The anatomy, physiology, and diseases of the bones and joints / by Samuel D. Gross.

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THE

ANATOMY,

PHYSIOLOGY, AND DISEASES

OF THE

BONES AND JOINTS.

BY SAMUEL D. GROSS, M. D.

Philadelphia:

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PREFACE.

To those who are acquainted with the medical literature of the United States and Great Britain, the appearance of a work on the diseases of the bones and joints can not be surprising; to those who are not, it will be sufficient to say that this work was written because it was deemed necessary. Excepting the lectures of Professor Boyer, edited by M. Richerand, and translated by Dr. Farrell, there is no treatise in our language at all commensurate with the subjects before us. The works of Wilson, Brodie, Bell, Cooper, and others, although replete with important and useful information, are nothing but insulated monographs, intended rather for the experienced practitioner than for the inexperienced student. In our own country, the diseases of the bones and joints have hitherto received but little attention; and, excepting some detached papers, scattered through the various journals of the day, our knowledge upon these important subjects is derived almost totally from the works of European writers; works so difficult of access, either on account of the expense and trouble attending their importation, or on account of the languages in which they are written, as to be only within the reach of a few.

To supply these deficiencies, and to furnish the student with a plain, concise, and practical digest of the present state of the science, embracing an account of the most important facts and observations, are the objects of the present undertaking. The work contains little, if any thing, that is either new or unknown; it is strictly elementary; and is

designed expressly for the use of students and junior practitioners.

In describing the various accidents and diseases of the bones and joints, it has been my study to express myself at once with brevity, clearness, and precision, and to generalize the results of the labours and researches of others rather than to speak from personal observation and experience. The numerous sources from which I have derived my information have, in most instances, been faithfully indicated, either in the margin, or at the end of each chapter, section, or article, with a view not only of carefully assigning to each individual the share of merit which justly belongs to him, but also of facilitating the progress of those who may be desirous of consulting the literature upon the multifarious topics of which I have been treating.

The anatomical descriptions which will be found in the different parts of the work, are to be regarded as mere outlines or sketches, intended to make the student more intimately acquainted with what may be termed the surgical anatomy of the bones and joints, and to excite an interest which they would not otherwise possess.

"If," to use the language of an eloquent writer,* "any one should conceive the present undertaking to be above the capacity of my age, I will say, even at the risk of a paradox, that young men are perhaps best fitted to compose elementary works; because the difficulties which they have encountered in their studies, as well as the steps which they have taken to overcome them, are still fresh in their memory." That my work is without errors, I have neither reason to expect nor the vanity to suppose; the subjects which it embraces are too numerous and diversified to admit of perfection. My sole aim has been to make it useful, and, by rendering it as complete as is consistent with the present state of our information, to discharge a part of that debt, which, according to Lord Bacon, every man owes to his profession.

* Richerand. Preface to his Elements of Physiology.

It had been my intention, originally, to illustrate some of the most important diseases of the bones and joints, as well as some of the principal apparatus used in the treatment of fractures, by means of plates; but upon more mature reflection, it was thought best, at least for the present, to omit them, as the expense of the work would thereby be materially enhanced, and probably prevent many of those, for whom it is chiefly designed, from possessing it.

In concluding these remarks, it gives me great pleasure to return my very grateful acknowledgments to the managers of the Pennsylvania Hospital, and to Mr. Malin, the amiable and industrious librarian of that institution, for the assistance which I have received from the perusal of many scarce and valuable works, not contained in any other library in this country, and without which the present work could scarcely have been completed.

S. D. GROSS.

Easton, July, 1830.

PART I.

THE ANATOMY, PHYSIOLOGY,

AND

Diseases of the Bones.

THE

Anatomy, Physiology, and Diseases

OF THE

BONES.

CHAPTER I.

Of the General Anatomy of the Bones.

SECTION I.

General Observations.

Definition.—The bones consist of an assemblage of hard, inflexible organs, which determine the general configuration of the body, furnish points of attachment to the muscles and ligaments, and are peculiarly fitted to give support to the soft parts.

Number and Division.—The number of bones of the human body has been variously estimated by different writers; but, in general, they amount to about two hundred and sixty. This estimate will be found to agree with that of Sœmmering,(*a*) Boyer,(*b*) Monro,(*c*) and the best anatomists of the present day. The bones exhibit every variety of figure and size, according to the part in which they are situated, and the offices which they are intended to fulfil. They are usually divided, however, into long, short, flat, and mixed. These four varieties, as will be seen hereafter, differ not merely in their external appearance, but likewise

(*a*) Corp. Hum. Fabric. § 12.

(*b*) Traité d'Anatomie, T. 1. p. 12.

(*c*) Outlines of Anatomy, vol. I. p. 14—15.

in the more essential points of their mechanical structure, their uses, and mode of development.

Situation.—The bones are always situated in the centre of the soft parts, and are covered by the muscles and the common integuments. This is the case not only in the human subject, but in all the vertebrated animals; but whether the hard osseous investment of crustacea and insects be strictly analogous to the bony skeleton of the higher classes, appears to be a point which has not yet been fully determined by naturalists and comparative anatomists.

Bony eminences and depressions.—The surfaces of the bones are marked by numerous eminences and depressions, which always modify their general conformation and are adapted to various purposes. The eminences may be divided into two great classes, into the articular and non-articular: the former of which are incrusted with cartilage, and enter into the composition of the joints, while the latter are more or less rough, are destitute of cartilage, and are intended for the most part to furnish points of attachment to the muscles and ligaments. The non-articular eminences are extremely numerous, and are generally smaller, and more imperfectly marked in women than in men, and in children than in adults.(*a*) The form of these eminences is also various: some consisting of diffused asperities, while others extend along the surface like rough lines, or project more or less from the bone, and are calculated to give origin and insertion to muscles, and increase their power of action. In consequence of these varieties of form, writers on osteology have usually been in the habit of distinguishing these eminences into several species. Thus, when they are extended from the extremity of a bone, and are smooth and round, they are commonly called heads; and condyles, when flattened either above or on their sides. When they are short, rough, and unequal, they are denominated tuberosities, or

(*a*) Bichat, Anatomie Generale, T. 3. p. 14. Paris, 1827.

tubercles; but the longer and more acute, are styloïd, or spinous, from their supposed resemblance to a species of thorn. The narrow and salious eminences are distinguished by the name of cristæ, or sharp prominent edges; others again, owing to their peculiar form, are called mamillary, or mastoïd, alar, or pterygoïd, and dentiform, or odontoïd. Examples of these last varieties, may be found in the temporal and pterygoïd bones of the head, and in the second vertebra of the neck.

The depressions or cavities on the external surface of the bones, like the eminences just alluded to, may be distinguished into articular and non-articular. The former, which, like the corresponding eminences, are incrusted with cartilage, and enter into the composition of the joints, will be treated of in a subsequent part of this work; at present we shall speak only of the non-articular. The non-articular cavities are extremely numerous, and are usually divided into external and internal. As a general rule, it may be assumed, that the external cavities are so superficial as to form mere depressions, though in some instances, as in the fossa navicularis of the os humeri, they constitute true cavities. The depressions are designated by various names, according to the magnitude and figure of the bones to which they belong. When they are large and broad at the beginning, and rather superficial and contracted at their ends, they are called foveæ or pits; when they are deep, narrow at their commencement, and wide in the remainder of their extent, they are denominated cells or sinuses, according to their number and capacity, which are always in an inverse ratio; the former being predominant in the cells, the latter in the sinuses. (*a*) Grooves or furrows are open canals which extend in the longitudinal direction of the surface of the bones, and are intended mostly to afford lodgment to blood-vessels and nerves

(*a*) Bayle and Hollard's Manual of General Anatomy, translated by Dr. S. D. Gross, p. 113. Philadelphia, 1828.

and to the tendons of muscles, as the bicipital groove of the bone of the arm. When there is a hollow, circular tube, which retains almost the same diameter from its commencement to its termination, and is more or less crooked or straight, long or short, it is denominated a canal. If the margin of a bone be of such a form as to exhibit the appearance as if a portion were taken out of it, it is called a notch. The foramina, on the contrary, are the apertures of canals, or they are formed by the excavated or hollow margins of two bones, placed against each other.

The cavities and depressions on the external surface of the bones serve for the attachment of the muscles and ligaments, and by giving the fibres of the former a more extensive surface of insertion, without increasing the size of the bone, they afford them more room for contraction. They serve also for the reception of some of the more delicate organs, for the passage of blood-vessels and nerves, and a variety of other purposes, which it would be needless to enumerate on the present occasion.

The different osseous eminences and cavities are formed either by a single bone, or, as it is more frequently found to be the case, by the union of two or more of these organs.(*a*) In many instances, also, the bones present asperities, or rough, unequal surfaces, which are designed to give insertion to muscles, ligaments, and aponeurotic fasciæ.

In addition to the cavities and foramina which are observed on the outer surface of the bones, there are some which occupy their central parts, and modify, in a very remarkable manner, their internal conformation. These cavities, of which we shall speak more fully hereafter, are always more perfect and conspicuous in the centre of the bones than at their extremities, and appear to be the immediate result of the texture of these organs (*b*). In some

(*a*) Meckel, Manuel d'Anatomie, T. 1. p. 295. Paris, 1825.

(*b*) Bayle and Hollard, op. cit. p. 114.

parts, as in the bodies of the long bones, they exhibit the appearance of large canals, while in the other parts of the osseous system they are presented under the form of cells, varying in number, size and shape, in the different parts of the body, and even in the different parts of the same bone. The use of these cavities is to protect the marrow or adipose substance of the bones, and to render them more light and strong.

Structure.—The proper structure of the bones is of a fibro-lamellated nature, in some parts the fibres being so closely aggregated together as to constitute a firm and compact substance, while in others they are separate, and enclose numerous spaces or cells, which give rise to the porous and spongy appearance which is observable in some of the bones, especially in the short, and the extremities of the long ones. The compact substance, which always serves as an investment to the other, and which, from this circumstance, has not unfrequently been called substantia corticalis or cortical substance, is so close in its texture, and so intimately connected together, that it is impossible by the naked eye to discover any interstices in it. By the aid of the microscope, however, we are enabled to discern numerous minute vascular canals, which run in a longitudinal direction, in the long bones, and maintain a free communication with the vessels on their external surface, and laterally with the great medullary cavity (*a*). The fibres of the compact substance are extremely irregular, and are applied upon each other so as to form lamellated layers, which are united together by numerous transverse or oblique fibrillæ. These lamellated layers or plates may be rendered perceptible by long continued ebullition, by maceration, by exposure to the weather, and in cases of mortification or necrosis of the osseous tissue.

The spongy or cellular structure of the bones is formed

(*a*) Quain's Elements of Descriptive and Practical Anatomy, p. 42-3. London, 1828.

by an interlacement of the osseous fibres and cancelli, and exhibits a great variety of cells, which are not unlike those of sponge or inflated cellular tissue (*a*). These cells, which are so large in some places as to present the appearance of a reticular or net-like texture, communicate freely with each other, as may be proved by pouring a small quantity of fluid mercury into the extremity of a long bone, or upon the surface of a short or flat one. The mercury will be found not only to penetrate through the cells, but it will also make its way through the vascular foramina, on the external surface.

The cells and cancelli, which have been distinguished by some writers, especially by Gagliardi (*b*), an anatomist who flourished in the latter part of the seventeenth century, into net-like, wrinkled and perforated, serve to sustain the adipose substance of the bones, to render them light, and to give passage to the blood-vessels which are distributed through the osseous tissue.

The osseous texture, as will be seen presently, is nothing but a kind of cellular tissue, which retains the interior form of its primitive state until the fat is deposited into its cells, when it becomes gradually hardened by its union with a gelatino-calcareous substance.

The view which has now been given of the internal structure of the bones, will be found to agree with that which is entertained upon the subject by the most distinguished anatomists of the present day. As it may not be uninteresting, however, to the student, to become acquainted with some of the principal opinions that have been promulgated at different periods, we shall endeavour to give a brief account of them in this place.

The mechanical structure of the bones formed a part of the investigations of Malpighi, a celebrated professor of Bo-

(*a*) Bayle and Hollard's Manual of General Anatomy, by Dr. Gross, p. 115.

(*b*) Anat. Ossium, Cap. 1. obs. 4 et Seg. Romæ, 1689.

logna, and physician to Pope Innocent the XII. He was born in 1628, and was the first anatomist in whose hands the knowledge of intimate structure became a science of accurate observation. Aided by the microscope, an instrument which he first employed in examining the circulation of the blood; he made a great number of experiments, and was thence led to believe that the bones are composed of a lamellated structure, analogous to the leaves of a book. This doctrine was no sooner promulgated, than it was embraced by the ingenious and fanciful Gagliardi, the friend and contemporary of Malpighi. This anatomist made his observations upon the bones which he found in some of the church-yards of Italy; and by a kind of loose analogy, which is unfortunately too frequently introduced in every department of science, he conceived that the bony laminæ or plates were held together by minute processes, which passed from one plate to the other, so as to perform the offices of nails. These he represented as being of four kinds, straight or oblique, crooked or hook-like, and some with small round heads, somewhat similar to bolts or pins.

This opinion, although exaggerated, is by no means destitute of truth; for, by a careful examination of the bones, it will be found, as has been already stated, that the different laminæ are connected together by a great number of small oblique or transverse fibres or little processes.

