not dilated. On passing a probe along the ureters in either direction it was evident that there was a decided constriction at a point half an inch distant from the bladder; the constriction was more marked in the left than in the right canal. When laid open the right ureter presented nothing definite at the point noted, but in the left ureter the constriction was marked by a very narrow whitish line. The bladder and urethra were quite natural. The liquid taken from the kidneys was of a pale brown colour, specific gravity 1012, with a faint trace of albumin and flocculent sediment—no doubt dilute urine.

2373a.—Kidneys, bladder, and portion of the rectum of a child. The pelvis and calyces of the right kidney are dilated, and considerable absorption of the glandular substance has taken place. The left kidney is less altered. The ureters are dilated and pervious. The bladder does not appear to be thickened.

From an infant aged fourteen days, who had an imperforate anus. At the autopsy the sigmoid flexure was found to be much distended; it turned across the sacrum to the right side, and ended in a blind dilated rectum. The bladder contained a drachm of healthy urine. The dilated condition of the kidneys may have been due to the distended and abnormal sigmoid flexure impeding the flow of urine along the ureters.

2370.—The bladder, kidneys, and ureters of a boy thirteen years old. The bladder is contracted, its muscular coat hypertrophied, and its mucous coat ulcerated. The ureters are very tortuous, widely dilated and thickened. The mucous membrane of each is rough, and lymph and pus are in some parts deposited upon it. The kidneys appear enlarged by the dilatation of their pelves and infundibula, which are thickened and rough on their internal surfaces. The glandular substance is thinned. The patient had

phimosis, and had suffered for four years with incontinence of urine. There was no calculus.

2369a.—A portion of the bladder with the right kidney and ureter. The kidney is little more than a membranous sac, owing to the entire absorption of its glandular substance. The pelvis is greatly dilated, and opens by two apertures into a distended double ureter. The ureters run separately in the first half of their course, and then fuse into a single dilated tube. The muscular wall of the bladder is somewhat hypertrophied.

From a man aged forty-seven, who was admitted with extravasation of urine resulting from a stricture of the urethra which had existed for several years.

NEPHRITIS.

Nephritis, or inflammation of the kidney, as it comes under the notice of the surgeon, is usually the result of long standing disease of the bladder, urethra, or prostate, or of irritation consequent upon the presence of a renal calculus in the kidney or in the ureter. When the inflammation is caused by an obstruction to the outflow of urine, as in long-standing stricture, the fibrous structure of the cortical and medullary substance of the gland becomes inflamed, and *interstitial nephritis* takes place. When the pent-up secretion is septic there is either suppuration of the lining membrane of the pelvis—*pyelitis*—or of the glandular substance—*suppurative nephritis*; or, as is more usually the case, the inflammation attacks all the substance, leading to *pyelonephritis*. If the pelvis and calyces become distended with pus, the kidney is converted into a suppurating cyst—*pyonephrosis*.

Suppurative Nephritis.

Suppurative nephritis is either acute or chronic. The chronic form or pyonephrosis is that condition in which suppuration of the renal substance has taken place. It is usually caused by the spread of inflammation along the urinary tract, or from the irritation of the kidney, caused by a calculus in its substance. In some cases the suppuration

is acute and assumes a diffuse form. This condition is liable to occur in the course of long-standing disease of the bladder and urethra, which has resulted in the septic decomposition of the urine. In these cases the glands are enlarged, and their surfaces are mottled, the capsule is readily peeled off, and small abscesses may be seen in the cortex. On making a section into the organ the pelvis and calyces are found to be dilated, and filled with purulent urine. Diffuse abscesses extend through the cortex.

Pyonephrosis resulting from Stricture of the Urethra. 2368.—The urinary organs, showing the effect of stricture. There is firm fibrous stricture in the membranous portion of the urethra. The bladder is slightly dilated, and its walls are much thickened. The ureters are largely and irregularly dilated. The pelvis and calyces of the kidney are dilated, and the parenchyma of the organs is atrophied. These changes are much more advanced in the left kidney. There are two ureters on the left side, one of which communicates with the upper and the other with the lower half of the pelvis of the kidney, each conducting away the urine from corresponding parts of the organ. They unite at their vesical extremities to form a single duct. From a boy aged fifteen years, who had long suffered from symptoms of stricture, due to an injury eight years before his admission to the hospital. Death took place from suppurative nephritis and acute cystitis.

Pyonephrosis due to the presence of the ova of Bilharzia hæmatobia. 2393c.—The kidneys, with the bladder and ureters, from a case of bilharzia hæmatobia. The bladder is small and contracted, whilst its mucous membrane is raised into numerous soft swellings which contain innumerable quantities of bilharzia ova. The ureters are dilated, and their mucous surface is studded with small soft projections which are also full of ova. The kidneys are also in a condition of pyonephrosis; their mucous membrane and pelves are covered with small granulations, each containing many ova. From a country Arab who was admitted into the hospital at Alexandria. He was passing bloody urine mixed with débris, which swarmed with bilharzia ova. He died from chronic uræmia.

Pyonephrosis from extension of inflammation. 2338b.—The bladder and left kidney from a patient who fractured his spine at the junction of the fourth and fifth dorsal vertebræ five months before death. The bladder is considerably hypertrophied, and its

mucous membrane is ulcerated. The ureters are dilated. The kidney is inflamed, and contains numerous small abscesses scattered throughout the cortex and pyramids.

From a man aged fifty-four. The patient fell sixteen feet from a scaffold across a wall. On admission he was sensible, but had total anæsthesia and akinesia in his lower limbs and in his trunk to the level of the sixth rib. Two months after the accident he had complete atony of the bladder and rectum.

See also "Tubercular Disease of the Kidney," page 587.

Pyonephrosis due to the irritation of a renal calculus. 2372e. —A kidney removed by the operation of nephrectomy, on account of the injury which it had sustained from the presence of a calculus. The organ is slightly enlarged, its pelvis is distended, and it is covered with a layer of flocculent lymph. The medullary portion has undergone very considerable absorption, the pyramids being converted into abscess cavities; this is more especially the case at the upper border of the kidney. The capsule is partially adherent. The ureter, dilated at its upper part, is constricted and thickened below.

From a patient aged thirty-one, who had suffered from symptoms of renal calculus for six years. During the latter part of this period she had profuse pyelitis with high temperature. After removal of the kidney she made a good recovery. Dr. Ord gives the following description of the stone which the kidney contained: The calculus is somewhat heart-shaped. It weighs 12 grains. Its colour is yellowish brown in parts, and dark gray in others. The surface is tubercular, and under a low magnifying power has very much the appearance presented by brown sugar, the semi-transparent nodules of which are covered in some parts by a deposit resembling a layer of the same crystals wetted. The calculus consisted of oxalate of lime, of phosphates, and of uric acid, with possibly a small intermixture of carbonate of lime. See also Nos. 2355a and 2358b.

Acute pyonephrosis. 2371a.—A "surgical kidney." It is rather smaller than natural; its surface is irregular, and in parts torn where the capsule was adherent; the pelvis and calyces are slightly dilated, and the mucous membrane lining them is discoloured and thickened. The gland as a whole is softened, and scattered throughout its substance, but more particularly in the cortical portions, are numerous abscesses, varying in size from a pin's head to a hazel nut.

From an old man who died a few days after lithotomy had been performed. The middle lobe of the prostate was enlarged, the mucous membrane of the bladder showed signs of recent and old inflammations, and the opposite kidney was in a similar condition to the present specimen. Neither of the ureters was much dilated, but the mucous membrane of both showed signs of old inflammation.

Chronic Interstitial Nephritis.

Chronic inflammation of the fibrous tissue of the kidneys may result from any source of chronic renal irritation, such as an obstruction to the flow of urine, and in these instances it is somewhat badly termed "chronic surgical kidney." In such a case the kidney does not differ in any respect from the ordinary small red kidney of Bright, for the organ is hard and smaller than usual, its capsule separates with difficulty, the cortex is irregular, puckered, and may contain cysts, whilst the glandular substance is atrophied.

2369.—The right kidney, showing a dilatation of the pelvis and ureter. The kidney is atrophied, indurated from increase of its interstitial substance, and contains cysts. It was taken from a man who had long suffered from enlarged prostate and difficulty in micturition. Death took place from extravasation of urine. Several false passages were formed at the vesical orifice of the urethra. See also No. 2371.

TUBERCULAR DISEASE OF THE KIDNEY.

Tubercular disease of the kidneys either occurs in the course of general tuberculosis or is secondary to disease of the testis, bladder or prostate. In it the pelves and calyces are chiefly affected, and two different terminations may result.

(a.) The outflow of urine may be obstructed on account of the swelling of the mucous membrane. The pelves and calyces are consequently distended, and suppuration ensues, the patient dying from exhaustion.

(b.) The inflammation may subside, and the inflammatory products may caseate.

In either case the patient usually dies of exhaustion.

2340.—A kidney, in which there are many large cavities, formed in consequence of abundant tubercular deposits in its substance. The cavities are lined by layers of false membrane, coated by tubercular matter. The ureter is thickened, and tubercular matter covers its internal surface. There are tubercles in the lungs and several other organs, including the prostate gland and vesiculæ seminales, which are preserved in No. 2847.

2338a.—A kidney enlarged and in an advanced condition of pyonephrosis. The cavities were filled with inspissated pus of the consistency of cream-cheese.

2341a.—A tuberculous kidney from a child who died of phthisis. The organ is much enlarged and its papillæ are partly destroyed. In the cortex are many abscess-cavities, each lined with a thick, white, pyogenic membrane, and not communicating with the pelvis of the organ. The ureter is much thickened and dilated; its mucous membrane is almost entirely removed, and on its inner surface are many tubercular ulcers. The mucous membrane of the bladder is the seat of a similar ulceration, which in this situation seems to be of more recent date. In the left kidney there was one large patch of tubercle; otherwise it was of normal size. See also No. 2341c.

2341b.—The left kidney from a case of tuberculosis of the genito-urinary tract. The organ is slightly enlarged, and is occupied by numerous abscesses, of which the largest is situated at the upper part of the kidney. In the recent state these abscesses were filled with inspissated pus. The ureter is enlarged and thickened, its mucous surface being much ulcerated. From a man aged forty-eight, who suffered for two years before his death from symptoms of tubercular disease of the genito-urinary tract. After eighteen months he presented symptoms of general tuberculosis. At the autopsy the lungs were found to be a mass of tubercle.

The bladder, prostate, and testes are preserved in Series xxix., No. 2412d.

MALIGNANT GROWTHS IN THE KIDNEY.

Sarcomata.

Sarcoma of the kidney occurs chiefly in children. It is usually spindle-celled. In some cases it is congenital, and the tumours have then been found to contain striated muscle.

There is only one specimen of sarcoma of the kidney in the Museum.

Striped myo-sarcoma of the kidney. 3293a.—Section of a tumour composed of striped muscle and round-cell tissue, removed from the right lumbar region. It is seven inches and a half long, and four inches and a half wide, of uniformly firm consistence, and yellowish-white colour. Its section presents the appearance of interlacing fasciculi of fibrous tissue, and in places small cysts are cut across. In the upper part of the bottle is suspended the right kidney, with which the tumour was in contact. The organ appears healthy, but presents on its anterior surface a concavity, over which the parenchyma is exposed, apparently by the pressure of the tumour. In histological structure the tumour consists of striped muscle-fibre, for the most part arranged in fasciculi, and nodules of round-cell tissue are scattered throughout it. The individual muscle fibres are long, very narrow, distinctly striated, but the sarcolemma is indistinguishable.

The specimen was taken from the body of a child, aged fifteen months, who came under treatment for a swelling in the right flank, which was soft, semi-fluctuating, and about the size of a hen's egg. This tumour grew rapidly, and its increase in size was attended with loss of strength and disturbance of the digestive organs, until at last the respiratory apparatus was encroached upon. Death took place from collapse.

Carcinomata.

Carcinoma of the kidney is usually of the medullary variety, but a few cases of epithelioma have been recorded.

Medullary cancer. 2390a.—A cancerous growth in the right kidney. The new tissue has infiltrated the whole of the organ, which is enlarged to the size of a fist. The glandular substance has almost entirely disappeared, except for traces of the calyces. In the pelvis was a ragged calculus about half an inch in length. The new growth, when examined by the microscope, was found to be a carcinoma with a very large fibrous stroma. From a woman aged forty-eight. There were cancerous deposits in the liver and lungs.

2390b.—A section of a large and soft cancerous mass involving the right kidney. The organ retains somewhat of its outline, but it is greatly enlarged. When fresh it measured nine inches in length, four inches in width, and three inches in thickness. In places the surface is nodular. The tumour is almost pulpy in consistency; it is contained within the capsule of the kidney, and

involves about a third of the lower portion of the organ. The ureter opens into a sort of cavity formed by the breaking down of the tumour. Microscopically the growth is a carcinoma, the constituent cells exactly resembling those in the renal tubes. The matrix is alveolar.

From a patient aged forty-nine, who had suffered for a year from hæmaturia with a gnawing pain in the right lumbar and inguinal regions. An exploratory operation was performed, but it was deemed unadvisable to remove the tumour. The patient died a fortnight later.

Colloid carcinoma. 2390c.—A section through a kidney infiltrated with a carcinoma which is undergoing colloid degeneration. The growth extends as a pyramidal mass through the whole thickness of the organ from the capsule to calyx.