Clopton Havers, who wrote a treatise on Osteology, in the latter part of the seventeenth century, is of opinion that the ultimate particles of the bones consist of fibres, which are aggregated together in the form of laminæ. These laminæ, according to this anatomist, are applied upon each other, and are traversed by longitudinal and transverse pores (*a*). This opinion was afterwards adopted by Wins-

(*a*) Osteologia Nova, p. 34 et seq. London, 1691.

low (*a*), Palfyn (*b*), Monro (*c*), Reichel (*d*), and other anatomists; and in their writings may be found various attempts to communicate a correct idea of the intimate structure of the osseous texture (*e*). The views of these writers, which were almost universally embraced by the anatomists of the eighteenth century, were first disputed by Professor Scarpa, of Pavia. In a work on the minute structure of the bones, published in 1795, this gentleman relates a great number of experiments, by which he attempts to show that bone, deprived of its earth by acid, and exposed to long continued maceration in pure water, consists, both externally and internally, of a cellulo-reticular structure. These views are probably correct as far as regards the original condition and ultimate analysis of bone; but they are unquestionably erroneous in reference to the state of the osseous tissue, when merely deprived of its earthy matter, and not subject to prolonged maceration, which completely destroys the fibrous arrangement already described.

Considerable light has lately been thrown upon this subject by Mr Howship of England. In his microscopic observations and experiments, of which an account has been published in the London Medico-Chirurgical Transactions (*f*), he has been led to revive the opinion of the existence of the minute longitudinal canals as entertained by Havers and Reichel; but agrees with Scarpa in asserting that the ultimate tissue of the bones is not of a laminated but reti-

(*a*) Anatom. Exposition, Trans. by G. Douglas, vol. 1. p. 8–9. London, 1743.

(*b*) Anatomie Chirurgicale.

(*c*) Anatomy of the Bones, &c. Edin. 1768.

(*d*) De Ossium Ortu, &c. §. V.

(*e*) "In general, says Winslow, op. cit., these fibres are so disposed as to form in some bones laminæ of a considerable extent; in some, little plates or small portions of the fore-mentioned laminæ; and in others, filaments of different sizes."

(*f*) Vol. 6. p. 287, and vol. 7. p. 392, et seq.

cular nature. As the limits of the present work are too restricted to enable us to do justice to the ingenious and highly creditable investigations of Mr. Howship, we must content ourselves by referring the reader to the work, to which we have just alluded, observing merely that future experiments will probably alone be able to determine the validity of his results.

Arteries, veins, nerves, and lymphatics.—Although the bones are more uniform in their appearance than any other parts of the body, they are evidently supplied with a great number of blood-vessels, nerves and lymphatics, as may be proved by a variety of circumstances.

1. *Of the blood-vessels.*—The arteries which enter the substance of the bones have lately been divided by anatomists into three orders. The first comprehends the small arteries which are observed to enter the minute capillary foramina on every part of the outer surface of the osseous system. They are derived from the vascular retiform arrangement of the periosteum, and are distributed to the compact or cortical substance of the bones. The second order consists of the branches which enter the foramina at the extremities of the long and the surfaces of the short bones, and is ramified upon their spongy substance; while those of the third order, which are generally, though erroneously, known by the name of nutrious arteries, pass through the long bones, properly so called, and are distributed to the membrana medullaris. The arteries of the third order are always accompanied by veins which correspond to them in number and size; but are by no means sufficient to return the blood which is conveyed to the bones by the arteries. The first two orders of arteries, on the contrary, are never accompanied by veins; for these vessels always pass out at separate orifices.

The veins of the osseous system, which were first described, in 1803, by Professor Dupuytren, of Paris, arise by a great number of small roots, which unite in a gradual

manner, like the veins of the soft parts, and form small twigs, then branches, and finally considerable trunks. These vessels pass through the spongy and compact substance of the bones, and terminate at length in the veins which are observable on their outer surface. The parietes of the veins of the bones, consist merely of the internal membrane of the venous system, and exhibit a very remarkable cellular arrangement, somewhat similar to that which constitutes the erectile tissue of the clitoris and the corpora cavernosa penis. Their walls are extremely thin, delicate, and transparent, are destitute of cellular substance, and are applied so firmly against the surface of the bones through which they pass, that they are altogether incapable of undergoing the slightest degree of motion.(*a*)

The existence of the arteries and veins of the bones can be demonstrated by injection, and a variety of other ways, as sawing, cutting and rasping. When they are filled with fine red matter, and steeped in nitric or muriatic acid, until the bone is deprived of its earthy substance, they will become quite distinct, especially if the bone be immersed in oil of turpentine.

The vessels of the osseous tissue undergo remarkable changes in consequence of age. In infancy and youth they are not only comparatively larger, but they are also much more numerous than in old age and decrepitude.

2. *Of the nerves and lymphatics.*—The nerves and lymphatic vessels of the osseous system are so extremely delicate as to elude observation; but there is every reason to suppose that they enter into the composition of the bones, especially if it be considered that the bones are living organized substances, and that they are liable to the same changes and diseases as the other parts of the body. Were this not the case they would be dead matter like the enamel of the teeth, the epidermis, the nails, and the hair; under-

(*a*) Meckel's Manuel d' Anatomie, T. 1. p. 300 et seq.

going no alteration during health, and suffering no derangement from disease.(*a*)

Remark.—Professor Langenbeck, one of the most able and accomplished of the anatomists and surgeons on the continent of Europe, is of opinion that the nerves form a kind of pulpy substance in the cells and medullary cavities of the bones, in the same manner as in the canals or cavities of the teeth.(*b*) Whether this opinion is correct, future observation can alone determine. As to myself I am inclined to believe that the nerves of the osseous tissue are conveyed to the bones through the medium of the arteries, that they enter the same foramina, and that they are, as it were, concealed in their coats, so as to escape our observation: this opinion, I find, is also entertained by J. C. Rosenmüller, (*c*) formerly professor of anatomy in the University of Leipzig.

Chemical properties.—Though the bones have been submitted to analysis by a great number of distinguished chemists, the results which have been hitherto obtained, are by no means so satisfactory as we might have reason to suppose. According to Berzelius, a celebrated chemist of Stockholm, one hundred parts of human bones consist of

Cartilage,	32.17
Blood-vessels,	1.13
Fluate of lime,	2.
Phosphate of lime,	51.09
Carbonate of lime,	11.30
Phosphate of magnesia,	1.16
Soda, hydro-chlorate of soda and water,	1.20

The results of this analysis are somewhat different from those obtained by Fourcroy and Vauquelin. According to these gentlemen, the bones consist of

Animal matter,	51.
Phosphate of lime,	37.7

(*a*) Lizars' Anatomy, vol. 1. p. 114.

(*b*) Neue Biblioth. für die Chirurgie und Opthalmologie, B. 1. p. 17.

(*c*) Handbuch der Anatomie, p. 9. Leipzig, 1815.

Carbonate of lime, ...	10.
Phosphate of magnesia, ...	1.3

In addition to these ingredients, the analysis of these chemists has furnished them with traces of the oxide of iron and manganese, silica, and alumina. The chemical composition of the bones also varies according to the age and health of the individual, according to the different parts of the body, and even in the different parts of the same bone.

If a portion of bone be subjected to the action of a charcoal fire, and the heat be gradually raised, it will be found to burn first with a considerable flame and to emit a disagreeable animal odour, and at length to become almost perfectly red. If it be now carefully removed and permitted to cool in a slow and gradual manner, it will exhibit a white chalk-like appearance, and be so light and brittle as to crumble on the slightest touch. In this operation the animal matter is removed by destructive decomposition, while the earthy matter remains almost entirely unchanged; at the same time that the bone retains its mechanical figure, having merely lost a small portion of its weight. These results may also be obtained in a more or less perfect manner by long continued boiling. A large part of the animal matter of the bone will thus be extracted, and furnish a solution, which, on becoming cool, gradually concretes into a kind of tremulous, gelatinous mass.

If a bone be exposed for some days to the action of a solution of nitric, muriatic, sulphuric, or acetic acid,(*a*) the saline or inorganic part is gradually removed, while the organic part remains and becomes gradually soft, flexible, and elastic. When dried it will be found to have lost a part of its weight, which is in direct proportion to the quantity of saline matter taken up by the acid; yet it will be impossi-

(*a*) For this purpose the acid should be in the proportion of one ounce to sixteen of water; and the mixture should be frequently changed, in order to expedite its action.

ble to perceive that the least atom of its substance has been mechanically removed, or that its form and aspect have been in any wise altered.

When bones have been thus prepared they present a homogeneous appearance, but by prolonged maceration in water they may be resolved into different layers, each of which will be found upon examination to consist of a series of fibres. By continuing this process, the fibres will gradually become soft and swollen, and at length exhibit an areolar texture, similar to the cellular tissue of the soft parts. It may be reasonably concluded, therefore, that this areolar texture is the nidus which receives that hard, calcareous, inorganic substance, which gives firmness and solidity to the osseous tissue.

The general results of these analyses serve to show that the bones are essentially composed of two substances, an animal and a saline one. For the discovery of this important distinction we are indebted to M. Herissant, a celebrated French anatomist, who lived about the middle of the eighteenth century, and who greatly contributed, by his industry and talents, to dispel the darkness which pervaded some of the most interesting parts of the organization of the human body.(*a*)

The bones, considered as dead matter, are the most permanent and unchangeable parts of our bodies. Long, in fact, after the soft parts have mouldered into dust and entered into new creations, they alone remain as the sad memorials of the dead. They withstand the continual revolutions which are taking place on the surface of the earth, and after the lapse even of many centuries, they are not unfrequently found in a state of excellent preservation. This circumstance has already proved of essential service to the naturalist, and has enabled him to enrich his zoological tables with accounts of animals that have long since ceased to inhabit our globe.

(*a*) Mem. Del. Acad. for 1758, p. 322.

Colour.—The colour of the bones varies according to the age and constitution of the individual, the disease which proved fatal to his existence, and the manner in which they have been prepared. During life they are usually of a bluish tint, owing to the number of blood-vessels which enter into their substance; but when properly dried, they are of a yellowish white, or light brown colour. The bones of dropsical subjects, in whom the marrow has been in part absorbed, and the air-bones of birds, are almost entirely white. It is well known, too, that bones which have been repeatedly washed in common lie, or sea-water, and then exposed to the sun, are much whiter than such as are prepared in the ordinary way.

It has been stated by a late writer,(*a*) that the bones of the negro are whiter than those of the European; but from my own experience upon the subject I am inclined to doubt the accuracy of the assertion. I am certain, indeed, that this difference can have no real existence, and that it is to be attributed rather to a peculiar mode of preparation of the bones than to any national or generic peculiarity.

Remark.—In some of the inferior classes of animals the bones have a very peculiar colour, different from any thing that can be observed in the human subject: thus, in some of the varieties of the common fowl, they have a dark dusky appearance, while in other animals again, as in the garpike, they are green.(*b*)

In infancy and youth the bluish colour of the bones is much more conspicuous than in any other period of life. In old age, in fact, it is seldom ever perceptible, in consequence, no doubt, of the great diminution in the number and size of the blood-vessels which are distributed to the osseous tissue. In cases of death from drowning or suffocation, the bones are

(*a*) Elements of Anatomy, by Alexander Monro, vol. i. p. 24. Edinb. 1825.

(*b*) Blumenbach's Manual of Comparative Anatomy, by Lawrence, p. 2. London, 1827.

said to be naturally well injected, a circumstance affording additional evidence of their vascularity. (*a*)

Various substances, such especially as the extract of log-wood and the rubia tinctorum, or madder, have the property of communicating to the bones of living animals peculiar colours. When taken with their food they alter the natural colour of the bones; the former giving them a purplish tint, the latter a crimson hue. These changes take place more rapidly in the bones of young, than in those of old animals, as has been ascertained by direct experiment. In young pigeons a rose-coloured tint may be communicated to the osseous tissue in about twenty-four hours; while it requires several days to effect the same thing in the bones of adult pigeons. If a young animal be fed for some time on madder, and then on ordinary food, the bones will gradually lose their red colour, and at length resume their former appearance. (*b*) From this fact physiologists have been led to conclude that, during life, the osseous tissue is subject to a constant renovation, and that this is more active in the early than in the subsequent periods of our existence. (*c*)

The phenomena above alluded to have been attempted to be explained by Dr. Rutherford, of Edinburgh, on the assumption that there is an elective attraction between the

(*a*) Craigie's Elements of General Anatomy, p. 534. Edinb. 1828.

(*b*) This well-known experiment, which was performed by Misaud, as early as 1572, is attended with very imperfect success in cold-blooded animals.—Blumenbach's Comparative Anatomy, by Lawrence, p. 1.

(*c*) From the experiments lately performed by Dr. Mussey, Professor of Anatomy and Surgery in Dartmouth College, New Hampshire, it appears that the colouring principle of madder may be communicated to the bones of the fœtus while yet locked up in the womb of its mother. About three or four ounces of madder were daily mixed with the food of a sow during the last eight weeks of utero-gestation. On the day the farrow was produced several of the pigs were killed, and upon examination it was found that every bone was strongly tinged with red, and that even the teeth were stained with a delicate pink colour.—The American Journal of the Medical Sciences, vol. 5. p. 20.

phosphate of lime of the bones, and the colouring principle of the mordant substance.

Characters and physical properties.—Having now given an account of the structure, the colour, and chemical composition of the bones, we shall proceed, in the next place, to take a brief view of their characters and physical properties.

The bones are characterised by a great degree of hardness and solidity, which are owing, as has been already stated, to the saline matter that is found to enter into their substance. In many parts they are extremely compact and resisting; and they are endowed with but a very small share of flexibility and elasticity. These two properties, which are more conspicuous in the long and small bones, than in those that are larger, are very evident in the early parts of life; but they gradually diminish, and are entirely wanting in old age.