Epithelioma. 2392a.—A kidney from a patient upon whom the operation of nephro-lithotomy was performed eight days before death. The organ has become converted into an irregular mass in which are many cavities of various sizes. The largest cavity opened into the operation wound. The cavities contained pus and some small calculi. The whole cortex of the gland is occupied by a mass of new growth, which was found upon examination to be of an epitheliomatous nature. The ureter was entirely compressed by the new growth.

From a woman aged sixty-three, who first noticed a swelling in the left lumbar region five months before admission to the hospital. Hæmaturia was observed on a single occasion four years previously. During the last year of her life the patient had been troubled with frequent micturition, but the amount of urine passed was exceedingly small. At the operation a large branched calculus was found occupying the pelvis of the kidney. This calculus was removed piecemeal; it consisted of uric acid encrusted with phosphates. At the autopsy the right kidney was found to be of twice the normal size, and fatty. The ureter was dilated and pervious; it contained urine.

The calculus is preserved in Series lii., No. 46c.

OPERATIONS UPON THE KIDNEY.

Many of the more ordinary operations performed upon the kidney are illustrated by preparations in the Museum.

Nephrotomy consists in making an incision through the

cortex of the kidney for the purpose of evacuating pus or other fluid which it may contain, or for purposes of exploration to detect the presence of a tumour or renal calculus. It is thus a preliminary to the more severe operation of nephrectomy.

2358b.—The right kidney, which is sacculated and distended to about twice its natural size. A sinus in the groin led into the pelvis of the organ. The greater part of the renal tissue is absorbed. A calculus, which sent its branches a short distance up the calyces, was firmly wedged into the ureter and pelvis, which it completely occluded. From a girl aged twenty, who suffered from pyonephrosis. An incision was made into the kidney, and the patient died six months later from chronic pyæmia. See also No. 2372c.

Nephro-lithotomy consists in exposing the kidney through a lumbar or lateral incision, cutting through the glandular portion of its substance and removing a renal calculus.

2392b.—The left kidney from a patient upon whom nephro-lithotomy had been unsuccessfully performed fifty hours before death. The operation wound is seen as a slit in the pelvis of the organ. Two small calculi lie in the uppermost calyx, the one smooth and oval, and the other spiculated. The pelvic portion of the ureter is considerably dilated. The greater part of the kidney appears to be healthy. From a boy aged fifteen years, who had suffered from several attacks of renal colic during a period of ten years. A calculus was felt in the pelvis of the kidney after laparotomy had been performed on the left side, but it could not be detected when an incision into the kidney was made through the lumbar region. Death occurred from shock. The right kidney was healthy.

Series lii., No. 209a.—A calculus removed from the kidney by the operation of nephro-lithotomy. It measures $1\frac{1}{2}$ inches in length, and weighs 68 grains. Chemical examination shows that it consists of urate of ammonium. The calculus is faceted at one extremity, and has evidently been formed in one of the calyces of the kidney. See also Series lii., No. 209, which is one of the first calculi removed in England by the operation of nephro-lithotomy.

Nephrectomy consists in the complete removal of the kidney either as a whole or in parts. The operation is

performed when a renal calculus has disorganized the gland; when tubercular disease has attacked one kidney and rendered it useless; for the extirpation of malignant disease which has been detected sufficiently early; for the relief of floating kidneys, and for other conditions.

2372d.—A kidney removed by the operation of nephrectomy for disorganization of its substance, as a result of a large branched renal calculus which occupied the pelvis. The kidney is seen to be little more than a series of thin-walled cysts. The stone consisted chiefly of phosphates. From a woman aged forty-one, who had noticed a swelling in the right flank for seven months. The urine was thick and creamy when passed, but there had never been any severe pain, nor was there hæmaturia. After removal the patient made a good recovery. The calculus is preserved in **Series lii., No. 52d.**

2338a.—A kidney enlarged and in an advanced condition of pyonephrosis. The cavities were filled with inspissated pus of the consistency of cream-cheese.

The organ was removed from a young woman who did not long survive the shock of the operation.

2372c.—Portions of kidney removed by the operation of lumbar nephrectomy. Very little of the glandular substance is to be seen, the specimen consisting chiefly of the cortical substance dilated into cysts of irregular size and shape.

From a boy aged seventeen years, on whom the operation of nephrotomy had been performed one year and nine months previously on account of continued pain in the left loin, associated with pus in the urine. For more than a year after this he was much relieved from his previous symptoms, but for some months previous to the removal of the kidney he had suffered from a more profuse discharge from the nephrotomy wound and steadily increasing hectic. The kidney was rather closely adherent to the surrounding structures. The patient made a good recovery. Microscopical examination revealed dilatation of the tubules, and an increase of the intertubular connective-tissue.

2358a.—The right kidney in a condition of acute inflammation (*pyonephrosis*), resulting from the presence of calculi in its substance and the obstruction of the ureter by the impaction of a calculus. The organ is greatly dilated, so that it forms a lobular cyst; and its parenchyma has undergone absorption until

there remains only a thin tough coating of the consistence of leather. In the fresh state the interior of the cyst was of a bright inflammatory colour, spotted with flakes of pus, and it still appears shaggy from the deposit of lymph upon its inner surface. The calculus, blocking up the ureter near its commencement, is oval and dark-coloured. Several small dark-coloured calculi of oxalate of lime lay in the infundibula of the kidney.

From a woman aged thirty-one, who suffered long-standing and severe pain of a wearing character in the right side, which she dated from her last confinement, two years previously. She never had any attack of renal colic, hæmaturia, or vesical irritability. A swelling below the liver, noticed for six months, gradually increased until it was as large as a foetal head. The urine contained pus. An exploratory puncture into the tumour let out thick greenish pus. Nephrectomy was performed, and the patient made a good recovery.

A drawing is preserved in **Series lvii., No. 324a.** See also **Nos. 2372a, 2372e.**

DISEASES OF THE URETERS.

The ureters are subject to inflammations of various kinds, which may lead to stricture; and to the extension of malignant disease, which may block their vesical orifices. They may become dilated from obstruction to the outflow of urine, or they may present certain congenital malformations.

2354a. — A large mass of fat, formed round a ureter which contained a calculus. The adjacent tissues were thickened by chronic inflammation.

Stricture of the Ureters.

2372b. — The ureter and bladder from the same patient as specimen **No. 2372a.** The upper portion of the former is enormously hypertrophied and dilated, and the surrounding tissues are matted together by inflammation. About an inch and a half above the bladder the ureter becomes greatly narrowed, so that its calibre before the tube was laid open barely admitted a small probe. The cause of the stricture is not evident.

Congenital Stricture of the Ureters.

2361a. — The kidneys, ureters and bladder. The kidneys are enlarged and sacculated, and their pelves are dilated. The right

ureter immediately beyond the pelvis of the kidney presents a very tight and tortuous stricture about an inch in length. The stricture is so tight that it was barely possible to inject water through it. Two inches lower down this ureter is again constricted, but the second stricture is not so narrow, and is annular in form. The left ureter is also constricted in two places, about two inches apart. The upper stricture is situated two inches from the kidney, and the ureter above it is dilated into a pouch. The strictures will admit of the passage of a No. 7 catheter. All the strictures are tough and fibrous, and appear to be of long standing. The bladder is very much hypertrophied.

From a man aged forty-four, upon whom urethrotomy was performed for the relief of an impassable stricture of the urethra.

Dilatation of the Ureters.

2355a.—The right kidney from a case in which suppurative nephritis occurred in both organs, owing to the presence of calculi. The kidney is enlarged to three times its normal size. The glandular portion is converted into a number of cysts, whilst the pelvis is completely obliterated by a dense growth, which is found on microscopic examination to consist of inflamed fat and fibrous tissue. A small oblong calculus of uric acid completely blocks the upper part of the ureter. The ureter near the kidney is constricted, but as it passes downwards it gradually dilates, until it attains nearly four times its natural diameter. The left kidney is preserved as specimen No. 2345b.

2367.—The bladder and a portion of the ureters from a case of long-standing stricture of the urethra. The specimen shows the ordinary effects of urinary obstruction, as well as an unusual prolapsed condition of the vesical end of both ureters into the bladder, with extreme hypertrophy and dilatation of the tubes themselves. Their vesical orifices are reduced to pin-hole apertures. The prolapsed pouch of the right ureter contains a calculus. On the posterior wall of the bladder a sacculus of mucous membrane is thrust out between the muscular fibres. The prolapse of the ureters seems to be due to the disproportionate size between the ureters themselves and their vesical orifices, as if, in the efforts to micturate, the urine being unable to escape freely from the bladder and distended ureters, the abdominal walls had compressed and borne down the ureters themselves.

2369a.—A portion of the bladder with the right kidney and

ureter. The kidney is little more than a membranous sac, owing to the entire absorption of its glandular substance. The pelvis is greatly dilated, and opens by two apertures into a distended double ureter. The ureters run separately in the first half of their course, and then fuse into a single dilated tube. The muscular wall of the bladder is somewhat hypertrophied. From a man aged forty-seven, who was admitted with extravasation of urine resulting from a stricture of the urethra, which had existed for several years. See also No. 2370a.

Tubercular ulceration of the Ureters.

2341a.—A tuberculous kidney from a child who died of phthisis. The ureter is much thickened and dilated; its mucous membrane is almost entirely removed, and on its inner surface are many tubercular ulcers. The mucous membrane of the bladder is the seat of a similar ulceration, which in this situation seems to be of more recent date.

2412a.—A bladder and ureter in an early stage of tuberculous disease. The bladder, which is inverted, presents numerous small papillæ (miliary tubercles) especially numerous near the orifices of the ureters. In other places the papillæ are ulcerated at their apices. There are several ulcers on the mucous membrane of the ureter, the inner surface of which is also rough and thickened.

2412b.—The urinary organs of a child, aged nine years, in an advanced stage of tuberculous disease. The mucous membrane of the bladder is rough and thickened, it has lost its natural polish, and is thickly set with small circular ulcers. The ulceration has in many places been succeeded by caseous degeneration, and close to the orifice of the left ureter the mucous membrane has been extensively destroyed. The kidney contains several large caseating masses, which are mostly situated in the neighbourhood of the pyramids, the cortical portion of the gland being nearly free. The right ureter, which is laid open, presents several ulcers similar to those found in the bladder.

SECTION XVIII.

DISEASES OF THE BREAST.

HYPERTROPHY.

HYPERTROPHY OF THE BREAST is very rare, but a good instance follows, in which very great symmetrical enlargement occurring in a young lady necessitated the removal of both glands.

3142a.—A section through a very greatly hypertrophied mammary gland. The hypertrophy is due to an infiltration of the gland with fibro-cellular tissue rather than to any true increase in the glandular substance. The breast was removed from an unmarried lady, aged twenty-one, in whom the hypertrophy had been proceeding for a period of three years. Both breasts were amputated; the right weighed forty-eight ounces, and the left eighty ounces.

SIMPLE CYSTS.

Simple or serous cysts of the breast are nearly always solitary. They occur as completely closed sacs embedded in the substance of the gland, having no connection with the ducts. They have thin delicate walls lined with squamous epithelium and contain a serous fluid, which generally re-accumulates after it has been drawn off. They are probably formed by the expansion and fusion of the intertubular connective-tissue spaces.

3142.—Portion of a mammary gland, in which is embedded a simple, thin-walled cyst, with a smooth and polished internal surface. The cyst was filled with a clear fluid.

3146a.—A cyst removed from the mammary gland in the substance of which it was deeply situated. Its interior presents a

partial division into separate cavities. Before removal it presented many of the signs of a solid tumour.

3146c.—A portion of the mammary gland containing two large and well-defined unilocular cysts. The breast tissue also contains numerous smaller cysts. Microscopical examination shows that the cyst-wall resembles granulation-tissue, being chiefly composed of leucocytes lying in a loose fibrous stroma. A section of the breast around the cyst shows a fibrous stroma in which is embedded normal gland-tissue and cysts formed by the dilatation of the acini. The epithelium of the lactiferous ducts is proliferating. From a married woman aged forty-four, who had sero-cystic disease of both breasts.

MILK CYSTS OR GALACTOCELES.

Galactoceles are produced either by the dilatation of an obstructed duct, or by the rupture of a duct and extravasation of the milk into the intertubular connective-tissue, which becomes condensed around it to form a capsule. They appear as one or more round or oval swellings in the substance of the gland, and generally contain a milk-like fluid, or when, as sometimes happens, the watery parts of the milk have been absorbed, an inspissated mass of oily, caseous material.

3143.—A cyst, removed from a breast in which it lay deep within or behind the mammary gland. It was of nearly spherical shape, thin-walled, and loosely connected with the adjacent parts. Its inner surface, now everted, is nearly smooth, polished, and of a pale brown colour. Some small portions of a white fatty substance like spermaceti adhere to it.

3145.—A cyst, the contents of which resembled inspissated milk. It was removed from the mammary gland of a young woman, where it had existed for eighteen months, without any material augmentation of its size.

PROLIFEROUS CYSTS.

Proliferous cysts, or cysts containing solid growths, will be found described under "Sero-cystic Sarcomata" (page 605).

MYXOMATOUS TUMOURS.

Tumours having the microscopical characters of the

myxomata occasionally occur in the breast. They vary greatly in their physical characters, but can generally be recognised by their soft, semi-transparent, gelatinous appearance on section. They generally contain cysts. Pure myxomatous growths are innocent, but the softer forms are liable to recur after removal. A good specimen presenting the typical microscopical structure follows.

3162.—Section of a tumour, which weighed eight pounds, and occupied the situation of a mammary gland. The outer surface of the tumour is uneven, knobbed, and appears to have been loosely connected with the adjacent parts. Its section shows that it is composed of a light gray semi-transparent substance, compact and glistening on the cut surface, and variously intersected by slender bundles of fibres. A few small cysts, with polished internal surfaces, are scattered in the substance of the tumour, and at the lower part of the section are appearances as if such cysts had been filled by lobular growths springing from their walls.

The tumour has the microscopical characters of the myxomata. A section of it is preserved in the Microscopical Cabinet, No. 143.

FATTY TUMOURS.

Fatty tumours of the breast are more properly to be regarded as fatty tumours occurring in the immediate neighbourhood of the mammary gland. They present the ordinary characters of lipomata found in other parts.

3160a.—A fatty tumour removed from the neighbourhood of the breast. It lay in close connection with a thin-walled simple cyst filled with brownish serous fluid. The lipoma easily shelled out; it is circular in shape, and is of the usual structure. It measures an inch and a half in diameter.

From a patient aged fifty-five, who had noticed a tumour on her left breast for about six months. It was hard, tense, and freely movable. The distal portion felt somewhat softer than the main part of the tumour.

FIBROUS TUMOURS.

Fibrous tumours in the breast are rare. They resemble the fibromata in other situations. They are usually of a globular shape, encapsulated and appearing fibrous on

section. They are perfectly innocent, and must not be mistaken for the atrophic variety of scirrhus cancer, or for the fibro-adenomata. It will be noted that the *pure* fibromata generally occur rather in the neighbourhood of the gland than in its substance. Two good specimens follow.

3161.—A portion of a very large tumour, which was removed with a woman's breast. It is composed of an elastic, tough, white, and homogeneous substance, arranged in closely-connected lobes. The whole tumour was of an oval form, and weighed seven pounds. The patient was between thirty and forty years old. The tumour had been growing thirteen years, and produced little inconvenience, except by its weight. She used to sit with the breast resting upon her knees until the integuments began to slough. The mammary gland lay under the tumour, and appeared healthy. The patient recovered completely after the operation. Under the microscope the tumour is seen to consist principally of fibrous tissue.

3161c.—A lobulated fibroma removed from the breast. The tumour consists of a soft fibrous tissue, which is divided up into small lobules by septa of connective tissue. A fibrous capsule invests the whole mass. Microscopic examination showed that the tumour consists of dense fibrous tissue without any trace of gland substance. From a woman aged twenty-eight, in whom the tumour had been growing for two years. After removal she made a good recovery.

CARTILAGINOUS TUMOURS.

Cartilaginous tumours of the breast are extremely rare. The following is a specimen of a cartilaginous tumour from the mammary gland of a bitch.

3160.—An oval nodulated tumour, consisting of a mixture of cartilage and bone, which was removed from the mammary gland of a bitch.

ADENOMATA.

The group of tumours called by Sir James Paget mammary glandular are now divided into several distinct classes according to their histological structure under the general term "*Adenoma*."

Adenomata occur as one or more distinct circumscribed growths in the substance of the gland. They are usually of

a round or oval shape, firm, elastic, lobulated on the surface, movable, and surrounded by a capsule of connective-tissue, from which the growth can be readily shelled out. The capsule is sometimes smooth and shining upon its internal surface, and is sometimes separated from the growth by a small quantity of serous fluid; such cases have led to the supposition that the capsule is really the wall of a cyst, and that the tumour is a secondary formation which has grown into and filled the cavity of the cyst. Mr. Birkett believes that this appearance of a growth projecting into a cyst is often due to the separation of the capsule by fluid.

The tumours on section generally appear lobular and of a yellowish-white colour, sometimes with a purplish tinge. The section does not become concave as in scirrhus, and when scraped it does not yield a cancer juice.

The lobular appearance of the section, as pointed out by Sir James Paget, suggests that these tumours, in many instances, consist of a number of proliferating intra-cystic growths; indeed, actual cysts are often laid open on section.

The adenomata are of slow growth and usually of small size, but they may attain large dimensions, when they occasionally ulcerate and protrude through the skin in the form of a fungus. They are nearly always innocent; they do not affect the corresponding lymphatic glands and distant organs as cancer does, nor do they commonly return when removed; they have occasionally, however, after removal, been followed by malignant growths (cancer or sarcoma). They generally occur in young women.

In minute structure they differ widely. They usually consist of a greater or less proportion of tissue resembling that of the healthy mammary gland, combined with a new growth consisting of fibrous, sarcomatous, or myxomatous elements in the intertubular connective-tissue. The acini of the gland are, however, blocked with cells, so that they are never functional. In many instances it is impossible to determine whether the gland-tissue is newly formed or is merely the remains of the original gland-tissue embedded in

the new growth. According as the sarcomatous, the myxomatous, or the fibrous elements prevail, the tumour is designated adeno-sarcoma, adeno-myxoma, or adeno-fibroma. In rare cases the tumour is composed of gland-tissue alone, without any admixture of other elements (true adenoma).

The adenomata frequently contain a number of cysts which often attain a large size, and into which proliferating masses of the growth appear to project. The cysts are formed in different ways: the smaller cysts are generally produced by the degeneration of the tumour elements, by the breaking down of blood-clots, or by the enlargement of some of the intertubular spaces. The cysts containing growths are probably formed by the dilatation of ducts, and, as pointed out by Mr. Birkett, by the accumulation of fluid between the capsule and the growth.

In some instances the whole tumour appears to be developed in a cyst. The growths are then designated cystic adeno-sarcomata, cystic adeno-fibromata, etc., according to the structure of the intra-cystic growth, and are included in the group of tumours designated by Sir Benjamin Brodie "sero-cystic sarcomas." In Sir James Paget's lectures on "Surgical Pathology" these tumours are described as proliferous cysts.

The specimens of adenoma are here classed according to their histological characters.

True Adenoma.

Pure adenomata are very rare, they occur as circumscribed ovoid tumours surrounded by a capsule of connective tissue. In microscopical appearance they closely resemble normal breast-tissue in which the acini are separated by areolar tissue.

3159a.—An adenoma of the breast. The tumour measures three inches by two inches. It is a fine specimen of a true adenoma. It is completely encapsuled. Its anterior surface is roughly divided by a constriction into two lobes. The larger of these lobes is

studded with nodules as in a case of "hobnail liver," whilst the smaller is smooth. On making a section of the tumour whilst fresh, it appeared pearly white like a normal mammary gland. It did not contain any cysts.

The tumour was removed from the pectoral border of the mammary gland of a lady who was four months pregnant. It had been noticed for five months. Three months before excision it was so soft that it appeared to be cystic; it was punctured, but no fluid was withdrawn. The father and father's mother died of cancer. Sections are preserved in **Series lv., No. 142a.**

Fibro-adenoma.

The fibro-adenomata are much more commonly found than the preceding variety. They consist of the same elements as the true adenomata, but the tissue surrounding the acini is much greater in quantity and is fibrous in character. They are more frequently found in the breasts of younger women than the true adenomata. These tumours are called by some pathologists (who look upon the glandular tissue merely as the remains of the normal breast) fibromata. Here, however, the term fibroma is reserved for those tumours [as **No. 3161c**] which consist entirely of fibrous tissue without intermixture of glandular elements.

3158.—A chronic mammary glandular tumour, very distinctly lobulated, removed from the right breast of a girl aged eighteen. It was discovered six months before the operation. It is partially divided by a vertical section. Microscopically it consists of fibrous tissue, with a small amount of gland tissue. A section of the tumour is preserved in the Microscopical Cabinet, **No. 142.** See also **No. 3157.**

3159.—A small tumour removed from the breast. It is of oval form, nodulated on the surface, and invested by cellular tissue forming a distinct capsule. It is composed of a soft, elastic, semi-transparent, glistening substance, traversed by opaque-white, undulating fibres, of which the larger appear on the section to form partitions dividing it into several round masses.

From a woman twenty-five years old, in whom it had been growing two years, and had occasionally been the seat of severe pain. Microscopically the tumour appears to be of the nature of an

adenoma, but the characters of the tumour have been rendered somewhat indistinct by the length of time the specimen has been preserved in spirit.

Myxo-adenoma.

The myxo-adenomata, as their name implies, consist of glandular tissue, separated by delicate connective tissue containing stellate cells, *i.e.*, myxomatous tissue. Sarcomatous elements are, however, often found in this stroma.

3162.—Section of a tumour which weighed eight pounds, and occupied the situation of the mammary gland. The outer surface of the tumour is uneven, knobbed, and appears to have been loosely connected with the adjacent parts. Its section shows that it is composed of a light gray, semi-transparent substance, compact and glistening on the cut surface, and variously intersected by slender bundles of fibres. A few small cysts with polished internal surfaces are scattered in the substance of the tumour; and at the lower part of the section the cysts are filled by lobulated growths springing from their walls. Microscopically the tumour consists of myxomatous tissue, containing small cyst cavities with occasional tracts of fibrous tissue. A section of the growth is preserved in the Microscopical Cabinet, No. 143. See also Nos. 3288 and 3288a.

3161a.—A tumour of the breast, which was encapsuled and of softish consistence. The cut surface is traversed by bands of glistening connective tissue, and presents to view many loculi and elongated spaces. The tumour consisted of soft ill-developed connective tissue containing many nuclei, and for the most part resembling mucous tissue; tubules and loculi, lined with small epithelial cells, are sparingly scattered in this tissue.

From a woman, aged nineteen years, who had observed the tumour about seven months. It was freely movable, and the lymphatic glands were not enlarged.

3161b.—Section of a large tumour, occupying the mammary gland, largely lobulated on the surface, and readily separable from the surrounding structures. The section shows that it is composed of a softish gelatinous tissue, containing cysts and loculi filled with soft proliferous growths, and presenting to view trabeculæ of fibrous tissue, which appear to have constituted the walls of cysts now filled up.

Removed from a woman, aged forty-six years. The tumour had been observed for three years. The skin over it was movable,

and the nipple was not retracted ; there was no enlargement of the axillary glands. Two aunts of her father had been operated upon for "cancer" of the breast ; they lived thirty and thirty-five years respectively afterwards, and neither died of cancer, nor was there any return of the disease.

Adeno-sarcoma.

These tumours resemble the adeno-fibromata, except that the stroma is composed of sarcoma elements instead of fibrous tissue. They occur as circumscribed growths, which in their earlier stages it is impossible to distinguish from the innocent forms except by microscopical examination.

3163.—Section of a breast and of a large tumour developed in the mammary gland. The tumour is spheroidal in form, and nearly three inches in diameter. It is composed of a very firm, compact, grayish substance, traversed by numerous undulating, white, fibrous bands. Microscopically the tumour consists of fibrous tissue, with a small amount of gland tissue, but in places it is largely composed of spindle cells. A section is preserved in the Microscopical Cabinet, No. 146.

SERO-CYSTIC TUMOURS.

The sero-cystic tumours of the breast are divisible into two great classes: (i.) Sero-cystic Tumours and (ii.) Sero-cystic Sarcomata.

(i.) *Sero-cystic Tumours.*

In the sero-cystic tumours cysts are developed as a result of dilatation of the acini or ducts of the breast-tissue. Growths of true connective-tissue derived from the fibrous and areolar tissue surrounding the ducts or acini project into the cysts thus formed, pushing before them the epithelial lining of the cyst, and, in many cases, reducing the space to a mere chink. These growths usually occur in women between the ages of thirty-five and forty. They are distinctly defined, lobulated and painless tumours, hard in some places, fluctuating in others, and often of large size. They grow slowly. They are innocent.

3152b.—A section through a large lobulated sero-cystic tumour

of the breast. The cysts are very large, and are filled with a firm growth. Microscopically the tumour is a true sero-cystic growth, the intra-cystic tissue being fibro-adenomatous in character. From a married woman, aged fifty-two, who first noticed a small lump in her breast ten years before the amputation was performed.

3153.—A portion of a sero-cystic tumour of the breast. On the surface of the section a large cyst is seen, almost filled by intra-cystic growth. The disease occurred in a woman, aged sixty-six, and had existed for twelve years, during the last six months of which it had rapidly increased from the size of a fist to that of a child's head. On microscopical examination the growth is seen to consist almost entirely of fibrous tissue. A section of the growth is preserved in the Microscopical Cabinet, No. 138.

(ii.) *Sero-cystic Sarcomata.*

The group of tumours called sero-cystic sarcomata by Sir Benjamin Brodie, and included by Sir James Paget under the head of proliferous cysts, have, by recent writers, been distributed amongst the various cystic tumours (cystic fibro-adenoma, cystic sarcoma, cystic carcinoma), according to their histological structure. Although differing in their anatomical structure, they all appear to be developed in the interior of a cyst which has been formed by the dilatation of a duct or in some other way. "From the inner surface of such a cyst," says Sir James Paget, "a vascular growth may spring (No. 3148), and as this increases at a rate beyond that of the increase of the cyst, it fills more and more of the cavity (No. 3153). At length the growth wholly excludes the fluid contents of the cyst, and its surfaces come in contact with, though they do not at first coalesce with the remainder of the cyst-walls (No. 3163a). Subsequently, however, the growth may coalesce with the walls of the cyst and form one solid tumour, enclosed in and connected with them, just as ordinary solid tumours are invested and connected with their connective-tissue capsules. Or, growing yet further and more rapidly, the growth, hitherto intra-cystic, may protrude (No. 3155) through its cyst-walls and the subjacent integuments, protruding

through them as a hernia of the brain does through the skull, growing exuberantly over the adjacent skin, and, like such a hernia, reproduced when cut away."