Bichat, to whom general anatomy is indebted for many of its most important improvements, was of opinion that the bones, notwithstanding the hardness and solidity of the osseous tissue, were endowed with a very evident degree of extensibility and contractibility. Their power of extension he supposed to be proved by the observation of numerous diseases, as for instance, in cases of hydro-cephalus, spina-ventosa, and enlargements of the maxillary sinuses, or the nasal cavities. Nothing, however, can be more erroneous than this hypothesis; an hypothesis which, like many of its predecessors, has been discarded by most anatomists since the time of its illustrious founder.

Vital properties.—In the healthy state the sensibility of the osseous tissue is so inconsiderable that the bones may be sawed or cut with almost perfect impunity. The application even of the actual cautery scarcely produces any pain; and the same may be said with regard to chemical re-agents, such, for instance, as the nitric or muriatic acid. When the osseous tissue, however, is in a state of disease, it becomes highly sensitive, and often gives rise to the most excruciating pain. Nothing, therefore, can be a better proof of the vitality of

the bones than this circumstance; for, although this property is quite obscure in their sound or healthy state, yet when they are morbidly affected, they are subject not only to inflammation, but likewise to suppuration, ulceration, and even mortification; thus showing in the most conclusive manner that they possess the same properties, though in a less degree, as the other parts of the body, of which they have too often been considered, if I may so express myself, as semi-dead appendages.

Remark.—Dr. Bostock, a late writer on physiology, is of opinion that the bones, in their healthy state, are entirely destitute of sensibility; a doctrine not altogether correct, as may be shown by direct experiment.(*a*)

Formation of bone.—The formation of bone has engaged the attention of physiologists perhaps more than any other subject in natural science. The ancients, who were unacquainted with the nature of bone, could, of course, form no correct idea upon this subject, and they were accordingly contented with the belief that there were floating in the blood ossific particles, which became condensed either by the evaporation of their watery substance, by the effects of pressure, or by the operation of animal heat. These fanciful hypotheses, however, as well as many others, equally erroneous, have long since been refuted by modern physiologists, especially by Haller and Albinus.

Without attempting to give a historical account of the opinions of physiologists, ancient and modern, respecting the conversion of the cartilaginous into the osseous tissue, I shall merely observe that it is the belief of modern writers that ossification results from a change of nutrition in the cellular structure of the temporary cartilage, in consequence of an increased flow of blood, and that by virtue of this change the albuminous homogeneous substance of the cartilage is converted into a lamellated, gelatino-calcareous tissue.

(*a*) Elements of Physiology, vol. i. p. 101.

Progressive development.—If the fœtus be examined in the earliest stages of its existence, it will be found that the bones, like all the other parts of the body, are at first in a fluid state, that they become gradually gelatinous, and that they pass successively into the fibrous and fibro-cartilaginous states, and from these into the osseous. During the early periods of embryotic life, the bones form an uninterrupted whole, of a soft homogeneous consistence, and of a white transparent aspect. About the fourth or fifth week the parts corresponding to the future skeleton are perfectly distinguishable, and their general outline is distinctly defined. The vessels at this period convey and deposit gelatine, the basis of the cartilaginous state, which is usually completed about the end of the second month; for it is at this time that the deposition of ossific matter in some parts begins to take place. The cartilages, being merely temporary substitutes for bone, differ from it in many respects. They present no appearance of fibres or vessels, have no internal cavity or medullary tissue; they are solid and homogeneous in their whole extent, but possess the outward form of bone, and are invested by a fibrous membrane analogous to that of bone. There is another peculiarity which deserves notice, and this is, that all those parts which are intended to be replaced by the flat bones, represent a continuous layer, without any perceptible boundary or distinction. About the eighth week the cartilage, which, for a longer or shorter time, supplies the place of bone, becomes hollowed into irregular cavities, and shortly afterwards into canals lined by a vascular membrane, and filled by a mucilaginous and viscid fluid. At this period a red speck is seen at some particular point, and ossification immediately commences. The first point of ossification is always situated within the substance of the cartilage, and never at its surface. Bichat was of opinion that the vessels were not developed at this period; that they existed before, but circulated only white fluids, and then for the first time began to admit red globules. But be this as it may,

the change is marked by the simultaneous admission of blood into the interior of the cartilage, and the deposition of calcareous matter. The cartilage always appears red and injected, where it is in close contact with the ossified points; but more externally it is somewhat opake, and marked by grooves or canals. Still farther outwards it retains its original character, presenting, however, in a few points some vascular canals directed towards the centre of ossification. As the process proceeds, the osseous point augments progressively by means of additions on its surface, as well as by an interstitial deposition in its substance, whilst the cartilage, as it becomes excavated by canals and cavities, lined by a vascular sheath, diminishes gradually as the bone increases, and finally, when ossification is completed, entirely disappears. (*a*)

Ossification commences, as has been already stated, about four or five weeks after conception, and is not entirely completed before the fourteenth, and in some unimportant accessary parts, not until the twentieth or twenty-first year. Ossification does not appear to result uniformly from the conversion of cartilage into bone. According to Howship, Serres, and Béclard, some parts of the osseous system, such as the diaphyses of the long, and the central portions of the broad bones, pass immediately from the mucous into the osseous state. The other parts of the system, however, are at first in a cartilaginous condition, and it is in them, more particularly, that we are enabled to observe the successive stages of ossification (*b*).

In the human subject the bones are developed in a slow and gradual manner, and may be observed to pass through the same stages of organization as in the lower animals. As a general rule it may be stated, also, that the long bones are formed before the broad or flat, and these before the

(*a*) Béclard's Anatomie Generale, p. 498.—Quain's Elements of Anatomy, p. 46—7.

(*b*) Béclard, op. cit. p. 462.

short.—The deposition of ossific matter generally takes place sooner in the bones which are situated nearest to the nervous and sanguineous centres, than in any other parts of the body. This provision is highly necessary, and is wisely intended for the protection of these important systems.

At the end of the first month, according to Béclard, ossification commences in the clavicle, and successively in the inferior maxilla, the os femoris, the tibia, humerus, superior maxilla, and the bones of the fore-arm, where it begins about the thirty-fifth day. About the fortieth day this process commences in the fibula, the scapula, and bones of the palate; and subsequently in the central portions of the occipital and frontal bones, in the arches of the cervical vertebræ, the ribs, the great wings of the sphenoïd, the zygomatic process of the temporal bone, the phalanges of the fingers, the bodies of the dorsal vertebræ, the nasal and malar bones, the ilium, the metacarpal bones, the condyles of the os occipitis, the squamous portion of the temporal, in the parietal and the vomer: in all these bones ossification begins about the forty-fifth day, or the middle of the seventh week. In the course of the same week it commences in the orbitar processes of the os sphenoïdes; and about the end of the week in the metatarsal bones, and the phalanges of the fingers and toes, and during the following days it commences in the sacral vertebræ, and around the tympanum. In about two months and a half after conception it is observed in the costiform appendix of the seventh vertebra; a few days after in the labyrinth of the ear, and about the end of the third month in the ischium, and the internal pterygoïd process. About the middle of the fourth month it is manifested in the small bones of the ear; and at half the term of utero-gestation in the pubes, the os calcis, the last phalanges of the toes, in the lateral portions of the ethmoïd, in the spongy bones of the nose, and soon after in the first pieces of the sternum. About the sixth month it commences in the body and odontoïd process of the se-

cond vertebra of the neck, in the anterior and lateral masses of the os sacrum, and somewhat later in the astragalus. In the seventh month it begins in the crista galli and pyramidal portions of the ethmoïd; and at the termination of pregnancy, in the first bones of the os coccygis, the os cuboïdes, and the anterior arch of the atlas. About twelve months after birth it is observable in the coracoïd process of the scapula, and in the os magnum and os unciforme of the carpus. About the third year it commences in the first of the cuneiform bones, the patella, and the ossa wormiana of the head; in the fourth it begins in the second and third cuneiform; in the fifth in the scaphoïd of the tarsus, the trapezium and lunare; in the eighth in the scaphoïd of the carpus; in the ninth in the trapezoides; and in the latter part of the twelfth in the pisciforme (*a*).

Remark.—The progressive development of the osseous system has been particularly examined by Kerkringius, Nesbit, Albinus, Vater, Baster, Duhamel, Haller, Dethleef, Richel, Senff, Hunter, Howship, Troja, Meckel, Medici, Lebel, Serres, Schultze, Béclard, and Dutrochet; but, notwithstanding the patient investigations of these celebrated men, our knowledge upon this curious and highly interesting subject is by no means so satisfactory as might be wished.

In many parts of the osseous system the deposition of bony matter takes place in several points; thus, in some of the symmetrical bones, such as the sphenoïd and the vertebræ, it begins by lateral and mesian points; while in others again, as in the frontal and the inferior maxillary, the two symmetrical halves are developed separately, and, coalescing from the opposite sides, are confounded with each other on the mesian line. In some of the symmetrical bones, which differ always from each other with regard to the arrangement of their primitive points of ossification, we may generally observe the line of demarcation which marks the place of union of some of the pieces of the same

(*a*) Béclard's Anatomie Generale, p. 496, et seq.

bone. This is the case more especially with the bones of the sacrum; and sometimes, though rarely, the same circumstance may be observed in the os frontis, as is exemplified in a negro skull which I have now before me.

Differences according to age.—In old age the bones are subject to remarkable changes: they become more dry and calcareous, lose their elasticity, and diminish in thickness, owing to the quantity of blood which they receive at this period being much smaller than in the earlier stages of our existence. In decrepitude the osseous tissue becomes frequently so brittle that the bones are broken by the most trifling accidents. The sensibility and vitality are also very remarkably diminished, as is exemplified in the reception and reunion of fractures.

Functions.—The bones give support and stability to the soft parts, determine the general configuration of the body, and regulate its various attitudes. They also afford points of attachment to the muscles and ligaments, and are peculiarly fitted to defend the more delicate organs from the impressions of surrounding objects.

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SECTION II.

OF THE DIFFERENT KINDS OF BONES.

Article 1.—*Of the Long Bones.*

Definition.—The long bones are those large, straight, cylindrical organs which contain a medullary cavity in the interior of their substance.

Situation.—They are situated in the superior and inferior extremities, and consist of the humerus, the os femoris, the radius and ulna, the tibia and fibula, the metacarpal and metatarsal bones, and the phalanges of the fingers and the toes.

Conformation and arrangement.—All the long bones present a body and two extremities. The shaft, or diaphysis, as it is often called by anatomists, is either prismatic, or round and cylindrical, and is always bent or twisted on its axis, so that the direction of its superior extremity does not correspond with the inferior (*a*). On its external surface the body of the long bones is generally marked by three ridges, which are separated from each other by an equal number of plain surfaces, and serve for the origin and insertion of muscles.

(*a*) Bichat, Anat. Generale. T. 3. p. 7.

At their extremities the long bones are always larger than at their middle, and are characterized by apophyses of insertion, and by articular eminences and cavities. This difference between the extremities and bodies of the bones is attended with considerable advantage, and is well calculated to contribute to the beauty and regularity of the form of the limbs to which they belong, at the same time that it enables them to present much greater resistance to such causes as may have a tendency to displace them.

When the long or cylindrical bones are examined from above downwards, or from the humerus and femur to the phalanges of the fingers and toes, it will be found that they gradually diminish in size in proportion as they increase in number. This arrangement is intended to enable the superior division of each limb to perform those extensive motions which are observable in the great joints, while it allows to the inferior and terminal ones a multiplicity of rapid movements within restricted limits.(*a*)

Structure.—By sawing a cylindrical bone in a longitudinal direction, it will be seen that there is a very material difference of structure between its body and extremities. The former is composed of a very hard, compact substance, which greatly diminishes towards the superior and inferior extremities of the bone, and becomes at length so thin as to form a mere delicate lamella. In its interior, there is a large medullary canal, which is usually of the same form in all the long bones, being circular in the tibia as well as in the femur. In the recent state, this canal is lined by a cellulo-vascular membrane, and is not intended merely to lodge and protect the adipose substance of the bones, but it also contributes materially to increase their strength, as has been satisfactorily shown by the experiments of modern physiologists. To illustrate the truth of this assertion, it is only necessary to take two cylinders which shall contain an equal

(*a*) Quain's Elements of Anatomy.

quantity of matter, and one of which shall be hollow and the other solid. Upon examination it will be found that the power of resistance of the former is much greater than that of the latter, owing to its greater diameter, and that it is much more capable to withstand the influence of surrounding bodies. This, however, is not the only advantage resulting from this conformation. By means of it the bones, without being increased in weight, afford a more extensive surface for the origin and insertion of muscles, and "acquire an adequate degree of lightness, together with sufficient superficial extent, which are important requisites in what may be considered as the passive organs of locomotion."(*a*)

The medullary canal runs generally in a straight direction, and terminates as it approaches the extremities of the bones. It is never altered in its form on account of the irregularities which are observable on the outer surface of the bones, but in the middle of the shafts of the bones its continuity is frequently interrupted by very delicate horizontal septa or partitions, which divide it into several distinct compartments.(*b*)

The interior of the extremities of the long bones consists of a great number of cells, which communicate freely with the large medullary canal. They vary in size and figure, being generally most delicate towards the body of the bones. They are evidently intended to increase the extent of surface of the joints, to facilitate the distribution of blood-vessels, and to exhaust, as it were, the effects of blows and other violence, inflicted upon the upper and inferior extremities.