The manner in which the tumour is supposed to grow into and to gradually fill the interior of the cyst is well illustrated in the following series of specimens, irrespective of the nature of the ingrowth into the cysts. As the intra-cystic growths differ in histological characters, the specimens are also described under the tumours to which they may be histologically referred.

3148.—Part of a breast, in which a cyst, with rather thick tough walls, is embedded in the mammary gland. A round lobulated mass of soft substance has grown from a portion of the inner wall of the cyst; the rest of its cavity was filled with serous fluid.

3149.—A breast removed from a middle-aged woman. The situation of the mammary gland is occupied by a large cyst, which contained a serous fluid, and around which the gland is spread out. The walls of the cyst are about a line in thickness, tough, but pliant; its interior is irregularly wrinkled and somewhat sacculated; a small, soft, lobulated growth projects from a portion of its wall into its cavity. Above this cyst (at a part of the mammary gland which during life lay near the axilla) is a small oval mass of scirrhus cancer, with irregular cavities, the result apparently of its partial softening. The patient died some time after the removal of the breast, with a return of the cancerous disease.

A section is contained in the Microscopical Cabinet, No. 136.

3150.—A breast, with two cysts embedded in it. The walls of the cyst are thin and tough, and they communicate by a small aperture. The larger cyst was distended by a watery fluid, and a lobulated growth has arisen from a part of its inner wall.

3151.—A breast, in which a cyst is embedded in the mammary gland. The cyst has the same general characters as those in Nos. 3149 and 3150, but its cavity is almost filled by a soft, lobulated, and vascular growth attached by a broad base to a large portion of its wall. It is loosely connected with the adjacent parts. The mammary gland is very small.

The breast was removed from a woman forty-nine years old. The cyst had been increasing slowly and with very little pain for between four and five years. She recovered from the operation. On microscopical examination the intra-cystic growth is seen to

consist of a fibro-adenoma. A section of the growth is preserved in the Microscopical Cabinet, No. 137.

3154.—A mammary gland, with two tumours embedded in it, which were removed by operation. Each tumour is circumscribed and surrounded by a distinct capsule of cellular tissue. The substance of each tumour appears to consist of separate portions loosely connected by cellular tissue, which in the recent state resembles the lobules of the pancreas. The arrangement of the lobules indicates that they are growths (such as are in Nos. 3148, 3150) which have arisen from the walls of numerous cysts, and have now filled their cavities, become firm, and coalesced with the cyst-walls so as to form a nearly solid mass. On microscopical examination the growths are seen to consist almost entirely of fibrous tissue.

3155.—Section of a woman's breast, and of a tumour seven pounds in weight, of which a part protruded through the ulcerated skin. The lower part of the tumour presents a section of a large cyst, with thick, soft sacculent walls, which contained a pale yellowish fluid. Above this the substance of the tumour is soft, elastic, somewhat glistening and jelly-like: the greater part of it protruded through the skin in the form of a deeply-lobed and very vascular mass, the surface of which was covered by healthy-looking granulations, and appeared to be in parts skinned over. The appearance of the tumour had been altered by a ligature tied round the base of the protruded part some time before it was removed; it is from this that the margins of the protrusion appear to overhang so far the surface of the surrounding integuments.

The microscopical characters of the tumour are those of a mixed-celled sarcoma.

3163a.—A portion of a large sero-cystic sarcoma of the female breast. The cyst-wall has been separated from the intra-cystic growth, and rods have been placed between the two to show that for a greater part of their extent they are not fused. Microscopic examination showed that the growth was a fibro-sarcoma.

From an unmarried lady, aged forty-nine, who had one-tenth of albumin in her urine at the time of the operation. The tumour had been growing for seven years. After removal it weighed seven pounds. The patient made an excellent recovery.

MALIGNANT DISEASE OF THE BREAST.

SARCOMATA.

Specimens of pure sarcomatous tumours in the breast are rare, the sarcomatous elements being nearly always intermixed with a greater or less amount of newly-formed gland tissue (adeno-sarcomata).

All varieties of the sarcomata, however, occasionally occur. Of those the spindle-celled sarcoma (the recurrent fibroid tumour of Paget) is the most common.

Spindle-celled sarcomata somewhat resemble the mammary glandular tumours; their section, however, is smooth and uniform, and does not present a lobulated or fibrous appearance. They may attain a large size, and return after removal, the subsequent growths generally being softer. They do not affect distant organs.

Round-celled sarcomata resemble either mammary glandular tumours or medullary cancer, from which it is often impossible to distinguish them except by the microscope. They are generally softer than the mammary glandular tumours, and the lymphatic glands are not affected as they are in cancer. They return on removal, and affect distant organs. Cysts are frequently developed in them, and they sometimes appear as intra-cystic growths, when they constitute one form (the malignant) of the sero-cystic sarcomata of Brodie.

A specimen of round-celled sarcoma which occurred after the removal of a pigmented round-celled (melanotic) sarcoma follows [No. 3186].

3164.—A tumour, exactly resembling in external appearance that preserved in No. 3163. It separated by sloughing from the breast of the same person. The patient was an unhealthy woman, forty-seven years old. The tumour in No. 3163 had existed many months, and, after an accidental blow, had grown rapidly and with much pain for seven weeks before the removal of the breast. About three months after the operation, when the wound had been long healed, the tumour in No. 3164 began to grow under the cicatrix. It increased rapidly, and in about three months the integuments

over it having ulcerated, it was completely separated by sloughing. The cavity left by its separation ulcerated widely and deeply, and the patient died exhausted nine months after the removal of the tumour. Hard white tumours, of sarcomatous appearance, were found in the lungs. Some of them are in **Series xi.**, No. 1740; and part of the patient's stomach is in **Series xvii.**, No. 1903.

Microscopically the tumour has the structure of the round-celled sarcomata.

3186.—Section of a mammary gland, exhibiting the deposit of melanotic sarcoma, both in small round masses and in a more diffuse form. From a young woman in whom the primary disease had its origin in a mole, or dark nævus, on the back, which had passed into a melanotic sarcoma a few months only before its removal. The patient died, about two years after the operation, with melanotic sarcomata in nearly every organ. The primary growth is contained in **Series xl.**, No. 3315.

Alveolar sarcoma of the breast is very rare, but the following specimen appears to be an example.

3156a.—Part of a breast containing a cyst with an intra-cystic growth. This latter is of a dark brown colour with a mottled surface on section, firm to the touch (though when fresh it was rather friable), and not sharply defined from the surrounding tissues.

From a married woman, aged sixty-seven, from whose breast a similar tumour, the size of a plover's egg, had been removed one year and eight months previously, having been noticed for seven months. The lymphatic glands were not affected, and there was no family history of importance. On microscopic examination, the tumour was found to consist of a collection of large, round cells of a connective-tissue type, enclosed in alveoli, the walls of which were composed of loose connective-tissue. In these were many large and thin-walled bloodvessels, from some of which small offshoots ran between the individual cells.

CARCINOMATA.

SCIRRHOUS CARCINOMA.

Scirrhus is the most common form of cancer in the breast. It generally begins as a small nodular mass in the substance of the gland, and after growing slowly for some time invades

the whole breast and surrounding adipose tissue. The cancerous mass becomes adherent to the skin and pectoral muscle; the lymphatic glands in the axilla and mediastinum, and afterwards those in the neck, especially a small one which is situated immediately above the centre of the clavicle, become enlarged, at first from irritation only, afterwards from deposits of cancer in their interior; the skin gives way, and a foul cavernous ulcer or a protruding fungating mass is produced. The arm and side of the chest become œdematous and swelled in consequence of the pressure of the enlarged axillary glands upon the blood-vessels; distant organs become affected, especially the lungs, pleuræ, and peritoneum; cancerous cachexia sets in, and the patient dies in consequence of exhaustion, or of repeated hæmorrhages due to the ulceration extending to the arteries supplying the cancerous mass, or of intercurrent pleurisy or peritonitis, or of some other affection of distant organs. Such is the common course of scirrhus cancer. Variations of this course are, however, not infrequent. Thus, the cancer may begin as a general infiltration of the whole gland, in which case it is usually very rapid in its course. In some instances the skin is chiefly affected, the whole side of the chest in such a case appearing hard, brawny, infiltrated, and leathery in consistence. In rare instances, again, it may begin as an infiltration of the nipple; or, as pointed out by Sir James Paget, it may follow upon chronic eczema of the nipple, when it appears to be due to the eczematous inflammation spreading along the ducts. In some cases (**No. 3335a**), too, scirrhus cancer of the breast may be associated with an abscess, though such an association of suppuration with malignant disease is not confined to the mammary gland. In old women the cancer may be very chronic, remaining stationary, if not interfered with, for many years. Moreover, the cancerous mass has at times undergone complete atrophy, and, even after ulceration has occurred, healing of the ulcer and atrophy of the mass have been known to ensue.

Pathological appearances.

Scirrhus cancer generally appears as a hard nodular mass, unencapsuled, with processes extending in all directions in the gland substance, and in the adipose tissue around. The nipple is usually retracted in consequence of the lacteal ducts being drawn inwards, in common with other tissues, by the contraction and shrinking of the cancerous mass (No. 3165a). In some cases, however, the nipple, instead of appearing retracted, becomes more prominent than usual, and hard and rigid, owing to its early infiltration with the cancer. The skin, in consequence of the traction upon the tissues surrounding the cancerous mass, frequently appears dimpled, *i.e.*, drawn inwards in places, some time before it has become infiltrated with the cancer.

On making a section of the tumour a peculiar creaking sensation is experienced, and "the cut surface becomes slightly concave, sinking in towards its centre through the persistence, I suppose," says Sir James Paget, "of that tendency to contraction to which during life we have to ascribe the traction of the surrounding tissues, and which is now no longer resisted by them." The section generally appears grayish-white, sometimes with a pinkish tint, semi-translucent, firm, and of uniform close texture, often intersected (as in No. 3168) in every direction by short, wavy lines, like bundles of white fibres, which mingle together in a close, irregular network, by which it is sometimes (as in No. 3166) imperfectly divided into lobes. It occasionally presents round or oval orifices, the section of lactiferous tubes involved in it, or it may be dotted with small, yellow spots (as in No. 3179), the contents of the tubes which have been cut across, or with patches of yellow due to fatty degeneration of the cancer-cells, resulting from the pressure exerted upon them by the contraction of the fibrous stroma. The fatty degeneration of the cellular elements frequently leads to the formation of cysts. When scraped

the section yields a juice containing nucleated cells, free nuclei, and granular material.

On microscopical examination the cancer is seen to consist of a fibrous stroma, the alveoli of which are infiltrated with epithelial cells, amongst which are a number of small, round cells.

Some differences of opinion exist as to whether the cancer begins in the acini, or in the connective-tissue around, or in both situations. Those observers who maintain that all cancers are epithelial in origin, believe that it begins by a proliferation of the epithelium lining the acini, and that the small-celled infiltration always observed in the intertubular connective-tissue is a secondary change. Others, however, and probably with less reason, maintain that the connective-tissue is the structure primarily affected.

3165a.—Section through a mammary gland and the surrounding fat, in which a large mass of scirrhus cancer is embedded. The tissue presents a hard white basis, intersected by bands like fibres, which are best seen at the periphery of the growth. The nipple is much retracted. From a woman aged fifty-two, whose nipple became retracted about eight months before the breast was removed; shortly after the retraction of the nipple she noticed a lump in her breast.

3173.—Sections of a mammary gland, the whole of which is occupied by scirrhus cancer. In the upper specimen one half of the gland is shown dissected from the parts around it; in the lower, the other half is embedded in the surrounding fat. The former specimen shows that the shape of the gland is retained, even while its structures, with the exception of little more than its larger ducts, are replaced by cancer structures forming an intensely hard and compact substance. The latter specimen shows especially the deep retraction of the cancerous nipple, the small size of the cancerous mammary gland, the branching of its larger ducts, and the abundant fat around them.

The patient was about fifty years old. The disease had probably been in progress for about six months before its removal. It recurred in two years and three quarters, and she died rather more than three years after the operation. See also No. 3168.

Chronic scirrhus cancer. 3166.—A tumour with a portion of

skin removed from a breast. The tumour is nearly spherical, and appears to have been slightly connected with the surrounding parts. It is of a pale, firm, and uniformly close texture, and is intersected by fine undulating fibres, like partitions imperfectly dividing it into lobes. Microscopically the tumour presents the characters of scirrhus cancer. A section is preserved in the Microscopical Cabinet, No. 149.

Acute scirrhus cancer. 3174.—Section of a mammary gland with a well-marked example of acute scirrhus cancer. The whole breast appears to have been large. The cancerous mass, of large size and of oval form, occupies the greater part of the gland, and is embedded on the surface of the pectoral muscle. The section of the cancer shows a texture much less compact and dense than that of the preceding specimens, and varied in aspect by the intermingling of the white-lobed portions of the mammary gland involved in the cancerous infiltration. A section of a similarly cancerous lymphatic gland is suspended above the section of the breast. See also No. 3170.