Remarks.—The medullary canal, which is at first merely a narrow cavity filled by the nutrient artery, is completely formed at birth, though, if we may believe Bichat, it is considerably shorter than in the adult. In old age it is remarkably enlarged, and forms one of the most striking

(*a*) Quain, op. cit.

(*b*) Bichat, Anatomie Generale, T. 3. p. 9.

peculiarities by which we are enabled to distinguish the bones of old animals from those that die at an earlier period.

2. In some of the inferior animals, as in the cetacea, the seal, and turtle, the medullary cavities are entirely wanting, even in the long bones. The bones of birds, on the contrary, are almost universally hollow; and their cavities, which never contain any adipose substance, are always filled with air.(*a*)

Characters and physical properties.—In addition to the physical characters which they possess in common with the rest of the osseous system, the long bones have the power of resisting, in a very remarkable manner, such violence as has a tendency to break them in a transverse direction. This circumstance is owing to the hard compact substance of the bodies of these bones, and to their large central cavities.

Vital properties.—The vital properties of the long bones are precisely the same as in the rest of the osseous system.

Mode of development.—The long bones are generally developed by three points of ossification; but sometimes only by two.(*b*) The first point is always developed in the body of the bone, and may be observed about two months after conception. The other ossific points are not visible until about the period of birth, when they may be seen in the temporary cartilages of the extremities of the bones. This singular mode of ossification gives rise to what are usually called the epiphyses,(*c*) which are not fully united to the bodies of the bones until the fifteenth or sixteenth year, and in some instances not until the twenty-first. These epiphyses are originally separated from the shafts of the long bones, by means of cartilage; and after they have become ossified, they assume the name of apophyses.(*d*)

(*a*) Blumenbach's Manual of Comparative Anatomy, by Lawrence, p. 3.

(*b*) Boismont, Traité Elémen. D'Anatomie, p. 202. Paris, 1827.

(*c*) Επι, upon, φυω, to grow.

(*d*) Απο, from, and φυω, to grow.

Functions.—The cylindrical bones form essential parts of the organs of locomotion; their extremities give form to the joints, and their bodies afford large and expanded surfaces for the origin and insertion of muscles.

Article II.—*Of the Short Bones.*

Definition.—The short bones are characterized by an equality of length, breadth, and thickness, and may, by this circumstance, be readily distinguished from the other parts of the osseous system.

Situation.—They are situated in the carpus, the tarsus, and the vertebral column.

Conformation.—The external conformation of the short bones is necessarily influenced and determined by that of the parts into the composition of which they enter. Some are globular or cuboïdal, others cuneiform or tetroïdal; but all present eminences and depressions which are either intended to enter into the formation of the joints, or to afford surfaces for the attachment of muscles and ligaments.

Structure.—The internal substance of the short bones consists of a soft, spongy tissue, which contains a great number of cells that freely communicate with each other. Externally they are covered by a thin lamella of compact tissue, which varies in thickness from a line to a quarter of an inch, and serves to protect from injury the more delicate texture within. The short bones are plentifully supplied with blood-vessels, and, like all those that have no medullary cavity, they are unprovided with a cellulo-vascular membrane, and contain but a small quantity of adipose substance.

Physical and vital properties.—These are the same as in the long, broad, and mixed bones.

Mode of development.—The short bones are developed in a very gradual manner, and may be observed to pass from the mucous into the cartilaginous state. The temporary

cartilages in which they are formed, have the shape and volume of the bone long before ossification is completed. The deposition of ossific matter in most of the short bones takes place from the centre towards the circumference, and is attended with the same phenomena as the ossification of other bones.

Some of the short bones are developed in the substance of the tendinous or ligamentous tissue, and pass successively from the fibrous to the fibro-cartilaginous state, and from this into the osseous. It is in this manner that are formed the patella and ossa sesamoïdea; so that they do not appear to be really essential parts of the skeleton, and are therefore considered by some as accidental bones.(*a*)

Functions.—As the short bones are always situated in those regions where it is necessary there should be a union of mobility and solidity, we find that they are uniformly arranged in groups, and that their number compensates for their diminutive size in the formation of those parts of the skeleton into which they enter.

Article III.—*Of the Broad or Flat Bones.*

Definition.—By the broad or flat bones writers on general anatomy understand those parts of the osseous system, which are nearly equal in length and breadth.

Situation.—The broad bones enter into the formation of the parietes of the cranium, the thorax, and pelvis.

Conformation.—The broad bones are either lamelliform, quadrilateral, or semi-circular, and present two surfaces, one convex, and the other concave; which conformation, by giving them an arched or contorted form, augments their

(*a*) Bayle and Hollard's Manual of General Anatomy, by Dr. S. D. Gross, p. 127—8.

power of resistance, at the same time that it affords additional security to the organs they enclose. The broad bones are always more thin at their middle than at their circumference, which is marked by different inequalities either for the purpose of entering into the formation of the joints, or giving attachment to muscles and ligaments.

Structure.—The two surfaces of the flat bones are always compact in their texture, the interval between them being composed of a soft areolar substance. In the cranial bones, the internal table is more dense than the external, and from being also more thin and brittle, it is usually called vitreous. In some of the broad bones the two surfaces are so closely in contact, that it is impossible to discover any of the spongy substance to which we have just alluded; in others, however, they are separated to a greater or less extent, and have between them an intermediate layer of cellular texture, commonly called the diploé or meditullium.

The diploé receives large, insulated veins, which were first pointed out by Hippocrates, and afterwards more fully described by some of the Parisian anatomists, especially by M. M. Chaussier, Fleury, and Dupuytren. They commence by small capillary ramifications, and are intended, like the other parts of the venous system, to return the blood towards the heart. They are situated between the two tables of the skull, are furnished with small valves, and have extremely thin and delicate parietes. The diploic veins not only communicate with each other, but likewise with those of the dura mater and the pericranium. They are generally much smaller in infancy than at any other period of life; and in old age and in some of the diseases of the bones of the cranium, they often exhibit a varicose appearance.

Functions.—The broad or flat bones generally serve to form the walls of cavities, or to enclose spaces. They also afford points of attachment for the origin and insertion of muscles and ligaments.

Article IV.—*Of the Mixed Bones.*

Definition.—The mixed bones are those which combine the form and characters of the bones of the preceding classes.

Situation.—The mixed bones are situated chiefly in the head and the thorax, and consist of the occipital and temporal bones, the sphenoïd and ethomoïd, the ribs, the clavicle, and the sternum.

Conformation.—The form of these bones is extremely irregular and variable, and can not be described in a general manner. It may be stated, however, as a general rule, that it results from the union of a broad, a short, and a thick part.

Structure.—The structure of the mixed bones is the same as in the other parts of the osseous system, and need, therefore, not be described on the present occasion.

Physical and vital properties.—The same as in the other bones.

Mode of development.—According to M. M. Bayle and Hollard,(*a*) to whom I am indebted for many of the preceding remarks, the mixed bones are developed by several points of ossification, having in each of their respective parts the mode of formation peculiar to the bones, of the form and characters of which they partake.

Functions.—The mixed bones contribute materially to the formation of the cranial and thoracic cavities; they surround and protect the organs which they contain, and present more or less expanded surfaces for the attachment of the soft parts.

SECTION III.

Of the Membrana Medullaris.

Definition.—The membrana medullaris is the delicate

(*a*) Manual of General Anatomy, by Dr. S. D. Gross, p. 129.

cellulo-vascular membrane which lines the central cavities of the long bones.

Conformation.—The membrana medullaris is of a cylindrical form, and gives origin to numerous prolongations, which will be more fully described hereafter.

Structure.—In order to be convinced of the existence of this extremely delicate membrane, it is necessary to saw one of the cylindrical bones in a longitudinal direction, and then plunge it into boiling water, or expose it to the action of some of the dilute mineral acids. The membrane will thus become detached from the parietes of the bone and adhere to the adipose substance, so as to be perfectly distinct.

When entirely separated from the bone, this membrane will be found to be essentially composed of cellular tissue, blood-vessels, nerves, and lymphatics.(*a*) It is pierced with a multitude of small foramina, and is so thin and delicate in its appearance as to bear a striking resemblance to a cobweb. It is connected to the parietes of the bones by very thin, slender membranous prolongations, and internally it sends off a great number of processes, which, by their interlacement with the cancellated structure in the central cavities of the bones, and with each other, form a vast multitude of cells for the reception of the adipose vesicles that are deposited into their substance.

Physical and vital properties.—The medullary membrane is so thin and delicate that it may be very easily torn; it is evidently possessed of a slight degree of sensibility and contractility, as is proved in cases of spina ventosa and amputation. In the healthy state, its sensibility is extremely obscured; but when irritated or diseased it often gives rise to very severe pain.

Remark.—Bichat asserts that the contractile power of the medullary membrane is rendered apparent in cases of amputation, in which the contraction of the cells of the adipose tissue of the long bones, prevents the fat from flowing out; which would otherwise take place on account of the communication of the cells just alluded to. This idea, however,

(*a*) Bayle and Hollard, op. cit. p. 123.

is altogether inaccurate, as will be seen in speaking of the adipose substance of the osseous tissue.

Development and differences according to age.—As the medullary canal, which is at first nothing but a narrow cavity filled by the nutrient artery, increases in size, the membrana medullaris becomes gradually more apparent, and assumes the characters which have already been described. In the fœtus and the new-born infant it is always so delicate that it is by no means an easy matter to distinguish it; but as we advance in years it continues to enlarge, and becomes at length so distinct that it is impossible to mistake it.

Remark.—Notwithstanding the truth of what has just been stated, it has been asserted by M. Portal, an eminent French writer, and by several other highly respectable anatomists, that this membrane does not exist as a distinct sac; but that it is derived from the prolongations of the periosteum which accompany the blood-vessels that are distributed in the interior of the long bones.

Functions.—The medullary membrane serves as a reservoir for the fat of the osseous system, or the marrow properly so called, and affords a large and expanded surface for the distribution of the nutrient vessels of the long bones.

SECTION IV.

OF THE ADIPOSE SUBSTANCE OF THE BONES, OR THE MARROW, PROPERLY SO CALLED.

Definition.—The adipose substance of the osseous system is a species of oil, contained in the cells of the membrana medullaris.

The nature of these cells is precisely similar to that of the adipose tissue of the other parts of the body. Like them, they are perfectly distinct, and do not communicate with each other. This fact has been fully established by the ex-

periments and observations of Hunter, Mascagni, and many other anatomists.

Chemical properties.—According to Berzilius, the adipose substance of the osseous system consists of the following ingredients.

Pure marrow, ...	96
Membrane and blood-vessels, . . .	1
Albumen, ...	3
Gelatine, ...	
Extractive and peculiar matter, . . .	
Water, ...	
	100

When subjected to the heat of a candle the marrow burns with a beautiful blue tinge, and emits an oily disagreeable odour. Exposed to putrefaction it assumes a dark greenish colour, becomes rancid, and highly offensive.

The marrow differs in appearance in different bones; and is deposited into the vesicles of the adipose tissue by the small arteries which are distributed upon their external surface. These arteries are extremely delicate, and are not obvious to our unassisted senses.

Differences according to age.—In the fœtus and the new-born infant, the marrow is of a thin aqueous consistence, of a pale reddish colour, and of a disagreeable taste. Towards puberty, however, it becomes gradually more firm, and acquires peculiar properties, somewhat analogous to those of butter. In old age it becomes rancid, and assumes a deep yellow colour. In corpulent persons its quantity and consistence are always considerably increased; but in emaciation, in phthisis pulmonalis, and in cases of dropsy, it is generally thin and aqueous, and greatly diminished in quantity.

Functions.—The marrow appears to have the same general uses as the fat in the other parts of the body, and forms a kind of aliment in reserve.

Remark.—1. It was formerly supposed that the marrow served to

give flexibility and tenacity to the bones; that it imparted nourishment to the osseous tissue; and that it was the source of the synovial fluid of the joints; but all these, as well as a host of other equally fanciful hypotheses, are perfectly erroneous and unworthy of a serious refutation.

2. The marrow does not appear to be subject to idiopathic diseases, but is only changed when the bones themselves are affected. Bonn found it spongy and fibrous in the callus of fractured bones; Navier, like fluid fat in mollities ossium; and Troja observed it became white, solid, and beginning to ossify in the upper part of a fractured bone.(*a*)

SECTION V.

OF THE PERIOSTEUM.

Definition.—The periosteum is the tough fibrous membrane which invests the external surface of the bones.

Form and arrangement.—The form of the periosteum is always influenced and determined by that of the bones which it surrounds and envelops. It is wanting on the cartilaginous surfaces of the moveable joints, and in those parts which are occupied by the insertion of tendons and ligaments. It gives off numerous prolongations which accompany the vessels of the spongy substance of the bones.

Structure.—The periosteum is of a dull whitish colour, and of a tough, compact consistence. Externally it is rough, and covered by a quantity of cellular tissue, by which it is connected to the adjacent parts; but internally it is smooth, being firmly attached to the surfaces of the bones by small blood-vessels and short fibrous threads. It may be divided, at least in some parts, into two layers, an external and an internal. The fibres of the former vary in number, size, and direction in different bones, and even in different parts of the same bone. Those of the internal layer, on the contrary, are somewhat more glistening than the preceding, and follow the same course as those of the bone which they serve to invest.(*b*)

(*a*) Lizars' Anatomy, vol. i. p. 107.

(*b*) Monro's Elements of Anatomy, vol. i. p. 31.

The periosteum is plentifully supplied with blood-vessels, which are derived from the adjacent arteries; but its nerves and lymphatic vessels are few in number.

Vital properties.—In health the periosteum possesses little sensibility; but in some cases of disease it appears to be highly sensible, and to give rise to the most acute pain.

Differences according to age.—In infancy the periosteum is soft, thick, and spongy, and may be readily separated from the bones. In adult life it is more firm and compact, and is often so intimately united as to be detached with difficulty. In old age it is extremely tense, and becomes not unfrequently ossified on its internal surface. Its vascularity, which is at first rather obscure, also gradually increases as we advance in years, but in old age it again diminishes.

Functions.—The periosteum transmits and supports the nutrient vessels of the bones; affords points of attachment to muscles and ligaments; and in infancy, before ossification is completed, it maintains the epiphyses in connexion with the bodies of the bones to which they are afterwards united.

Remark.—Dr. Physick, the distinguished Professor of Anatomy in the University of Pennsylvania, is of opinion that the periosteum often prevents the bones from participating in the diseases of the neighbouring parts, in the same manner "as the pleura turns off an abscess in the parietes of the thorax from its cavity, or the peritoneum from the cavity of the abdomen."(*a*)

(*a*) Wistar's Anatomy, by Dr. Horner, vol. i. p. 5.

CHAPTER II.

OF FRACTURES OR INJURIES OF THE BONES, AND THEIR APPENDAGES.

SECTION I.

OF FRACTURES IN GENERAL.

ARTICLE I.—*Of Simple Fractures.*

Definition.—A simple fracture is a solution of continuity of the osseous tissue, unattended by severe contusion or other injury of the surrounding soft parts.

Seat.—All the bones are more or less liable to fracture, but those which are most frequently affected are the long bones of the extremities, particularly those of the leg and fore-arm. As a general rule it may also be stated that the bones are more often broken at or near their middle, than at their superior or inferior extremity. This circumstance should be carefully borne in mind by the surgeon, as it exerts an important influence over the prognosis and treatment of the injuries under consideration.

Direction.—Simple fractures may be either transverse or oblique, but never longitudinal.

Causes.—The causes of fractures may be divided into predisposing and remote. In the first class are included the age of the patient, the situation of the bones, and their diseases; in the second, inordinate muscular action, and external violence, such as falls and blows.

As fractures are most frequent during winter, many writers have supposed that cold affects the osseous tissue, and

renders it preternaturally brittle. The absurdity of such an opinion, however, is at once obvious, and may be readily accounted for on the assumption that persons in walking while the ground is hard and slippery are obliged to make unusual exertion to sustain themselves, and if they thus happen to fall while their muscles are tense and thrown into full action, fractures or still more important injuries are almost daily the inevitable consequence.

Symptoms.—The signs or symptoms of a simple fracture are extremely various, and can not be said to be always sufficiently characteristic of the nature of the accident. In general, however, the irregularities of the ends of the fragments, and the crepitus, or that peculiar grating noise produced by rubbing together the broken pieces, are more to be relied on than any other, and may, in almost all cases, be regarded as the certain indications of a solution of continuity of the osseous tissue. In addition to these there is generally more or less distortion, pain, and swelling at the injured part, and an inability to move the limb; but as these symptoms may arise from a mere bruise, a luxation, or other injury, they can by no means be depended upon as unequivocal proofs of the existence of a fracture. Whenever, therefore, the practitioner entertains any doubt concerning the nature of the injury, he should always trace the outlines of the suspected bone with the fingers, and wherever there is any unusual pain, or unnatural irregularity, he should endeavour to produce a grating or crepitus by rubbing together the ends of the fragments. In no instance, however, should he roughly or unnecessarily handle the part by an overanxiety to feel the crepitation, as doing so will only have a tendency to torture the unfortunate patient, and to increase the pain and inflammation which must necessarily follow the accident.

When the broken bone is so deeply embedded in the soft parts that it is difficult to feel a crepitus, or to ascertain the existence of the injury, the diagnosis may perhaps sometimes

be elucidated by means of the stethescope, as recommended by Lisfranc, a celebrated surgeon of Paris.

Displacement of the fragments.—The displacement of the fragments of a broken bone may be produced either by the action of the muscles, by the weight of the body, or that of the injured part; or by external violence inflicted at the moment of the accident, or at a period more or less remote after its occurrence. The derangement of the broken pieces is sometimes angular, sometimes longitudinal or parallel with the axis of the bone, sometimes in the direction of its diameter, and sometimes again in that of its circumference. In the first species of displacement the ends of the two fragments form a more or less prominent angle, and give the bone an arched appearance; in the second, they ride more or less over each other, and produce a shortening of the affected limb; in the third, they remain either in partial contact, or are entirely separated; and in the fourth, the one performs a rotary movement, while the other continues perfectly stationary.

Prognosis.—Simple solutions of continuity of the osseous tissue are seldom of a very serious nature, and unless they are situated at or near a joint, or are improperly managed, they generally unite without much difficulty. It may be assumed also as a general rule that fractures are more easy of cure when their direction is transverse than when it is oblique, and in strong and healthy individuals, than in those who are worn out by old age or debility. The time which is usually required for the consolidation of a simple fracture varies in different cases, and will be fully pointed out in a future part of this work.

It was formerly supposed by surgeons that pregnancy always retarded or prevented the union of fractures, and the opinion was supported with considerable warmth even by writers of respectability. It must be remarked, however, that such assertions are altogether gratuitous, and that they have been amply refuted by the observations of some of the

best practitioners of the present day, especially by Cooper, Boyer, and Levéillé.

Remark.—Let it not be supposed from what has just been stated, that this circumstance never takes place, or that it has not been often observed by practitioners; that it does sometimes occur there can be no doubt; all I wish to inculcate is, that it does not take place as a general rule.

TREATMENT OF SIMPLE FRACTURES.

Indication.—After the surgeon has ascertained the existence of a fracture, he should immediately endeavour to restore the ends of the fragments to their natural situation, to keep them in this position by appropriate mechanical means, and to prevent or subdue any unpleasant symptoms that may attend or be likely to follow the accident.

Reduction.—The reduction consists in restoring the broken pieces to their original situation, and is usually accomplished by extension, counter-extension, and coaptation. By the term extension is meant the force or action which is required in drawing the superior extremity of the inferior fragment below the inferior extremity of the superior fragment, in order to bring them into their natural situation; by counter-extension, on the contrary, is implied the force or resistance which is employed to prevent the limb, or even the whole body, from being drawn along by the extending power. Coaptation, or setting, as the name sufficiently indicates, signifies the proper adjustment of the broken pieces, or the re-establishment of their natural relations.

These means should always vary according to the species of the displacement; for in some fractures, especially in those of the patella and olecranon, extension and counter-extension are not only absolutely useless, but highly improper.

The extending force should generally be applied to that part of the limb which is articulated with the lower fragment, and the counter-extension to that which is articulated with the upper. For instance, in a fracture of the fore-arm the extending power acts upon the hand, and the counter-

extending upon the arm; and in a fracture of the arm the extension is applied to the fore-arm, while the counter-extending power fixes the chest.

The English surgeons generally prefer the plan recommended by Mr. Pott, which consists in applying the extending force to the lower fragment, and the counter-extension to the upper; but in this country most practitioners adopt the French method, except in some particular cases which will be pointed out in a subsequent part of this treatise.

In reducing a fracture, the injured part should always be put in the most favourable position for relaxing the muscles, and the extending force should be applied in as slow and gradual a manner as possible. If the limb be suddenly or violently extended, the muscles will be thrown into powerful spasmodic contraction, and will either frustrate our design, or produce more or less injury in the soft parts. The degree of force which should be used in making extension must vary according to the species of the displacement, and the number and power of the muscles concerned in producing it; but in all cases it should be sufficient to remove the shortening of the limb, and overcome every obstacle that may oppose the reduction. The extension is to begin in the direction of the lower fragment, and be continued in that of the injured bone.

After having made the necessary degree of extension and counter-extension, the next indication is to endeavour to place the ends of the broken bone in their natural situation. This may usually be done by acting upon the lower fragment, so as to regulate the contact of the extremities of the bone, or by pressing gently upon the situation of the fracture, care being taken not to injure the soft parts, or to inflict any unnecessary pain.

Whenever there is any difficulty in effecting the reduction, it may generally be overcome by premising a copious bleeding, and putting the limb in such a position as will completely relax the muscles which are inserted into the

lower fragment, or that part of the limb which is articulated with it. If at the time the surgeon is called in, the parts happen to be extremely tender, inflamed, and swollen, it will sometimes be proper, instead of proceeding to the reduction immediately, to wait for a day or two until the pain and inflammation have been combated by appropriate antiphlogistic measures. This precaution is of considerable importance, and should, therefore, be carefully borne in mind.

Retentive means.—After the bones have been restored to their natural relations, the next and most important indication is to employ such measures as are calculated to maintain the extremities of the fragments in even contact. For this purpose the broken limb should be so fixed that it may continue perfectly motionless during the whole time requisite for the union of the fracture; and this is to be attempted by an advantageous position, quietude, bandages, splints, and pads or cushions.

In all cases of fracture of the lower extremities the patient should be placed in the recumbent posture, until the ends of the broken pieces have become completely consolidated. The bed in which he is confined should not be much more than a yard wide, and should be composed of firm and unyielding materials. A horse hair mattress is the best that can possibly be employed, and whenever it can be procured, none other should be used: feather-beds should always be carefully avoided.

The fractured limb should always, if possible, be placed in the most favourable position for relaxing the muscles, and should bear equally and perpendicularly throughout its whole length upon the surface upon which it rests. In most cases the semi-flexed position is that which is the most natural, and in which all the muscles, passing over the fracture, enjoy an equal degree of relaxation; but its employment is liable to some exceptions, as will be seen in speaking of particular fractures.

The bandages which are usually employed in fractures

should be made of coarse linen or muslin, and should possess sufficient strength to answer the purpose for which they are intended. If the materials are new, they should always be washed before they are used, and the selvage or rough edge torn off, in order to prevent it from exciting irritation, or producing welts in the skin. The bandages which are at present most commonly used in the treatment of fractures, are the single-headed roller and the bandage of Scultetus, so called in honour of a celebrated German surgeon who flourished about the beginning of the seventeenth century.

The bandage of Scultetus is chiefly used in fractures of the thigh and leg, and has the advantage that it can be un done so as to allow the parts to be examined without the smallest disturbance of the limb. It consists of numerous strips or pieces, each of which should overlap the other about one-half or two-thirds. They should be of the same breadth, and of equal or unequal length, according to the size and shape of the part they are intended to surround.

In applying a bandage care should be taken to put it on with sufficient tightness to fulfil the object for which it is designed, without running any risk of interrupting the circulation, or of doing other mischief. If it be not tight enough to support the parts in a proper and uniform manner, it will be useless; if, on the contrary, it be too tense, it will give rise to severe swelling, inflammation, and even gangrene. In order to apply a roller with neatness and dexterity, the part which is to be covered should be put in its proper position, and only so much of the bandage should be unrolled as is necessary for the commencement of the application.

Splints are commonly made of wood, or of very strong thick paste-board, such as that used by book-binders. They should be as thin and light as is consistent with the necessary degree of strength for keeping the ends of the fragments in apposition, and should be at least as long as the fractured bone, or, if the situation of the limb will allow, they ought

to extend throughout its whole length, or even considerably beyond it. Whenever they are composed of hard materials, the ill effects of their pressure upon the soft parts should be carefully counteracted, by interposing between them and the limb a sufficient quantity of tow, cotton, or other soft substance.

In some instances, especially in fractures of the lower jaw, and in very young children, considerable advantage may be derived from splints made of common paste-board; but in most other cases they are too thin and flexible to give any support to a fractured bone. Before applying them they should always be carefully moistened, so that when they become dry they shall have the exact shape of the part, and form every where a firm and solid covering, without incommoding the patient.

The number of splints must vary according to the size and situation of the fractured bone, and will be more particularly noticed hereafter.

Pads or cushions are generally made in the form of small bags, and are stuffed with oat-chaff, finely cut straw, carded cotton, or any other soft materials. They are intended to fill up the inequalities between the splints and the limb, and must necessarily vary in shape, length, and breadth, according to the circumstances of the case.

In oblique fractures of the thigh and leg, the difficulty of effecting a complete cure by the ordinary means has led practitioners to the idea of employing another apparatus, which, by continually drawing the fragments of broken bone in opposite directions, prevents them from gliding over each other, and keeps them in even contact until they are completely united.

In order to derive from this mode of treatment the utmost benefit, and render the apparatus as supportable as possible, it is highly important, first, that the extending and counter-extending force should be divided upon as large a surface as possible; secondly, that the extension should act in the di-

rection of the axis of the broken bone, and in as slow and gradual a manner as possible; thirdly, that the compression made by the tapes, or other pieces of the apparatus, should be perfectly equalized; and lastly, that the parts upon which the extending and counter-extending force acts should be carefully defended by the interposition of carded cotton, tow, or other soft substances.

In fractures of the upper and lower extremities, the treatment formerly recommended by Mr. Cowper,(*a*) of Leicester, and lately again by Baron Larrey,(*b*) may sometimes prove useful, more especially if the fracture be transverse and not complicated with any other injury. Under these circumstances, indeed, I think it possesses a decided advantage over the splints and bandages now in use. It consists in putting the limb in a proper posture, and in encircling it with compresses and bandages, dipped in a solution of glue, gum shellac, or a mixture of the albuminous parts of eggs and a little wheat flour. When this apparatus dries it forms a firm and inflexible case for the injured limb, and keeps the fragments more completely in contact than almost any other contrivance.