UNUSUAL CONDITIONS OF SCIRRHUS CARCINOMA.

Scirrhus Carcinoma following Eczema of the Nipple; or, Paget's Disease of the Nipple.

Paget has described an eczema which is limited to the nipple and its areola (see Drawing No. 531c) which is very difficult to cure, and which is particularly liable to be succeeded by carcinoma of the breast. This eczematous eruption is an antecedent of cancer, and is to be distinguished from a somewhat similar condition which often manifests itself during the growth of cancer. The exact relation which the eczema bears to the cancer is at present involved in obscurity. The local eczema may be the primary disease, and by travelling up the epithelial lining of the ducts may produce changes which eventually terminate in cancer. The eczema, on the other hand, may be a precancerous condition, inasmuch as it indicates a diseased state of the acini, whose morbid secretion irritates the epithelial surfaces with which it comes in contact.

3181a.—Section of a breast. The nipple and the surrounding

skin are excoriated and eczematous, the former being retracted to such an extent as to be almost below the level of the surrounding integument. Beneath the nipple the substance of the gland is indurated and hardened by chronic inflammation, while at the margin of the breast is situated a small mass of scirrhus cancer.

From a woman, aged thirty-six, who had five children, all of whom she suckled. Both breasts had been frequently the seat of cracked nipples, and, twelve months before coming under notice, the eczematous condition seen in the specimen showed itself. Microscopical examination showed the nipple to be the seat of scirrhus cancer. The surrounding skin, and that part of the indurated breast immediately subjacent to the nipple, only presented the ordinary appearances of chronic inflammation, whilst the tumour at the margin of the gland was of a typically cancerous nature.

3181b.—Section of a breast. The surface of the nipple is irregular, excoriated, and eczematous. It is deeply retracted below the level of the surrounding integument, and blends with a small, firm mass of scirrhus cancer, not larger than a walnut. The whole breast appears to have atrophied, for there is no trace of glandular structure, its place being taken by a quantity of fat.

The patient was a woman aged forty-nine, who had suffered from eczema of the nipple for three years; the tumour in the breast had been noticed about twelve months. Two years after the operation there had been no return of the growth. See also Nos. 3181c, 3181d, and 3181e.

Scirrhus growing in conjunction with a fibro-adenoma.

3165a.—A breast showing a scirrhus growing coincidently with a fibro-adenoma. The upper part of the tumour presents the appearance of a normal scirrhus carcinoma, whilst the lower part has the nodular shape of an adenoma, appearances which were verified by microscopical examination. From a woman aged forty-eight, who injured her breast four years before it was removed.

Suppuration occurring in scirrhus carcinoma.

3335a.—Part of a large scirrhus cancer of the breast, in the centre of which is an irregular ragged abscess cavity, which in the recent state contained some foul-smelling but well-formed pus. There was no history of an injury to the diseased breast.

Scirrhus carcinoma of the male breast.

3171.—Section of a man's breast, with scirrhus cancer of the whole mammary gland. The cancer forms an irregular rounded mass nearly two inches in diameter; it is intensely hard, pale-gray, with branching white lines, and small yellow spots. It has extended to that part of the skin which is stretched tensely over it, and to the nipple, which is depressed and enlarged on the centre of its surface. At its deepest part, fibres of the great pectoral muscle are included in its surface.

The patient was forty-eight years old, of healthy aspect. He had observed the disease for six months. It had increased quickly, and had been painful for two months. Two axillary glands were similarly diseased, and were removed with the breast. The patient recovered from the operation. A drawing in **Series lvii., No. 529**, shows the appearance of the disease when recent.

3175.—Scirrhus cancer of the right mammary gland, removed from a man aged sixty-two. It had existed for twelve months. Five or six enlarged and indurated glands, in which, however, no cancer structure could be detected, were at the same time removed from the axilla. The tumour forms a circumscribed oval mass, surrounded by adipose tissue.

3176.—An ulcerated scirrhus cancer of the left male breast, removed from a man aged forty-one. The disease had existed eighteen months. Some large cancerous glands were removed from the corresponding axilla.

Characters of the carcinomatous ulcer.

It has already been stated that the cancer, if not removed, becomes adherent to the skin, which finally gives way and a cancerous ulcer results. The ulcer may be superficial, or deeply and irregularly excavated, and covered with a sanious, foul-smelling discharge; the skin around is adherent, and infiltrated with nodules of cancer. The appearances of the ulcer are well seen in the following specimen.

3179.—Section of a scirrhus cancer in a woman's breast. The cancer structures occupy the whole mammary gland, and much of the skin over it, and protrude through the skin with a deeply ulcerated surface. The section through the substance of the cancer shows a firm, close-textured, white substance, well defined,

intersected by short branching white lines, and dotted with what appear to be the orifices of lactiferous tubes filled with a yellowish material. The ulcerated surface is deeply and unequally excavated, and coarsely nodular; its border is elevated, slightly everted, sinuous, and in part surrounded by nodules of the cancerous substance elevating and thinning the adjacent skin.

The patient was fifty years old when the disease commenced. After nearly two years of painless progress and four months of ulceration the fungating mass was removed with the breast, and some diseased axillary glands. Within three months after the operation small cancerous nodules began to form in the skin about the scar, and in twenty months the patient died.

In very rare instances the cancer, even after ulceration has occurred, may undergo atrophy and the ulcer may partially heal or skin over. Such healing occurred in the following specimen.

3177.—A scirrhus cancer of the breast, in which, after the disease had been six or more years in progress, and had ulcerated and protruded through the integuments, it ceased to increase, shrivelled and partially healed. It appears now as a dry, lobed mass, closely fixed to the ribs and intercostal muscles.

A drawing of a similar condition is preserved in **Series lvii., No. 531ci.**

Effects of treatment with caustics.

3181.—A sloughing cancerous mass from the breast of a woman aged fifty-nine, in whom it had existed for two years. The skin over the breast was first destroyed by acid nitrate of mercury, and chloride of zinc was afterwards applied to the sloughing surface of the cancer, at intervals of a day or two. The whole process lasted about a fortnight, and the present slough was separated about four weeks from the first application of the caustic.

3181f.—Scirrhus of the breast, removed as a slough after treatment by caustics. The skin was first destroyed by concentrated nitric acid, and a paste of zinc chloride was applied daily to the cancerous mass. The furrows in the slough are the result of incisions made to facilitate the action of the chloride of zinc. The slough came away five weeks after the first application of the nitric acid.

3181g.—Section of a breast infiltrated with scirrhus cancer, to show the sloughing which occurs after the application of a caustic. The first application was made three weeks before the removal

of the gland. Almost the whole of the cancer is separating as a slough.

MEDULLARY CARCINOMA.

Medullary cancer of the breast is far less common than scirrhus. It occurs as a soft, rapidly-growing tumour in the substance of the gland, and speedily involves the surrounding parts and protrudes through the skin as a fungating mass of bleeding cancer. It appears, in some instances, to originate in the interior of cysts.

3184.—A tumour removed from a breast. It consists of a close-textured medullary substance, and in its lower part were small cysts full of blood. See also No. 3183.

3309.—A large tumour with the surrounding skin, removed from the front of the chest of a middle-aged lady. The section of the tumour shows that it is composed of a soft but compact, pure white brain-like medullary substance, with blood effused through its lower half.

In the course of the eleven years preceding the removal of this tumour, three similar operations had been performed on the same lady. At the first operation, the part removed appeared to be a simple hypertrophied mammary gland. At the second, a large tumour was removed from the opposite breast. At the third, a large tumour removed from the seat of one of the former operations appeared to be partly fibrous and partly medullary. At the fourth, the tumour above described was removed from the front of the sternum between the cicatrices of the other operations. The effusion of blood into the lower part of this tumour was the consequence of its being punctured. Profuse hæmorrhage occurred at the same time, and a large portion of the tumour, as the preparation shows, protruded through the wound.

3310.—Sections of a tumour, with the surrounding skin, removed from the same patient as the tumour last described, and from the situation of the cicatrices of the previous operation. The sections display the same medullary character as the preceding tumour presents, but the morbid substance is softer and more uniformly coloured with effused blood.

During her recovery from this, the fifth operation, the patient died suddenly. A mass of fibrin, mixed with cancerous matter, was found in the pulmonary artery. See No. 1564.

COLLOID CARCINOMA.

Colloid cancer occurs in women at about the same age and under precisely the same conditions as ordinary scirrhus. It is, indeed, the result of colloid degeneration occurring in medullary or scirrhous carcinomata. The effect of such degeneration is, however, to delay the course of the disease without leading to spontaneous cure, so that the duration of life in such cases is estimated at twelve years, instead of two or three years, which is the average duration in cases of ordinary carcinoma of the breast.

3185d.—A section of a breast containing a small mass of recurrent colloid cancer. The mass is circular in outline, and measures three-quarters of an inch in diameter. It is situated about a quarter of an inch below the nipple, and has a well-defined outline. A considerable quantity of medullary carcinoma still remains, which has not yet undergone any colloid change.

From a woman aged thirty-nine, in whom the primary growth was first noticed nine years previously. The recurrent growth was observed a year after the first operation. See also Nos. 3185a, 3185b, and 3158c.

DUCT CARCINOMA.

The term duct-cancer, or villous carcinoma, has been applied to a special and very rare variety of cancer which generally occurs in patients who are above middle age. The tumours are occasionally multiple in the same breast, and are firm and elastic to the touch rather than hard and nodular like a carcinoma, so that clinically they more nearly resemble cystic-sarcomata. In a considerable number of cases there is a discharge of fluid from the nipple, but the growths are never associated with eczema of the nipple. The axillary glands are not usually affected. The tumours are not of very rapid growth. On section the tumours are seen to be encysted, and are generally darkly blood-stained, soft and friable. Some of the cysts are almost filled with solid growth, whilst others contain little more than blood-clot and serum. The cysts may be situated either in the

gland or in the surrounding fat. The tumours are liable to recur locally, but are not so prone to affect the glands or to disseminate as are the spheroidal-celled carcinomata, *i.e.*, the scirrhus and medullary cancers.

3186b.—Section of a breast with two recurrent nodules of duct cancer, one of which is situated in the fat outside the breast-tissue. The masses are circular, and measure a third of an inch in diameter ; they are situated in a dense stroma of connective-tissue. Each mass is dark red in colour, and consists of a soft and very friable new growth. From a single woman aged forty-three, in whom the lumps had been growing for four or five months. There were no enlarged glands. The growth recurred a year after the operation.

3186c.—A cystic tumour, removed from the breast ; the cyst is formed by the dilatation of one of the milk-ducts ; a small pedunculated papillomatous growth sprouts into its cavity. This growth, when it was fresh, resembled a ripe raspberry, being bright red in colour. There are ten or twelve smaller growths situated on the inner wall of the cyst, none larger than a pin's head, and all sessile. Microscopically they have the structure of a duct-carcinoma, for they are all papillary in nature, the papillæ growing from the epithelial lining. The base of each papilla is formed of a very delicate connective-tissue, on which grow several layers of short columnar epithelial cells.

From a woman aged thirty-nine, the mother of five children. The tumour had been noticed for seven months, and for six months she had a discharge from her nipple.

A microscopical section is preserved in **Series lv., No. 153d.**



INDEX.

ABSCESS, cervical, 228
 " iliac, 228
 " lumbar, 228
 " postpharyngeal, 228
 " psoas, 228
 " spinal, 227
 " urinary, 497
 Acute arteritis, 305
 " arthritis, 143
 " hydrocele, 514
 " rickets, 60
 " synovitis, 142
 Acromegaly, 60
 Adenoid vegetations of pharynx, 348
 Adenomata of breast, 599, 602
 " larynx, 361
 " rectum, 480
 Adeno-sarcoma of breast, 604
 Adhesive phlebitis, 332
 Alveolar sarcoma of breast, 609
 Anchylosis after dislocation, 189
 " " excision of joints,
 182
 " bony, 143, 145, 175
 " fibrous, 175
 " ligamentous, 175
 " of vertebral joints, 235
 " spurious, 174
 Aneurysm, 313-330
 " arterio-venous, 290, 325,
 329
 " by anastomosis, 325, 330
 " circumscribed, 326
 " cirroid, 325, 329
 " classification of, 324
 " consecutive, 314, 324,
 326
 " cure by diet, 322

Aneurysm, cure by flexion, 324
 " ligature, 323
 " pressure, 324
 " diffused, 324, 326
 " " sacculated, 314
 " " traumatic, 293,
 325
 " dissecting, 314, 325, 328
 " false sacculated, 324, 326
 " fusiform, 313, 324, 325
 " ligature of arteries for,
 323
 " method of curing, 316
 " pressure, effects of, 320,
 323
 " rupture of, 318
 " sacculated, 313, 324, 326
 " spontaneous, 324
 " structure of, 313
 " termination of, 318
 " treatment of, 322
 " traumatic, 289, 293, 325
 " true sacculated, 324, 326
 " Tuffnell's method of
 treatment, 322
 " varicose, 291
 " varieties of, 324
 Aneurysmal dilatation, 313, 325
 " varix, 290, 314, 325,
 329
 Angioma of bone, 88
 " cheek, 374
 Angular curvature of spine, 224
 Ankle, dislocation of, 204
 Anus, fissure of, 469
 " fistula of, 473
 " imperforate, 487
 Aphthous ulcer of tongue, 404

Appendix vermiformis in hernial
sac, 442

„ „ removal of, 424

„ „ foreign body in,
424

Arterial varix, 325, 329

Arteries, aneurysm of, 313

„ atheroma of, 306

„ calcareous degeneration of,
307, 312

„ degeneration of, 306, 312

„ embolism of, 309

„ fatty degeneration of, 306

„ fibroid degeneration of, 308

„ Hunterian ligature of, 298

„ inflammation of, 305

„ injury of, 288

„ ligature of, 323

„ „ in continuity, 298
„ „ the cut end of,
294

„ primary degeneration of,
312

„ rupture of, 292, 325

„ thrombosis of, 309

„ tumours of, 304

„ wounds of, 286

Arterio-venous aneurysm, 290, 292,
329

Arteritis, 304

„ acute, 143, 305

„ chronic, 306

„ gangrene in, 311

„ syphilitic, 308

Arthritis, gouty, 171

„ rheumatic, 159

„ tabetic, 168

Arthropathy, tabetic, 168

Articular caries, 153

Artificial anus, 452

Astragalus, dislocation of, 206

„ fracture of, 140

Atheroma, 306

Atlas, dislocation of, 234

Atrophy of bone, 43

„ nerves, 277

„ testicle, 528

B.