Treatment after the reduction.—After having reduced the fracture, and taken every precaution for retaining it in its place, the limb should be maintained perfectly at rest, and the part should be kept constantly wet with cold water, or a solution of the acetate of lead. The patient should be confined upon low diet, and his drink should consist of lemonade, or any cooling acidulated infusion. If he be young and plethoric, and there is reason to apprehend that the swelling and inflammation will be considerable, recourse should be had to the abstraction of blood, carried to such an extent as the nature of the case may seem to indicate; if, on the other hand, however, he should be old or enfeebled, and extremely irritable, the lancet should be carefully avoid-

(*a*) Cheselden's Anatomy, p. 38. Boston, 1806.

(*b*) Journal des Progrés, T. 4.

ed, and recourse should be had to the administration of opium or other anodyne remedies. Costiveness should be averted by the use of clysters and mild aperients; and whenever the patient has occasion to relieve his bowels, he should make use of a bed-pan. In no instance, unless the fracture be situated in the superior extremities, should he be permitted to leave his bed, or to disturb the parts more than can possibly be avoided.

As fractures are constantly liable to be followed by weakness and stiffness of the limb, it should be laid down, as a general rule, to move the joints, nearest the fracture, as soon as the union is sufficiently advanced to preclude the possibility of displacing the fragments or interrupting the consolidating process. The motion should at first be gentle, and be gradually increased until the limb has completely recovered.

As soon as the callus has acquired sufficient firmness, the splints and tight bandages should be discontinued; but the part or limb should still be kept quiet, until the union is perfectly consolidated. In fractures of the inferior extremities, some days should always elapse before the patient is permitted to rise, or bear upon the limb. These precautions are extremely important, and should in no instance be neglected.

Article II.—*Of Complicated Fractures.*

Definition.—A complicated fracture is a solution of continuity of the osseous tissue, attended with some injury of the soft parts, a protrusion of one or both ends of the fragments, a comminuted or shattered state of the bone, a dislocation, or a lacerated state of a large blood-vessel or nerve.

Direction.—Complicated fractures may be either oblique, transverse, or longitudinal; and the frequency of their oc-

currence is in direct ratio to the manner in which they are here noticed. The possibility of a bone being fractured in a longitudinal direction was first asserted by Duverney, afterwards admitted by Heister, and since conformed by the observations of Levéillé, Cole, S. Cooper, Boyer, and others.

Causes.—Complicated fractures are always occasioned by external causes, such as gun-shot violence, falls from a great height, severe blows, or the passage of the wheels of a heavy carriage or wagon.

Symptoms.—The symptoms of a complicated, like those of a simple fracture, are sometimes extremely obscure, but in most cases they are sufficiently well marked to enable the surgeon to distinguish the nature of the accident, more especially if he is called in before the parts have become much swollen.—See the symptoms of simple fractures.

Prognosis.—Complicated fractures are always of a more or less dangerous character, being not unfrequently followed by violent and extensive inflammation of the limb; extreme pain, delirium, and fever; large abscesses; necrosis; mortification of the soft parts; and even death. Complicated fractures of the inferior extremities may generally be considered as more dangerous than those of the superior ones, and are more apt to be attended with deformity and stiffness of the limb.

TREATMENT OF COMPLICATED FRACTURES.

The treatment of a complicated fracture varies according to the circumstances of the case, and the nature and severity of the complication.

When the fracture is complicated with violent contusion of the soft parts, the apparatus should always be applied rather slackly, and the bandages should be kept constantly wet with cold water, or some resolvent lotion. The limb should be placed in an elevated position, and recourse should

be had to general and local bleeding. The bowels should be freely opened by clysters or mild aperients, and the system should be kept cool by diluent and mildly acidulated drinks. In about twenty or twenty-four hours after the application of the dressings, the parts should be carefully examined, and if they be found hard, tumefied, and painful, they should be covered with a soft emollient poultice, wet with a small quantity of laudanum.

It sometimes happens that the cuticle, owing to the tension and swelling of the parts, becomes detached and raised in the form of little vesicles, containing a small quantity of thin limpid fluid. When this is found to be the case, they ought to be punctured with a fine needle, and covered with pledgets of fresh cerate, or any simple digestive ointment. These vesicles should be carefully distinguished from those which are attendant on mortification, and should not impress the young and inexperienced practitioner with the belief that the limb is threatened, or actually affected with gangrene.

When the fracture is attended with a dislocation, the latter should always be reduced before the former is set. If this, however, be impossible, either on account of the nature of the joint, the situation of the injury, or other circumstances, the fracture must be first attended to, and after it has become perfectly united, an attempt should be made to rectify the luxation. Under these circumstances recourse should be had to emollient and relaxing applications, and as soon as the state of the callus will permit, the limb should be gently and frequently moved, in order to preserve the motion of the joint and the suppleness of the ligaments. Little hope, however, can be expected from this mode of treatment, and in most cases our attempts at reduction, after the consolidation of the fracture, prove abortive.

When the fracture is conjoined with the rupture of a large artery, and the cellular tissue of the limb becomes distended by the extravasated blood, no time is to be lost in cutting

down upon the vessel, and securing it with the ligature. Great care, however, should always be taken before resorting to this measure, to ascertain that the tumour be not owing to a venous effusion, which may generally be dispersed by cold or emollient applications.

When the solution of continuity of the osseous tissue is accompanied by the laceration of the principal nerve of the limb, the case will generally be of such a nature as to require amputation, and the sooner the operation is performed the better.

In case the fracture is complicated with a wound of the soft parts, and the limb is thought capable of preservation, the first and most important consideration is the reduction of the fracture. This may generally be done by putting the limb in the most favourable position for relaxing the muscles, and by well-directed and gentle efforts at extension and counter-extension, especially if the fracture be transverse and the wound large; but if it be oblique, and there is a projection of one or both ends of the bone, they often fail, and oblige us to have recourse to other measures. Under these circumstances the soft parts which appear to gird or bind the bones, and prevent them from yielding, should be freely divided; after which new attempts should be made at reduction. Should every endeavour of the kind, however, prove fruitless, no time should be lost in cutting away a portion of the protruded bone, especially if it terminate in a very long and narrow point.

If the bone be broken into several pieces, and any of them are completely detached, or so loose as to render their union highly improbable, all such pieces ought to be carefully removed; after which the edges of the wound should be slightly approximated, and kept in this position by a few short strips of adhesive plaster. The limb should be placed upon a pillow and surrounded with the bandage of Scultetus, and every care taken to obviate and remove inflammation. When the wound suppurates, it should be frequently dress-

ed with some digestive ointment, or soft emollient poultices, as circumstances may require, care being taken that at each application of them, the fracture be disturbed as little as possible. As soon as the inflammation has subsided, and the parts begin to heal, the ends of the fragments should be brought into contact, and be maintained in apposition by appropriate splints and dressings.

In complicated fractures of the leg, it not unfrequently happens that the soft parts about the ankle are so much contused, or otherwise injured, as to render it impossible to employ the usual extending bands. When this is found to be the case, the difficulty may usually be remedied by applying along each side of the leg, as high up as the seat of the fracture will admit, a piece of strong muslin, about two feet and a half in length, two inches and a half in width, and spread at one of its extremities with adhesive plaster. The part which is applied upon the limb should be confined by three or four circular strips, so as to keep it firmly in its place, and equalize the extending power. The free extremities of the extending bands should then be tied under the sole of the foot, and be secured to the block or bar which connects the lower ends of the splints. This mode of making extension, for which we are indebted to the ingenuity of my friend and preceptor, Dr. Swift, of this place, will, I am fully persuaded, be found highly useful in practice, and satisfactorily obviate the inconveniences to which I have just alluded.

When the bone is shattered or broken into many pieces, the soft parts enormously lacerated, and almost totally disorganized, it will be impossible to save the limb, and the sooner, therefore, it is removed the better. It is true, that apparently desperate cases are sometimes cured; and that limbs so shattered and wounded as to render amputation the only probable chance of success, are now and then saved. Such cases, however, are extremely rare, and if we take into account the protracted sufferings of the patient, and the

probability of his ultimately falling a victim to the disease, the reasons for performing immediate amputation are "vindicable upon every principle of humanity, or chirurgic knowledge."

Secondary amputation will be necessary, when, after an attempt to save the limb, and the employment of the most vigorous antiphlogistic remedies, the parts become gangrenous; or when the consolidation of the fracture is prevented by profuse suppuration, and the patient becomes gradually enfeebled by diarrhœa and colliquative sweats. In the first case, the operation should be performed as soon as the mortification is stopped, and there is a line of demarcation between the dead and living parts; in the second, as soon as it is perceived that the suppuration can not be arrested, and that the patient has still sufficient strength to bear the pain and the shock which must necessarily result from the operation.

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Article III.—*Of the Formation of Callus.*

The formation of callus being not only an extremely interesting subject, but one which has excited a great deal of discussion among some of the most learned and able physiologists of ancient and modern days, I shall endeavour to lay before the student, a brief account of the opinions that have hitherto been advanced upon this curious and highly important topic.

The ancients were of opinion that callus was formed by the extravasation of a gelatinous or osseous fluid, which gradually acquires consistence, and at length united the fragments firmly together, in the same manner as a joiner or cabinet-maker would glue together two pieces of wood. Under the influence of this belief, they were in the habit of recommending their patients to eat large quantities of osteocolla, viscid farinacious aliment, and all kind of jellies.

According to Duhamel, whose name is identified with the subject under consideration, callus is formed by the elonga-

tion of the periosteum, either alone, or conjointly with the medullary membrane, which, becoming connected with each other, and interposed between the ends of the broken bone, serve to unite them intimately together. The opinion of Duhamel was warmly opposed by Haller and Dethleef, who instituted a long series of experiments, and finally came to the conclusion, that callus or the uniting medium of broken bones, was formed by a kind of glutinous fluid, which exudes from the ends of the fragments, becomes organized, and is at length changed from the cartilaginous into the osseous state. These experiments were afterwards carefully repeated by Bordenave, who was induced to suppose that fractures are united by a process somewhat analogous to that which nature employs for the union of the soft parts. This theory was founded upon the assumption that the texture of the bones was capable of undergoing a considerable degree of dilatation, and that it was endowed with sufficient vascularity to carry on the circulation in the extremities of the broken pieces. Mr. John Hunter refers the formation of callus to the organization and ossification of the blood which is effused around the ends of the fragments; M. Fougeroux, to the extravasation of an unorganized lymph which is capable of becoming an organized substance by inspissation; and Baron Larrey to the action of the vessels which are distributed through the substance of the osseous tissue. The doctrine of Mr. Hunter has lately been revived and extended by Mr. Howship, who, after a great number of well-performed experiments, came to the conclusion that the blood which is effused immediately after the occurrence of a fracture, became, under all circumstances, the medium in which the ossific process is first established. Mr. Howship is also of opinion that the periosteum assumes by degrees the characters of cartilage, and that ossific matter is deposited successively upon the surface of the broken bone, the circumference of its extremities, and within its medullary cavity. Little, however, was known, with regard to the formation

of callus, or the phenomena of osseous cicatrization until about the year 1819, when a number of experiments was instituted with a view of elucidating this important subject, by Dupuytren, Breschet, and Villermé, of Paris. According to those gentlemen, whose ideas are in accordance with some of those advanced by Duhamel, Haller, and Howship, there are three distinct stages for the formation of callus. In the first stage, the small quantity of blood that is extravasated between the ends of the fragments at the moment of the accident, is soon followed by the effusion of a thick viscid serum which gradually increases in quantity and consistence, and serves as a bond of union between the periosteum, the medullary membrane, and the divided soft parts. The second stage is characterized by inflammation and swelling of the parts which surround the ends of the fracture, accompanied by the secretion of a small quantity of coagulating lymph into the substance of the periosteum, and between it and the injured bone. As this substance becomes ossified, bony matter is gradually deposited upon the surface of the medullary membrane, as well as into the substance of the cellular tissue, which is in immediate contact with the seat of the fracture. The next circumstance that may be remarked during this curious process is the formation of a kind of osseous plug, which completely obliterates the medullary cavity, and extends from one end of the fracture to the other. At the same time that this is taking place, the surface of the contiguous extremities of the injured bone becomes incrusted with a kind of osseous matter, forming a sort of provisional callus, or retentive apparatus, and serving the purpose of maintaining the fragments in contact. In the third and last stage the bone itself becomes sensibly changed; the substance which was effused between the fragments acquires consistence and firmness; numerous vessels are developed which communicate with those of the bone and the periosteum; and at length, ossification being completed, the two ends of the broken bone are firmly reunited.

When the ends of the fragments are perfectly consolidated, the provisional retentive apparatus, to which I have just referred, is gradually absorbed, the soft parts around the fracture, resume their natural state, the swelling formed by the callus diminishes in size, and the medullary cavity is at last completely reestablished.

In fractures complicated with a solution of continuity of the soft parts, the union is generally effected by the development of fleshy granulations, which arise from the broken extremities of the bone, assume the ossifying disposition, and thus form the connecting link between the two fragments.

From what has already been stated, it is evident that callus is an organized substance; and that it is formed by a process analogous to that which nature adopts in the union of wounds. The principal difference appears to consist in the changes which take place in the surrounding parts, and in the formation of a provisional callus or kind of temporary retentive apparatus.

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SECTION III.

OF PARTICULAR FRACTURES.

Article I.—*Of Fractures of the Bones of the Head and Trunk.*

Description of the nasal bones.—The nasal bones are situated at the middle and upper part of the face, beneath the os frontis and between the ascending processes of the superior maxillary bones. They are thin and weak, irregularly quadrilateral, and form what is usually called the *bridge* of the nose. They are convex externally, concave internally, and are supported by the azygos process of the os frontis and the perpendicular plate of the os ethmoïdes.

They are articulated above with os frontis; below with the nasal cartilages; externally with the ascending processes of the superior maxillary bones; and internally with each other.

Attachments of muscles.—The bones of the nose are placed superficially under the integuments, and give attachment to the pyramidalis and compressor nasi muscles.

FRACTURES OF THE NASAL BONES.

Direction.—The direction of the fracture may be either oblique, transverse, or longitudinal.

Causes.—The accident is usually the result of falls, and direct blows upon the face.

Symptoms.—The symptoms of a fracture of the nasal bones must necessarily vary according to the direction of the injury, and a variety of other circumstances. In general, however, the soft parts are either much contused or wounded; the bones are splintered and crushed into the cavity of the nostril; and the nose has lost its natural form. These signs are commonly sufficient to enable us to form a correct diagnosis; but when there is no displacement of the fragments, or solution of continuity of the soft parts, it is often extremely difficult, and sometimes even impossible to discover the fracture.

In some instances this accident is attended with very dangerous and alarming symptoms; depending either upon the very intimate connexion subsisting between the bones of the nose and the os frontis, or upon the violent concussion of the brain, produced by the same blow or fall that occasioned the fracture. (*a*)

Prognosis.—In most cases the fragments may be restored to their proper situation without much difficulty, and the patient get well with little or no deformity. Sometimes, however, the injury inflicted upon the adjacent parts is so great as to cause the death of the patient, or give rise to considerable distortion.

Reduction.—In order to restore the displaced parts to their natural situation, the patient is to be seated upon a chair, and his head is to be supported against the breast of an assistant. The surgeon then passes a strong probe, a female

(*a*) Delpech's Precis. Elém. des Mal. Chir. T. 1. p. 221. Boyer on the Bones, p. 47.

catheter, or a pair of ring-handled forceps into the nostril, and using it as a lever, he carefully pushes the fragments outwards, and thus accomplishes the reduction. Should the perpendicular lamella of the os ethmoïdes be thrown more or less to one side or the other, as is sometimes the case, it is to be carefully replaced either by means of a probe or the little finger, as well as the nature of the case will allow.

Treatment after the reduction.—When the fragments have been properly reduced, they will generally remain in their situation with little or no difficulty. In some instances, however, they have a tendency to fall inwards; and in order to remedy this inconvenience it has been recommended to support them with gum elastic tubes, or dossils of lint, smeared with some digestive ointment, and introduced up the nostril: but I am inclined to believe with Professor Delpech, Mr. Charles Bell, and others, that all contrivances of this kind will be more likely to be injurious than beneficial, inasmuch as they must necessarily act as foreign bodies. Any displacement of this description may, I am convinced, be readily and effectually obviated by the plan suggested by the late Dr. Dorsey. This consists in applying a piece of leather, spread with adhesive plaster, directly over the bridge of the nose; but in order to obtain the full advantage of this mode of treatment, the leather strip should be applied while the fragments are pressed from within outwards, and should be long enough to extend from the middle of the nose to the prominences of the cheek-bones. As soon as the plaster has become united to the skin, it will assume the form of the nose, and thus prevent the fragment from falling inwards.

The symptoms which commonly follow this accident, such as inflammation of the pituitary membrane, with swelling of the nose and adjacent parts, are to be combated by general and local bleeding and the usual antiphlogistic means.

Description of the lower jaw.—The inferior maxilla,

situated at the lower part of the face, is shaped somewhat like a horse-shoe, or the Greek letter υ, and is divided into a body and two branches or rami.

The body is that part of the bone which is usually called the chin; it is convex on its external surface, and is marked at its middle by a vertical line indicating the original separation of the bone into two lateral halves. Its internal surface is concave, and is marked by a central depression corresponding with the symphysis of the chin, and by an oblique and prominent line, denominated the mylo-hyoïdean ridge. The external surface of each ramus is flat and somewhat rough, while the internal presents the posterior dental foramen, and is characterized by inequalities for the origin and insertion of muscles. In the superior border of the lower jaw are sixteen sockets for the roots of the teeth; and behind the alveolar arch on each side, this border terminates in a pointed extremity, called the coronoïd process, which is grooved at its commencement, and gives attachment to some of the fibres of the buccinator and temporal muscles. The inferior border of the lower jaw is thick, and terminates in a convex articular head, termed the condyle of the bone. The interval between this and the coronoïd process is deeply excavated, and is called the sigmoïd or semi-lunar notch.

In infancy the lower jaw consists of two equal lateral halves, which are slightly connected together by a thin cartilage in the middle of the chin. In more advanced age, however, this union becomes gradually more perfect, and the coronoïd and articular processes, which are at first short, become more large and acute. In youth and manhood the alveolar processes are more numerous and elongated, and the teeth are firmly rooted. In old age and decrepitude the jaw returns again, as it were, to its infantile state; the teeth fall out; the alveolar processes are in great measure absorbed; and the bone loses considerably of its breadth, and projects beyond the upper jaw.

Attachments of muscles.—The muscles which are at-

tached to the lower jaw are the levator and depressor labia inferioris; the depressor anguli oris; a small part of the platysma myoïdes; the genio-hyo-glossus; the genio-hyoïdeus; the digastricus; the mylo-hyoïdeus; a small part of the superior constrictor of the pharynx; the masseter; the temporal; and the internal and external pterygoïd.

FRACTURES OF THE LOWER JAW.

Seat and direction.—Fractures of the lower jaw may be oblique, transverse, or longitudinal; and experience has proved that the bone may be broken in any part of its extent, even at the symphysis itself. This circumstance, which has been denied by some very respectable writers, especially by Professor Delpech, of Montpellier,(*a*) has been placed beyond the possibility of a doubt by the investigations of Bell,(*b*) Gibson,(*c*) Dorsey,(*d*) and other practitioners.

Causes.—The accident is generally produced by a fall from a height, by a severe blow, or the kick of a horse. In a case of fracture of the lower jaw which I had an opportunity of seeing several years ago, the injury was occasioned by the blow of a heavy cudgel, and in another by violence received in falling down a pair of stairs during a fit of intoxication.

Symptoms.—The symptoms denoting a fracture of the lower jaw are generally so well marked that there is seldom any difficulty in forming a correct diagnosis. Crepitation can almost always be observed on moving the two pieces of the jaw on each other, and upon looking into the mouth the teeth will be found to have lost their natural relation. There is commonly a perceptible inequality at the inferior border

(*a*) Precis Elémentaire des Mal. Chir. T. 1. p. 223.
(*b*) Operative Surgery, vol. ii. p. 378.
(*c*) Institutes of Surgery, vol. i. p. 381.
(*d*) Elements of Surgery, vol. i. p. 139.

of the bone, and severe pain is felt in the affected part. When the bone is fractured in two places the central portion is always drawn downwards by the action of the muscles of the throat; the mouth is more or less open and so distorted that the corner or commissure of the lips is much lower on the injured side than on the other; the front teeth are forced below the level of the molares; and the regularity of the alveolar processes and the dental arch is destroyed.(*a*)

When the ramus of the jaw is broken, the patient experiences great pain near the ear; there is a grating noise in moving the bone; and, owing to the fact that the masseter muscle is inserted into both fragments, there is seldom, if ever, any considerable displacement.

A fracture of the neck of the articular or condyloïd process may generally be detected by the pain and crepitus produced in the neighbourhood of the ear on moving the jaw, and by the circumstance that the condyle is pulled forwards by the action of the external pterygoïd muscles and the approximation of the jaws.(*b*)

In addition to the symptoms already enumerated as characterizing fractures of the lower jaw, there is usually a considerable degree of contusion of the soft parts, and the patient experiences great pain on moving the bone, and a difficulty in articulating sounds. In some instances there is also more or less hemorrhage, owing to the laceration of the inferior dental artery.

Prognosis.—Fractures of the lower jaw are rarely attended with any very serious mischief; and if the fragments be well set and maintained in contact, the patient will generally recover without deformity. Complicated fractures, however, are always more dangerous, since they are not unfrequently followed by troublesome and tedious exfoliations,

(*a*) S. Cooper's First Lines of the Practice of Surgery, vol. ii. p. 407.

(*b*) Delpech's Precis Elém. des Mal. Chir. T. 1. p. 215.—Boyer on the Bones, p. 49.

and sometimes even by paralysis of some of the muscles of the face.

Reduction.—In reducing a fracture of the lower jaw, the patient is to be seated upon a chair, and his head is to be supported upon the breast of an assistant. The surgeon is then to place his fingers along the inferior margin of the bone, and as soon as he has succeeded in modelling the parts into a proper shape, he is to close the mouth, and make the lower teeth rest fairly against the upper. When one end of the fracture overlaps the other, the two parts are to be pushed in opposite directions, and if this be properly done, the slightest degree of pressure will generally suffice to effect the reduction.

If any of the teeth are loosened, or forced from their sockets, they should be immediately replaced, and, if necessary, secured to the adjacent ones, by means of a strong ligature, or gold wire. It was formerly the opinion of surgeons, that every loosened tooth should be extracted as extraneous matter; but such practice would at present be considered highly improper, and would justly deserve to be reprobated.

When the fracture is properly reduced, which may always be known by the evenness of the dental arch and of the inferior margin of the jaw, our next and most important object is to keep it in this position. To accomplish this, however, is by no means an easy task; and it can only be well done by supporting the lower jaw, and keeping it firmly applied against the upper. For this purpose a piece of pasteboard, softened with vinegar, is to be placed along the inferior margin of the bone; and over this are to be applied a middle-sized compress and a four-tailed bandage. The centre of the bandage is to be placed on the patient's chin, and the two posterior tails are to be pinned to the front, and the two anterior ones to the back part of his night-cap.

Another convenient method of keeping the ends of the fracture in contact, consists in applying a thick compress under the lower jaw, long enough to extend from the angles

of the bone nearly to the chin, and securing it by means of a roller about five yards in length and one inch and a half in width. Having made several turns under the jaw, along the sides of the face, and over the head, the surgeon changes the course of the bandage, and causing it to pass off at a right angle from the perpendicular cast, he passes it several times horizontally round the temple, the occiput and forehead, and finishes by making several additional horizontal turns round the posterior part of the neck. To prevent the roller from changing its position, a short piece of linen is to be secured to the horizontal turn encircling the forehead, and passed backwards along the middle of the head as far as the neck, where it is to be fixed to the lower horizontal turns.(*a*)

In bandaging fractures of the lower jaw, it was formerly customary to fill up the irregularities between the upper and lower teeth by the interposition of pieces of cork; but at present, the practice is almost totally abandoned, and perhaps justly so. When the irregularity between the dental arches is very great, and prevents the fragments from being brought evenly into contact, I am sure that in most cases all the desired advantage may be obtained by filing away some of the most projecting parts of the teeth. This operation, however, should always, if possible, be done by a skilful dentist.

When there is no displacement of the fracture, as is sometimes the case, all that is required is to cover the jaw with paste-board, and apply the four-tailed bandage, as already mentioned.

In cases of comminuted fractures of the lower jaw, it sometimes happens, in spite of our best directed efforts, that the ends of the fragment can not be maintained in contact. Under these circumstances surgical writers have generally advised us, in addition to the mode of treatment already recommended, to tie the pieces together, by means of a gold

(*a*) Gibson's Institutes of Surgery, vol. i. p. 305.

or silver wire. This plan, however, is by no means so well calculated to insure success as might at first sight be supposed; and I feel almost confident that in most cases of comminuted fractures of the lower jaw, far more benefit may be derived from a mode of treatment which I witnessed some years ago in the practice of Dr. M'Clellan, the distinguished professor of surgery, in Jefferson College. The treatment referred to, consists in applying a thin plate of silver, adapted to the shape of the jaw, between the cheeks and the dental arches, and securing it with a silver wire to a number of the teeth. The shape of the bone is to be taken with a piece of wax; and the plate, which can be easily made by a silver-smith, is to be fastened by a dentist, or the surgeon himself.

In fractures of the neck of the articular or condyloïd process of the lower jaw, the maintenance of the reduction is always peculiarly difficult; and can only be properly effected by placing a thick, graduated compress behind the angle of the bone, and keeping it steadily supported with a roller or the four-tailed bandage.

The treatment of fractures of the lower jaw, complicated with a solution of continuity of the soft parts, is to be regulated according to the same principles as in similar injuries of the other parts of the osseous system. The wound should always, if possible, be healed by union of the first intention; but should the attempt fail, the parts are to be kept perfectly clean by changing the dressings as often as the circumstances of the case may indicate.

Treatment after the Reduction.—When the parts have been returned to their natural situation, the jaw should be kept perfectly quiet, and every thing should be avoided that may have a tendency to produce a new displacement. The patient should be nourished upon such food as does not require mastication; and he should carefully avoid talking or laughing. If these precautions be neglected there will be much danger of deformity, and the cure must necessarily

be protracted. The rest of the treatment is to be regulated according to the violence of the symptoms, and the age and constitution of the patient.

In adults, the fracture commonly unites in about three or four weeks; and in children, in about a fortnight. It should be observed, however, that the consolidation is by no means perfect until sometime after; and that it will be of the utmost importance, until this shall have taken place, that the patient should abstain from chewing solid food.