Bigelow's classification of disloca-
tion of hip, 198

Bilharzia hæmatobia, 481, 564

Bladder, calculus in, 565

Bladder, carcinoma of, 561, 563

„ changes due to stricture,
498

„ condition after lithotomy,
547

„ „ lithotripsy, 547

„ „ puncture, 548

„ congenital defects of, 576

„ dilatation of, 555

„ epithelioma of, 562

„ extroversion of, 576

„ growths in, 557

„ hypertrophy of, 551

„ injuries and diseases of,
545

„ rupture of, 424, 545

„ sacculation of, 551

„ sarcoma of, 559

„ tubercle of, 556

„ tumours of, 557

„ villous, growth of, 558

Blood-clot, organization of, 299

Bone, abscess in, 23, 42

„ acromegaly in, 60

„ angioma of, 88

„ arthritis deformans, 159

„ atrophy of, 43

„ carcinoma of, 84

„ caries of, 17, 18, 21, 25

„ diseases of, 1

„ constitutional affections of, 46

„ chronic abscess of, 42

„ chronic rheumatic arthritis
of, 159

„ cysts, 88

„ epithelioma of, 86

„ enchondromata, 69

„ endosteal sarcoma of, 77

„ epiphysitis of, 156

„ exfoliation of, 33

„ exostoses, 64

„ fatty tumour of, 63

„ fibromata of, 64

„ fracture of, 89

„ hydatids in, 88

„ hypertrophy of, 45

„ inflammation of, 2, 12

„ lipomata of, 63

„ malignant tumour of, 75

„ malum coxæ senilis, 159

„ medullary cancer of, 84

„ melanotic sarcomata of, 83

„ mercurial, necrosis of, 25, 26

Bone, myeloid sarcomata of, 79-82
 „ necrosis of, 24
 „ „ from whitlow, 26
 „ osteomalacia of, 61
 „ osteomata of, 64
 „ osteo-arthritis of, 159
 „ periosteal sarcoma of, 74
 „ phosphorous necrosis of, 25, 26
 „ rarefaction of, 12, 18, 21
 „ scirrhus in, 85
 „ sclerosis of, 15, 18
 „ scurvy of, 60
 „ suppuration of, 42
 „ syphilitic caries of, 48
 „ „ diseases of, 46
 „ „ osteitis of, 47
 „ „ periostitis of, 47
 „ „ ulceration of, 48
 „ traumatic necrosis of, 26
 „ tubercle in, 52
 „ tubercular caries of, 21
 „ „ disease of, 153
 „ „ ulceration of, 22
 „ ulceration of, 17, 18, 22, 25
 Brain, contusions of, 261
 „ hæmorrhage into, 258
 „ hernia of, 265
 „ inflammation of, 264
 „ laceration of, 261
 „ malformations of, 267
 Breast, adenoma of, 599
 „ adeno-sarcoma of, 604
 „ carcinoma of, 609, 615
 „ cartilaginous tumours of, 599
 „ colloid carcinoma of, 618
 „ duct-carcinoma of, 618
 „ diseases of, 597
 „ fatty tumours of, 598
 „ fibro-adenoma of, 602
 „ fibrous tumours of, 598
 „ hypertrophy of, 597
 „ malignant disease of, 608
 „ medullary cancer of, 617
 „ myxomatous tumours of, 597
 „ myxo-adenoma of, 603
 „ proliferous cysts of, 597
 „ sarcomata of, 608
 „ scirrhus of, 609
 „ „ in male, 615
 „ sero-cystic sarcomata of, 605
 „ „ tumours of, 604
 „ simple cysts of, 604
 „ villous cancer of, 618

Bronchocele, 366
 „ calcification in, 369
 „ carcinomatous, 370
 „ cystic, 368
 „ fibrous, 367
 „ malignant, 370
 „ multiple cystic, 369
 „ sarcomatous, 370
 „ simple, 367
 Bursæ, diseases of, 220
 „ enlargement of, 220
 „ inflammation of, 220

C.

Cæcocele, 442
 Cæcum in hernial sac, 442
 Calcaneum, fracture of, 140
 Calculi in bladder, 565
 „ „ colour of, 568
 „ „ effects of, 575
 „ „ shape of, 571
 „ „ situation of, 574
 „ „ spontaneous fracture of, 573
 „ „ structure of, 568
 „ kidney, 579
 „ prostate, 543
 „ submaxillary gland, 401
 Calculi, salivary, 401
 Calculus, carbonate of lime, 568
 „ cystin or cystic oxide, 567
 „ phosphatic, 566
 „ urate of ammonium, 565
 „ uric acid, 565
 Callus, varieties of, 90
 Cancellous necrosis, 38
 Carcinoma in bone, 84
 „ of bladder, 561
 „ breast, 609-619
 „ fauces, 412
 „ kidney, 589
 „ larynx, 363
 „ pharynx, 412
 „ prostate, 541
 „ scrotum, 505
 „ spine, 240
 „ testicle, 523
 „ tongue, 407
 Caries, articular, 18, 153
 „ cervical, 232
 „ due to syphilis, 48
 „ necrotica, 18, 23, 42
 „ of bone, 17

- Caries of odontoid process, 234
 " of spine, 225
 " simple, 18
 " strumous, 22
 " syphilitic, 24
 " tubercular, 21
 Cartilaginous tumours, 69
 " " of breast, 599
 " " of testicle, 525
 Central necrosis, 12, 37
 Cephalhydrocele, 254
 Cerebral hernia, 265
 " inflammation, 264, 267
 " membranes, hæmorrhage into, 258
 " " inflammation of, 262, 264
 Cervical caries, 232
 Charcot's disease, 168
 Cheeks, diseases of, 372
 " nævus of, 374
 Chimney-sweep's cancer, 505
 Chronic interstitial nephritis, 587
 " intestinal obstruction, 434
 " enlargement of prostate, 587
 Circulation, diseases and injuries of organs of, 283
 Cirroid aneurysm, 329
 Clavicle, dislocation of, 191
 " fracture of, 104
 Cleft palate, 398
 Clergyman's sore-throat, 353
 Clitoris, hypertrophy of, 503
 Cloacæ, formation of, 30, 34
 Clot active in aneurysm, 317
 " passive in aneurysm, 317
 Colles' fracture, 111
 Colloid carcinoma of breast, 618
 Concentric atrophy of bone, 44
 Concretions of prostate, 543
 Congenital dislocation of hip, 208
 " " knee, 209
 " inguinal hernia, 455
 " malformation of bladder, 576
 " malformation of rectum, 488
 " syphilis in bone, 49
 " tumours of testis, 529
 Costal cartilages, fracture of, 102
 Craniotabes, 49, 55
 Cranium, malformation of, 267
 " soft nodes on, 6
 Croup, 356
 Curvature of spine, angular, 224
 " " anterior, 238
 " " lateral, 235
 " " lordotic, 238
 " " posterior, 237
 Cut throat, 364
 Cystic disease of testicle, 526
 " tumour, multilocular, 391
 " tumours of jaws, 390
 Cystin, or cystic oxide calculi, 567
 Cystitis, 549, 551
 Cysts, dentigerous, 392
 " dermoid, of floor of mouth, 408
 " in bone, 88
 " of breast, 597
 " in nerves, 281
 D.
 Dead bone, characters of, 29
 " separation of, 29
 Dental ulcer of tongue, 403
 Dentigerous cysts, 392
 Depressed fracture of skull, 253
 Dermoid cysts of floor of mouth, 408
 " tumour of soft palate, 397
 Diffused osseous growths, 68
 Digestive track, injuries and diseases of, 372
 Digits, dislocation of, 197
 Dilatation of bladder, 555
 " ureters, 594
 Dislocations, 183
 " ankylosis after, 189
 " compound, 189
 " congenital, 183
 " " of hip, 208
 " " of knee, 209
 " from disease, 153
 " of ankle, 204
 " astragalus, 206
 " atlas, 234
 " clavicle, 190
 " digits, 197
 " femur, 197
 " foot, 204
 " hand, 197
 " hip, 197
 " " regular, 198
 " " irregular, 201
 " humerus, 191
 " patella, 202
 " radius, 196

Dislocations, of shoulder, 191
 „ spine, 245
 „ sternum, 190
 „ thumb, 197
 „ toes, 207
 „ ulna, 196
 „ wrist, 197
 „ simple, 184
 „ subastragaloid, 206
 „ Wormald's, 198
 Diphtheria, 357
 Displacements, congenital, of bone, 208
 Dissecting aneurysm, 328
 Duodenum, rupture of, 424
 Duct carcinoma, 618
 Dupuytren's contraction of palmar fascia, 223
 „ enterotome, 453
 Dysenteric ulceration of rectum, 472
 Dyspeptic ulcer of tongue, 403
 E.
 Eccentric atrophy of bone, 43
 Ecchondroses, 160
 Ectopia vesicæ, 576
 Elephantiasis scroti, 504
 Elevated fracture of skull, 253
 Embolism in arteries, 309
 Encephalitis, 264
 Encephaloid cancer of bone, 85
 Encephalocele, 267
 Enchondromata, 69
 „ of jaws, 384
 Encysted hæmatocele of spermatic cord, 513
 „ „ „ testis, 513
 Endosteal sarcomata, 77
 „ tumours of jaws, 383
 Enostoses, 65
 Enterocoele, 440
 Entero-epiplocele, 440
 Enterotome, use of, 452
 Epididymitis, 514
 Epiplocele, 440
 Epiphysis, necrosis of, 41
 Epiphysitis, 156
 Epispadias, 500
 Epithelioma of bone, 86
 Epitheliomatous ulcer of tongue, 405
 Epulis, epitheliomatous, 377

Epulis, fibrous, 375
 „ myeloid, 376
 Excision of joints, 179
 „ larynx, 364
 „ rectum, 487
 Exfoliation of bone, 33, 36
 Exostosis, 64
 „ cancellous, 65
 „ compact, 67
 „ ivory, 67
 „ malignant, 80
 „ multiple, 67
 „ mushroom, 67
 „ soft, 65
 Extroversion of bladder, 576
 F.
 Fallopian tube in hernial sac, 442
 False joint, 98, 124
 „ passages, 500
 Fasciæ, diseases of, 223
 „ contraction of, 223
 Fatty degeneration of prostate, 543
 „ tumour of bone, 543
 „ „ breast, 598
 „ „ spermatic cord, 532
 Fauces, carcinoma of, 412
 „ syphilis of, 410
 „ tubercle of, 411
 Femoral hernia, 459
 Femur, dislocation of, 197
 „ fracture of, 117, 118, 125, 129
 Fibro-adenoma, 602
 Fibula, fracture of, 136, 139
 Fingers, dislocation of, 197
 Fistula in ano, 473
 „ fæcal, 490
 „ urinary, 496
 Follicular laryngitis, 353
 Foot, dislocation of, 281
 Fracture, causes of, 89
 „ Colles', 111
 „ false joint after, 93
 „ fibrous union of, 97
 „ gunshot, 141
 „ Pott's, 139, 204
 „ repair of, 90
 „ „ in animals, 90
 „ „ in man, 93
 „ „ in compound, 99
 „ ununited, 97

- Fracture, varieties of, 89
 Fracture of astragalus, 140
 „ calcaneum, 140
 „ carpus, 116
 „ clavicle, 104
 „ costal cartilages, 102
 „ fibula, 139
 „ humerus, 107
 „ inferior maxilla, 101
 „ malar bones, 101
 „ nasal bones, 100
 „ metacarpus, 116
 „ os calcis, 140
 „ patella, 133
 „ pelvis, 116
 „ radius, 110
 „ rib, 102
 „ scapula, 105
 „ skull, 253, 256
 „ „ repair after, 567
 „ „ varieties of, 253
 „ spine, 240-244
 „ sternum, 104
 „ tarsus, 140
 „ tibia, 137
 „ ulna, 113
 Fusiform aneurysm, 325
- G.
- Galactoceles, 597
 Gall-stones impacted in intestine, 426
 Gall-bladder in hernial sac, 443
 „ rupture of, 422
 Ganglion, 219
 „ compound palmar, 219
 Gangrene from atheroma, 311
 Gastrostomy, 417
 Genito-urinary organs, injuries and diseases, 490
 Genu valgum, 59
 Gland, parotid, diseases of, 399
 „ thyroid, diseases of, 368
 Glanders, 351
 Glossitis, 402
 Glottis, oedema of, 355
 Goitre. See Bronchocele
 Gout in fasciæ, 223
 „ tendons, 217
 Gouty arthritis, 375
 Gunshot injuries, 141
 Gutter fracture of skull, 255
- H.
- Hæmatobia bilharzia, 564
 Hæmatocele, 512
 „ of cord, 532
 Hæmophilia, 173
 Hæmorrhage, intracranial, 258, 261
 „ subarachnoid, 261
 „ subcranial, 259
 „ subdural, 259
 Hæmorrhoids, 476
 Hand, dislocation of, 197
 Hard palate, necrosis of, 394
 „ tumours of, 394
 Hare-lip, 374, 398
 Heart, injuries of, 283
 „ wounds of, 285
 Heberden's nodes, 172
 Hernia, anatomy of, 437
 „ artificial anus in, 452
 „ cæcum in, 442
 „ cerebri, 265
 „ congenital, 455
 „ direct inguinal, 458
 „ encysted congenital, 456
 „ external inguinal, 453
 „ femoral, 459
 „ unusual forms of, 461
 „ of gall-bladder, 443
 „ impediments to reduction of, 444
 „ incarcerated, 452
 „ infantile, 456
 „ inflamed, 451
 „ inguinal, 453
 „ into canal of Nuck, 455
 „ „ fossa intersigmoidea, 433
 „ „ vaginal process of peritoneum, 455
 „ irreducible, 444
 „ oblique inguinal, 453
 „ obturator, 463
 „ of ovary, 442
 „ radical cure of, 452
 „ reducible, 443
 „ sac, appearance of, 438, 441
 „ „ contents of, 440, 442
 „ „ incomplete, 440
 „ „ inflammation of, 439
 „ „ obliteration of, 443
 „ „ sloughing of, 439
 „ „ sigmoid flexure in, 442
 special forms of, 453

Hernia, strangulated, 446
 „ „ causes of, 446
 „ „ mechanism of, 447
 „ „ réduction en masse, 450
 „ „ seat of stricture in, 446
 „ testis, 516
 „ umbilical, 463
 „ vermiform appendix, 442
 Hey's internal derangement of knee, 204
 Hip, dislocations of, 197
 Howship's lacunæ, 14
 Humerus, dislocation of, 191
 „ fracture of, 107
 Hunterian ligature, 298
 Hydatids of bone, 88
 „ muscle, 214
 „ vas deferens, 543
 Hydrocele, 507
 „ of cord, 530
 „ congenital, 509
 „ encysted, 509
 „ fluid, 507
 „ radical cure of, 511
 Hydrocephalus, 268-270
 Hydronephrosis, 582
 Hypertrophy of bladder, 551
 „ bone, 45, 46
 „ breast, 597
 Hypospadias, 500

I.

Imperforate anus, 488
 Infantile scurvy, 60
 Inferior maxilla, fracture of, 101
 Inflammation. See the Various Tissues
 Inguinal hernia, 453
 Injuries, gunshot, 141
 Internal abdominal strangulation, 426
 Intestines, impaction of foreign bodies in, 426
 „ rupture of, 423
 Intestinal obstruction, 424
 „ „ causes of, 425, 434
 „ „ chronic, 434
 „ „ varieties of, 425

Intracerebral hæmorrhage, 261
 Intracranial hæmorrhage, 258
 Intraosseous necrosis, 38
 Intussusception, 429
 Invagination of sequestrum, 33
 Irreducible hernia, 444

J.

Jaws, carcinomata of, 390
 „ cystic tumours of, 390
 „ dentigerous cysts of, 392
 „ diseases of, 377
 „ enchondromata of, 384
 „ fibrous tumours of, 381
 „ mercurial necrosis of, 379
 „ multilocular cystic tumours of, 391
 „ myeloid sarcomata of, 388
 „ myeloid tumours of, 82
 „ necrosis of, after cancrum oris, 380
 „ „ after fever, 379
 „ „ after injury, 380
 „ osteomata of, 384
 „ phosphorous necrosis of, 377
 „ reproduction of, 380
 „ sarcomata of, 387
 „ syphilitic necrosis of, 379
 Joints, ankylosis after excision, 182
 „ ankylosis of, 174
 „ chronic tubercular disease of, 147
 „ diseases of, 142
 „ dislocation of, 183
 „ epiphysitis of, 156
 „ excision of, 179
 „ hæmophilia of, 173
 „ loose bodies in, 176
 „ sacro-iliac, disease of, 158
 „ synovitis of, 142
 „ syphilitic disease of, 173
 „ triple displacement of, 152
 „ tubercular synovitis of, 148
 „ wounds of, 209

K.

Kidney, calculus in, 579
 „ carcinoma of, 589
 „ changes in, due to urethral stricture, 501
 „ inflammation of, 584
 „ injuries of, 423

Kidney, malignant disease of, 588
 „ operations on, 590
 „ rupture of, 423
 „ sarcoma of, 588
 „ surgical diseases of, 579
 „ tubercle of, 587
 Knee, congenital dislocation of, 209
 „ dislocation of, 203
 „ subluxation of, 204
 Knock-knee, 59
 Kyphosis, 56, 237

L.

Labial cysts, 501
 „ glandular tumours, 373
 Labium, cancer of, 502
 „ cysts of, 501
 „ hypertrophy of, 501
 „ sarcoma of, 502
 „ tumour of, 501
 Laceration of abdominal organs, 422
 Larynx, injuries and diseases of, 352
 „ foreign bodies in, 365
 „ excision of, 364
 „ ossification of, 363
 „ wounds of, 364
 Laryngeal adenomata, 361
 „ carcinomata, 363
 „ fibromata, 361
 „ papillomata, 360
 „ polypi, 360
 „ sarcomata, 362
 Laryngitis, acute, 352
 „ chronic, 352
 „ croupous, 356
 „ diphtheritic, 357
 „ follicular, 353
 „ syphilitic, 358
 „ tubercular, 353
 „ typhoidal, 358
 „ variolous, 358
 Lateral curvature of spine, 235
 Lepto-meningitis, 263
 Ligature of arteries, 294
 Lingual diseases. See Tongue
 Lipoma nasi, 347
 Lipomata of bone, 63
 Lips, congenital malformations of, 374
 „ diseases of, 372
 „ epithelioma of, 372
 Lithotomy, condition of bladder after, 547

Lithotrity, condition of bladder after, 547
 Liver, rupture of, 422
 Loose bodies in joints, 176
 Lordosis, 56
 Lower jaw, fracture of, 101
 Lupoid ulcer of tongue, 405

M.

Macroglossia, 402
 Malar bone, fracture of, 101
 Male breast, scirrhus of, 615
 Malformation of bladder, 576
 Malignant exostosis, 80
 Maxillary bone, malignant tumour of, 387
 Meckel's diverticulum, 427
 Melanotic sarcomata, 82
 Melon seed bodies, 221
 Meningitis, 262
 Meningocele, 267
 Meningo-myelocele, 250
 Mesentery, rupture of, 423
 Metacarpus, fracture of, 116
 Milk cysts of breast, 597
 Mollities ossium, 61
 Multilocular cystic tumours of jaws, 391
 Multiple polypi of rectum, 481
 Muscles, abscess of, 212
 „ entozoa of, 214
 „ fatty degeneration of, 211
 „ hydatids, 214
 „ ossification of, 212
 „ rupture of, 211
 „ trichina in, 214
 „ tumours of, 213
 „ ulceration of, 213
 Mushroom exostosis, 67
 Myeloid sarcomata, 79
 Myxœdema, 371
 Myxo-adenoma, 603

N.

Naegelé pelvis, description of, 272
 Nævus of cheek, 374
 Nasal bones, fracture of, 100
 Natiform skull, 50
 Necrosis, causes of, 24-28
 „ central, 10, 12, 37
 „ constitutional causes, 28
 „ from blows, 28
 „ „ burns, 27

Necrosis, from calomel, 28
 „ „ chicken-pox, 28
 „ „ falls, 28
 „ „ fever, 28
 „ „ fracture, 27
 „ „ glanders, 29
 „ „ mercurial fumes, 25, 26
 „ „ phosphorus, 25, 26
 „ „ rheumatism, 29
 „ „ syphilis, 28
 „ „ sawing, 27
 „ „ trephining 27
 „ „ whitlow, 26
 „ inflammatory causes of, 24
 „ intra-osseous, 38, 39
 „ of bone, 24
 „ cancellous tissue, 38
 „ epiphysis, 41
 „ hard palate, 394
 „ jaws, 377
 „ „ after cancrum oris, 380
 „ „ „ fever, 379
 „ „ „ injury, 380
 „ „ „ mercury, 379
 „ „ from phosphorus, 377
 „ „ reproduction after 380
 „ „ syphilitic, 379
 „ of shafts of long bones, 39-41
 „ of turbinated bones, 351
 „ peripheral, 36
 „ popliteal, 37
 „ quiet, 40
 „ special forms of, 36
 „ syphilitic, 51
 „ traumatic, 26
 Necrotic caries, 42
 Nephrectomy, 591
 Nephritis, 584
 „ suppurative, 584
 Nephro-lithotomy, 591
 Nephrotomy, 590
 Nerves, atrophy of, 277
 „ cysts in, 281
 „ repair of, 274
 „ section of, 278
 „ trophic changes in, 278
 „ tumours of, 279
 „ wounds of, 274

Neuroma, 279
 New bone, after necrosis, 33
 Node, 5
 „ hard, 6
 „ Heberden's, 172
 „ non-syphilitic, 7
 „ soft, 6, 51
 Nose, adenoid vegetations of, 348
 „ chronic inflammation of, 348
 „ deviation of septum of, 347
 „ glanders of, 351
 „ injuries and diseases of, 347
 „ lipoma of, 347
 „ necrosis of turbinal bones of, 351
 „ polypi of, 348
 „ rhinoliths of, 348
 „ rhinoplastic operation on, 351
 Nuck, hernia into canal of, 455

O.

Obturator hernia, 463
 Occipito-atlantoid disease, 232
 Odontoid process, caries of, 234
 Oesophagus, carcinoma of, 414-417
 „ dilatation of, 418
 „ fibrous stricture of, 413
 „ foreign bodies in, 420
 „ inflammation of, 412
 „ perforation of, 420
 „ post-mortem digestion of, 419
 „ rupture of, 419
 Omentum, hernia of, 440
 „ strangulated, 448
 Operations on kidney, 590
 Orchitis, 513
 Os calcis, fracture of, 140
 Osseous growth, diffuse, 68
 Osseous tumours, 64
 Osteitis, 12, 18, 21, 24, 25
 Osteitis deformans, 76
 „ syphilitic, 47
 Osteo-arthritis, 159
 „ of elbow, 166
 „ hands, 167
 „ hip, 163
 „ knee, 165
 „ shoulder, 164
 „ spine, 167, 239
 „ suppuration in, 167
 „ of temporo-maxillary joint, 167

- Osteomata, 64
 " of jaws, 384
 Osteo-malacia, 61
 Osteo-myelitis, 8-12
 " circumscribed, 37
 " diffuse, 10
 " idiopathic, 10
 " infective, 10
 " septic, 10
 " simple, 8, 24
 " traumatic, 11
 Osteophytes, 161
 Ovary in hernial sac, 442
 Oxalate of lime calculus, 366

 P.
 Pachymeningitis, 263
 Palate, cleft, 398
 " hard, congenital malformation of, 375, 398
 " " disease of, 394
 " " epithelioma of, 395
 " " fatty tumours of, 395
 " " fibrous tumours of, 395
 " " necrosis of, 394
 " " tumours of, 394
 " soft, dermoid tumour of, 397
 " " fibro-adenoma of, 396
 " " myxomata of, 396
 " " sarcoma of, 396
 " " syphilis of, 397
 " " tubercle of, 397
 " " tumours of, 396
 Palmar ganglion, 219
 Paracentesis, injuries during, 421
 Paronychia tendinosa, 218
 Parotid gland, diseases of, 399
 " " tumours of, 399
 Parrot's nodes, 50
 Patella, dislocation of, 202
 " fracture of, 133
 Pelvis, rickets of, 57, 272
 " fracture of, 116
 " in angular curvature, 273
 " in lateral curvature, 272
 " in mollities ossium, 272
 " in oblique distortion, 272
 " in rickets, 57, 272
 Penis, carcinoma of, 491
 " chancre of, 491
 " congenital malformation of, 500
 " phagedæna of, 490
 " tubercle of, 491
 " warts on, 490
 Perforating ulcer of foot, 281
 Periosteal sarcomata, 74
 Periostitis, acute infective, 5
 " " simple, 3, 24
 " chronic, 5
 " diffuse infective, 3
 " ossifying, 6
 " suppurative, 7
 " syphilitic, 47
 Peripheral necrosis, 36
 Pharynx, carcinoma of, 412
 " syphilis of, 410
 " tubercle of, 411
 Phlebitis, 332
 " adhesive, 332
 " suppurative, 343
 " causes of, 333
 " idiopathic, 332
 " plastic, 332
 " simple, 332
 Phlegmasia dolens, 342
 Phosphatic calculi, 566
 Pigeon breast, 58
 Piles, 476
 Pirrie's fracture, 205
 Polypi of bladder, 557
 " larynx, 360
 " nose, 348-351
 " rectum, 480
 Pond fracture of skull, 255
 Pott's curvature of spine, 224
 Pott's fracture, 139, 204
 Popliteal necrosis, 37
 Proliferous cysts, 597
 Prostate, calculi in, 543
 " carcinoma of, 541
 " chronic enlargement of, 534
 " diseases of, 533
 " fatty degeneration of, 542
 " inflammation of, 533
 " injuries of, 533
 " malignant disease of, 541
 " sarcoma of, 540
 " tubercle of, 541
 " retention of urine in enlargement of, 539
 Pseudarthrosis, 98
 Pulpy degeneration of synovial membrane, 149

Puncture of bladder, 547
 Punctured fracture of skull, 253
 Pyelitis, 584
 Pyelo-nephrosis, 584
 Pyonephrosis, 584

Q.

Quiet necrosis, 40

R.

Radius, fracture of, 110, 115
 „ dislocation of, 196
 Ranula, 408
 Rectal polypi, 480
 Rectum, carcinoma of, 485
 „ congenital malformation of, 488
 „ diseases of, 468, 490
 „ dysenteric ulceration of, 472
 „ excision of, 487
 „ fæcal fistula of, 489
 „ fibrous polypi of, 482
 „ „ stricture of, 483
 „ malignant stricture of, 485
 „ multiple polypi of, 481
 „ perforation of, 468
 „ prolapse of, 479
 „ simple stricture of, 483
 „ „ ulceration of, 469
 „ stricture of, 483
 „ syphilitic ulceration of, 470
 „ tubercular ulceration of, 473
 „ ulceration of, 469
 „ villous tumour of, 483
 Reducible hernia, 443
 Réduction en masse in hernia, 450
 Renal calculi, 579
 Respiratory tract, diseases of, 347
 Retention of urine in enlarged prostate, 539
 Rheumatic arthritis, 159
 Rhinoliths, 348
 Rhinoplastic operation, 351
 Ribs, fracture of, 102
 Rickets, 54
 „ deformities of bone in, 55
 „ cranium, 55, 270
 „ pelvis, 57, 272
 „ spine, 56, 270
 „ thorax, 56, 271
 „ scurvy, 60

Rupture of abdominal viscera, 422
 „ arteries, 293
 „ bladder, 545

S.

Sacculated aneurysm, 326
 Sacculation of bladder, 551
 Sacro-iliac disease, 158
 Salivary calculi, 401
 Sarcoma of bladder, 559
 „ breast, 608
 „ kidney, 588
 „ larynx, 362
 „ prostate, 540
 „ spine, 239
 „ testicle, 521
 „ tongue, 406
 Sarcomata, endosteal, 27
 „ in bone, 74
 „ melanotic, 82
 „ myeloid of bone, 79
 „ secondary changes occurring in, 83
 „ sero-cystic, of breast, 605
 Scirrhus cancer of bone, 85
 „ „ breast, 609
 „ „ „ unusual conditions of, 613
 „ „ of male breast, 615
 Scapula, fracture of, 105
 Scrotum, cancer of, 505
 „ elephantiasis of, 504
 „ epithelioma of, 505
 „ hypertrophy of, 503
 „ osseous tumour of, 507
 „ tumours of, 504
 Scurvy rickets, 60
 Senile struma, 53
 „ tubercle, 53
 Sequestrum, characters of, 29
 „ invagination of, 33
 „ separation of, 29
 Sero-cystic sarcomata of breast, 605
 „ tumours of breast, 604
 Serous cysts of breast, 597
 Simple cysts of breast, 597
 Shoulder, dislocations of, 191
 Skull, fractures of, 253
 „ hydrocephalic, 270
 „ myeloid tumours of, 82
 „ rickety, 55, 270
 Small-pox, laryngitis after, 358
 Soft node, 51

- Soft palate, tumours of, 396
 Soot cancer, 505
 „ wart, 505
 Spermatic cord, diseases of, 530
 „ fatty tumour of, 532
 „ hæmatocele of, 513, 532
 „ hydrocele of, 530
 „ varicocele of, 532
 Spina bifida, 248
 „ meningo-myelocele, 250
 „ spinal meningocele, 249
 „ syringo-myelocele, 251
 „ ventosa, 80
 Spinal cord, condition after fracture, 242, 243
 „ pressure upon in caries of spine, 231
 „ wounds of, 247
 Spinal meningocele, 249
 Spine, abscess of, 227
 „ angular curvature of, 224, 270
 „ anterior curvature of, 238
 „ atlas, dislocation of, 234
 „ carcinoma of, 240
 „ caries of, 225
 „ cervical caries of, 232
 „ cyphosis of, 237
 „ diseases of, 224
 „ dislocations of, 245
 „ „ atlas, 234
 „ enchondroma of, 239
 „ fractures of, 240
 „ kyphosis of, 237
 „ lateral curvature of, 235, 271
 „ lordosis of, 238
 „ malformations of, 248
 „ occipito atlantoid diseases of, 232
 „ odontoid caries, 234
 „ osteo-arthritis of, 239
 „ posterior curvature of, 237, 271
 „ rickets in, 56
 „ sarcoma of, 239
 „ tumours of, 239
 „ treatment of fractures of, 244
 „ tubercular disease of, 224
 Spleen, rupture of, 422
 Spontaneous fracture of calculi, 573
 Starred fracture of skull, 253
 Sternum, dislocations of, 190
 Sternum, fracture of, 104
 Stomach, gastrostomy of, 417
 „ rupture of, 423
 Strangulated hernia, 446
 Strangulation, internal abdominal, 426
 Stricture of œsophagus, 413, 417
 „ rectum, 483
 „ ureters, 593
 „ urethra, 492
 Struma, senile, 53
 Strumous caries, 22
 Subarachnoid hæmorrhage, 261
 Subcranial hæmorrhage, 259
 Subdural hæmorrhage, 259
 Subastragaloid dislocation, 206
 Subluxation of knee, 204
 Suppurative phlebitis, 343
 Surgical diseases of kidneys, 579
 Sweep's cancer, 505
 Synovial membrane, pulpy degeneration of, 149
 Synovitis, acute, 142, 145
 „ chronic, 147
 „ infective, 142
 „ traumatic, 142
 „ tubercular, of joints, 148
 Syphilis, changes in teeth from, 50
 „ in bone, 46, 49
 „ joints, 173
 „ larynx, 358
 „ soft palate, 397
 „ tongue, 405
 „ natiform skull in, 50
 „ of testicle, 519
 „ Parrot's nodes in, 50
 Syphilitic arteritis, 308
 „ caries of bone, 48
 „ necrosis, 51
 „ osteitis, 47
 „ periostitis, 47
 „ ulceration of bone, 48
 „ „ fauces, 410
 „ „ pharynx, 410
 „ „ rectum, 470
 „ „ tongue, 404
 Syringo-myelocele, 251
 T.
 Tabetic arthropathy, 168
 Tarsus, fractures of, 140
 Teeth, syphilitic changes in, 50
 Tendons, diseases of, 218

- Tendons, evulsion of, 214
 " gouty deposits in, 217
 " inflammation of sheaths of, 218
 " injuries of, 214
 " repair after section, 215
 " sloughing of, 218
 " tumours in, 217
 " uratic deposits in, 217
 Teno-synovitis, 218
 Tenotomy, repair after, 215
 Testis, encysted hydrocele of, 509
 Testicle, abscess of, 516
 " atrophy of, 528
 " carcinoma of, 523
 " cartilaginous tumour of, 525
 " congenital tumours of, 529
 " cystic disease of, 526
 " diseases of, 513
 " fibrous tumours of, 526
 " hæmatocele of, 513
 " chronic inflammation of, 515
 " fibroid degeneration of, 517
 " induration of, 516
 " inflammation of, 513
 " inflammatory infiltration of, 516
 " malignant disease of, 521
 " sarcoma of, 521
 " syphilis of, 519
 " tubercle of, 517
 " undescended, disease of, 528
 " undeveloped, 529
 Thorax in angular curvature, 271
 " in lateral curvature, 271
 " in rickets, 56
 " rickety, description of, 271
 Thrombosis, causes of, 333
 " from arteritis, 309
 " in veins, 331
 Thrombus, 331
 " appearances of, 338
 " changes in, 340
 Thumb, dislocation of, 197
 Thyroid gland, diseases and injuries of, 366
 Tibia, fractures of, 137
 Traumatic aneurysm, 293
 Toes, dislocation of, 207
 Tongue, aphthous ulcer of, 404
 " carcinoma of, 407
 Tongue, carcinomatous ulcer of, 405
 " chronic ulcer of, 403
 " dental ulcer of, 403
 " diagnosis between syphilis and cancer of, 407
 " diseases and injuries of, 402
 " dyspeptic ulcer of, 403
 " epithelioma of, 407
 " epitheliomatous ulcer of, 405
 " fatty degeneration of, 406
 " gummata of, 405
 " hypertrophy of, 402
 " inflammation of, 402
 " injury of, 408
 " lupoid ulcer of, 405
 " malignant disease of, 406
 " " ulcer of, 405
 " sarcoma of, 406
 " syphilitic diseases of, 405
 " " ulcer of, 404
 " tubercular ulcer of, 404
 " ulceration of, 403
 Tonsils, chronic inflammation of, 409
 " diseases of, 409
 " fibrous tumours of, 410
 Traumatic aneurysm, 289, 325
 Trichina spiralis in muscles, 214
 Triple displacement of joints, 152
 Trophic changes in nerves, 278
 Tubercle, senile, 53
 Tubercular caries, 21
 Tubercle of bladder, 556
 " bone, 52, 153
 " fauces, 411
 " kidney, 587
 " larynx, 353
 " pharynx, 411
 " prostate, 541
 " rectum, 473
 " soft palate, 397
 " testis, 517
 " tongue, 404
 " ureters, 597
 " vesiculæ seminales, 544
 Tubercular synovitis, 148
 Tufnell's treatment of aneurysm, 322
 Tumours of bladder, 557
 " breast, 597
 " cartilaginous, 69
 " fibromata, in bone, 64

Tumours, fatty, in bone, 63
 „ in veins, 336, 345
 „ labial glandular, 373
 „ osteomata, 64
 „ sero-cystic, of breast, 604
 Tunica vaginalis, diseases of, 507
 Turbinate bone, necrosis of, 351
 Typhoid fever, laryngitis after, 358

U.

Ulcer, perforating, of foot, 281
 Ulceration of bone, 17, 48
 Ulna, dislocations of, 196
 „ fractures of, 113, 115
 Umbilical hernia, 462
 Undescended testicle, disease of, 528
 Undeveloped testicle, 529
 Ununited fracture, 97
 Ureters, changes in, due to urethral
 stricture, 499
 „ diseases of, 593
 „ dilatation of, 594
 „ prolapse of, 499
 „ inflammation of, 593
 „ stricture of, 593
 „ tubercular ulceration of,
 595
 Urethra, anatomy of, 492
 „ annular stricture of, 494
 „ bridle stricture of, 494
 „ cartilaginous stricture of,
 495
 „ congestive stricture of,
 493
 „ false passage in, 500
 „ sloughing of, 497
 „ gristly stricture of, 495
 „ linear stricture of, 496
 „ organic stricture of, 493
 „ packthread stricture of,
 494
 „ spasmodic stricture of,
 493
 „ stricture of, 492
 „ traumatic stricture of, 493
 „ ulceration of, 495
 Urethral caruncle, 504
 „ stricture, causes of, 493
 „ „ changes in blad-
 der in, 498
 „ „ changes in kid-
 ney from, 500

Urethral stricture, changes in ureters
 in, 499
 „ „ consequences of,
 495
 „ „ impaction of cal-
 culus in, 498
 „ „ seat of, 493
 „ „ varieties of, 493

Uric acid calculi, 565

Urinary abscess, 496

„ fistula, 496

Urine, extravasation of, 495, 496

V.

Varicocele, 532

Varicose aneurysm, 291, 325

„ veins, 344

Variolus laryngitis, 358

Varix, 344

„ aneurysmal, 290

Vas deferens, diseases of, 543

„ hydatids of, 543

Veins, growths in, 336

„ inflammation of, 332

„ injuries of, 330-346

„ thrombosis of, 333

„ tumours of, 336, 345

„ varicose, 344

„ wounds of, 330, 335

Vermiform appendix in hernial sac,
 442

„ „ impaction of
 foreign body
 in, 424

„ „ removal of, 424

Vesiculæ seminales, diseases of, 543

„ „ tubercle of, 544

Villous growths of bladder, 558

„ „ rectum, 483

„ cancer of breast, 618

Volvulus, 428

W.

Wallerian degeneration, 275

Whitlow, 218

Wormald's dislocation, 198

Wounds of arteries, non-penetrat-
 ing, 290

„ „ penetrating, 286

„ heart, 285

„ veins, 330

Wrist, dislocation of, 197



ERRATUM.

Page 417, lines 21, 23 and 27, *for* 'Gastrotomy' *read* 'Gastrostomy.'

Page 418, line 1, *for* 'Gastrotomy' *read* 'Gastrostomy.'