Remark.—Before I conclude these observations on fractures of the lower jaw, it may be proper to state, as a general rule, that the patient's food should be put into his mouth with a tea-spoon. In very bad cases, however, in which every attempt at deglutition would give rise to severe pain, or be likely to displace the fragments, it would be highly judicious to convey the necessary nourishment into the stomach by means of a gum elastic tube, passed through one of the nostrils. In no instance should we resort to that abominable practice, which was formerly so much insisted upon by surgeons—of extracting one of the front teeth, and passing the food through the space thus produced.

DESCRIPTION OF THE CLAVICLE.

The clavicle, or collar-bone, is situated at the supero-external part of the chest, between the acromion process of the scapula and the summit of the sternum. It is elongated and irregular, shaped somewhat like an italic *f*, and is divided into a body and two extremities.

The superior surface of the body of the bone is irregular from without inwards, and principally subcutaneous; the inferior surface presents inequalities and depressions for the attachment of muscles and ligaments; its anterior border is thin and concave towards the acromial, broad and convex towards the sternal extremity; the posterior border presents, of course, the inverse arrangement of the preceding.

The sternal extremity is bent obliquely downwards and forwards, and terminates in a triangular unequal surface, which is incrusted with cartilage, and enters into the for-

mation of the sterno-clavicular articulation. The acromial extremity is oblong, inclined backwards and upwards, and articulates with the acromion process of the scapula.

Attachments of muscles.—The clavicle gives attachment to the deltoïd, the trapezius, the sterno-cleido-mastoïdeus, the subclavius, and the pectoralis major.

FRACTURES OF THE CLAVICLE.

Seat and direction.—The clavicle may be broken either in an oblique or transverse direction, and the accident may occur in any part of the bone, though it most frequently happens near its middle, where its curvature is greatest, and its situation most superficial.

Causes.—Fractures of the clavicle are usually occasioned by a fall upon the point of the shoulder, the elbow, or the palm of the hand; or by violence inflicted directly upon the part. (*a*)

Symptoms.—The symptoms which characterize this accident are, severe pain at the affected part; an inability to touch the shoulder of the opposite side, or to carry the hand to the head; impossibility of performing circular or rotatory motions; bending of the head and body towards the injured side; hanging of the arm close to the trunk; the depression of the shoulder and its approximation towards the mesian line of the body; mobility of the two broken ends of the bone; crepitation produced by rubbing them against each other; the patients' supporting the weight of his arm with his other hand; the displacement of the fragments; the inequality felt at the situation of the injury by passing the fingers over the upper surface of the bone; the facility of restoring the ends of the fragments to their natural situation, by carrying the shoulder upwards, backwards, and outwards, and the immediate return of the displacement when the arm is left unsupported. (*b*)

(*a*) Delpech's Precis Elém. des Mal. Chir. T. 1. p. 245.

(*b*) Desault's Treatise on Fractures, p. 24-5.—Delpech, op. cit. T.

Remark.—The most remarkable symptom in fractures of the clavicle is the inclination of the head and body, caused by the weight of the arm, towards the affected side. This peculiar attitude, according to Desault and Bichat, is often of itself sufficient to disclose the nature of the injury.

The symptoms which have just been enumerated are generally so characteristic, especially in oblique fractures of the clavicle, that it is impossible, even for the most inexperienced practitioner, to mistake the nature of the accident. In transverse fractures, however, the diagnosis is sometimes more difficult, but even here every doubt may soon be dissipated by placing the fingers upon the two extremities of the bone, and ordering an assistant to move the arm.

Prognosis.—Fractures of the clavicle usually assume a mild aspect, being seldom accompanied by any serious accident. The ends of the bone may always be easily restored to their natural relations, but, as it is very difficult to maintain them in this position, the patient seldom recovers without some degree of deformity. This circumstance, which was already noticed by some of the early Greek writers, has been amply confirmed by the experience of modern surgeons.

Reduction.—In reducing a fracture of the clavicle, the patient is to be seated upon a high stool, and a thick, wedge-shaped cushion, about four or five inches broad, and long enough to reach from the axilla to the elbow, is to be placed between the arm and trunk. Its base, which is to be placed upwards, should be about three inches and a half thick, and be fastened to two strings or pieces of tape, passed across the anterior and posterior part of the chest, and on the opposite shoulder. An assistant is then to elevate the arm of the injured side, and while he keeps it extended at a right angle with the body, the surgeon applies the end of a roller, about two inches and a half wide, and eight yards long, upon the

1. p. 245-6.—C. Bell's Operative Surgery, vol. ii. p. 330.—Boyer on the Bones, p. 73.

middle of the pad, and fixes it by two or three circular turns round the body. The roller then ascends obliquely over the anterior part of the chest to the sound shoulder, passes over the back part of it, under the axilla, appears again on the fore part of the chest, makes a circular turn nearly round the body, ascends obliquely over the sound shoulder to the axilla, appears again on the posterior part of the chest, and finishes by circular turns which completely cover the pad, and fix it firmly to the side of the body. The two turns of the roller on the sound shoulder are to be prevented from slipping by means of a pin.

The pad being thus properly secured, the surgeon reduces the fracture by carrying the arm downwards, laying it closely along the pad, bending the fore-arm across the chest, and pushing the ends of the fragments into even contact by means of his fingers. Two compresses, dipped in vinegar or camphorated spirits, are next to be placed along the fractured bone, and while the arm is retained in the position just described, the surgeon takes another roller, of the same size as the preceding, and carries its end under the axilla of the sound side. It is then brought obliquely across the chest, over the injured clavicle, and from thence by oblique and circular turns round the body and arm, gradually descending until it passes under the elbow as far as the middle of the fore-arm, care being taken that each turn overlaps the other, and increases in tightness in proportion as the roller approaches nearer to the lower extremity of the humerus.

Remark.—Before applying the second roller, care should always be taken to fill up the vacant spaces between the trunk and the anterior and posterior parts of the arm. This may be readily done with soft compresses or wadding, and will be found to be of essential service in preventing the bandage from becoming deranged.

The surgeon now taking the third and last roller, and fixing its end under the axilla of the sound side, he carries it

across the anterior part of the chest, over the injured shoulder, and from thence downwards along the posterior part of the arm, under the elbow, obliquely across the chest to the axilla from whence it commenced, across the back to the shoulder of the affected side, over the situation of the fracture, along the anterior part of the humerus, below the elbow, and obliquely behind the back to the axilla of the sound side. This plan being twice repeated, the remainder of the roller is to be passed circularly round the body and arm in order to prevent the first turns of the bandage from becoming displaced. The apparatus is then to be secured by pins, wherever they are likely to be useful; the patient's hand is to be supported in a sling fastened to one of the rollers, and the whole is to be covered with a large muslin or linen cloth. (*a*)

Remark.—The indications which this apparatus is intended to fulfil, are to keep the shoulder elevated, and drawn backwards from the trunk.

The apparatus of Desault, which I have just described, has long been extensively employed in this country, and from the fact that it has been found more successful than any other that has yet been used, it deserves a decided preference over every other contrivance of the kind. It may not be improper, however, to give a short description of the apparatus of Professor Boyer, of Paris, and of the one lately recommended by Dr. Brown, of New York.

The apparatus of Boyer consists of a quilted girdle, six inches broad, which passes round the trunk on a level with the elbow, and is fastened on by means of three straps, and an equal number of buckles. On the outside of this girdle, at some distance from its extremities, are placed four buckles, two before and two behind the arm. On the lower part of the arm is to be laced a bracelet of quilted cloth, about four or five inches broad. Four straps are to be attached to

(*a*) Desault's Treatise on Fractures and Dislocations, p. 39.

it, which correspond to the buckles on the outside of the girdle, already described, and are calculated to confine the arm close to the trunk, and prevent it from moving either backwards or forwards. In this, as in the apparatus of Desault, it is necessary to make use of a wedge-shaped cushion, to keep the shoulder upwards, outwards, and backwards.(*a*)

The apparatus of Dr. Brown is somewhat similar to that of Desault, and is applied in the following manner. The surgeon taking a single-headed roller, about eleven yards in length and three inches and a half in width, places its end near the axilla of the sound side, and secures it there by several circular turns round the upper part of the chest. A pad, similar to the one already described, is then to be placed under the axilla, and fastened to the opposite shoulder by means of two pieces of tape. The fracture is then to be reduced upon the same principles as in the preceding case, and while an assistant supports the fore-arm, bent to a little less than a right angle, the surgeon brings the roller obliquely down across the breast, nearly over the middle of the fore-arm, under the elbow, and obliquely across the back to the lower part of the scapula of the opposite side, from whence it is to be again carried over the breast and fore-arm as already stated. Having repeated this plan four or five times, with the precaution of letting each turn overlap about two-thirds of the other, and bringing it nearer to the elbow, so as to form a proper support for it, the remainder of the bandage is to be carried round the body and arm in order to confine the lower extremity of the humerus closely against the trunk. The apparatus is then to be secured by pins or stitches, and the patient's hand is to be supported in a sling.(*b*)

Before applying the bandage a large compress should be placed upon the shoulder and fore-arm, to prevent excoriation.

(*a*) Boyer on the Diseases of the Bones.

(*b*) See the American Medical Recorder, vol. iv. p. 652.

The apparatus of Dr. Brown is extremely simple, and can be much easier applied, by the generality of practitioners, than that of Desault; but whether it will be found equally useful, experience, I believe, has not yet determined. I should certainly, however, think it entitled to our confidence, and as such it deserves to be fairly tried.

Remark.—To describe all the various apparatus and contrivances that have been proposed by surgeons for fractures of the clavicle, would not only be fatiguing to myself, but unprofitable to my reader. I shall merely mention, therefore, that the figure-of-eight bandage, formerly so much in vogue in England, the leather strap recommended by Brunninghausen, the iron cross proposed by Heister, and the corselet described by Brasdor, are at present never employed in this country.

Treatment after the reduction. When the fracture is reduced the patient is to be treated upon the same principles as in fractures of other bones; but here, as the bandages are particularly liable to become relaxed, it will be necessary frequently to take off the apparatus, and carefully reapply it. In making this remark, I wish it to be particularly understood to mean that the apparatus should be removed only when it is relaxed, or when there is reason to suppose that the ends of the bone have become displaced.

The fracture will generally unite in about four or five weeks, and the patient may be allowed to walk about during the cure.

DESCRIPTION OF THE SCAPULA.

The scapula is situated at the supero-posterior part of the thorax, and is of an irregular triangular shape. Its anterior surface, somewhat concave, looks towards the ribs, and is intersected by prominent lines, directed from within, outwards and upwards. The posterior surface is divided into two unequal parts by a large triangular ridge, called the spine of the scapula. It is flattened from above downwards, and as it proceeds forwards it becomes gradually more large and

elevated, until it terminates in an elongated projection, which surmounts the scapulo-humeral articulation, and is denominated the acromion process. The posterior and upper surface of this eminence is irregularly convex and subcutaneous, while the anterior and inferior one is concave and smooth. The superior border presents a small oval surface for its articulation with the clavicle, and its summit gives attachment to the coraco-acromion ligament.

The scapula has three borders, a superior or cervical, a posterior or vertebral, and an inferior or axillary. The superior is the shortest of the three; and near its fore part is situated a notch, which, in the recent state, is converted into a foramen. In front of this opening it is surmounted by the coracoid process, so called from its imaginary resemblance to the beak of a crow. It is an elongated projection, curved upon itself, and affording attachment to muscles and ligaments. The posterior or vertebral border, called also the base of the scapula is slightly rounded, and forms, in conjunction with the preceding, the postero-superior angle of the scapula. The axillary or inferior border is extended obliquely from the third to the eighth rib, and at its union with the base of the scapula, it forms the inferior angle, which is very acute and is made smooth by the passage of the latissimus dorsi muscle.

At the convergence of the superior and inferior borders may be observed a strong narrow part, usually denominated the neck of the scapula. This is surmounted by a shallow, oval depression, which articulates with the head of the os humeri, and is called the glenoïd cavity.

The scapula belongs to the class of broad or flat bones, being like them of unequal thickness.

Attachments of muscles.—The muscles which either arise or are inserted into the scapula, are the biceps and coraco-brachialis, the levator anguli scapulæ, the omo-hyoïdeus, the pectoralis minor, the serratus magnus, the supra and infra spinati, the rhomboïdeus major and minor, the triceps

extensor, the trapezius, the sub-scapularis, the deltoïd, and the teres major and minor.

FRACTURES OF THE SCAPULA.

In treating of fractures of the scapula, it will be proper to speak, first, of those which occur in the acromion process, and secondly of those which take place in the neck and inferior angle of the bone.

§ I. FRACTURES OF THE ACROMION.

Seat and direction.—The fracture is generally transverse, and may be situated either at the base or at the summit of the process.

Causes.—The accident is commonly the result of a fall upon the shoulder, or of violence applied directly to the part.

Symptoms.—When the acromion is fractured, there is always a severe pain at the seat of the injury which is increased by the elevation of the arm; the head is inclined towards the affected side; the external fragment is displaced by the weight of the arm, which hangs motionless along the side of the body; the natural rotundity of the shoulder is destroyed; the head of the humerus is sunk towards the axilla; the distance between the shoulder and the sternal extremity of the clavicle is diminished; the patient experiences great difficulty in raising the arm; a depression is felt at the situation of the fracture; and a distinct crepitus may be observed at the point of the shoulder by pushing up the head of the humerus, and rotating it. (*a*)

Prognosis.—Fractures of the acromion process of the scapula, although usually accompanied by more or less con-

(*a*) Desault's Treatise on Fractures, p. 68.—Sir Astley Cooper's Treatise on Dislocations, p. 325.—Delpech's Precis. Elém. Des Mal. Chir. T. 1. p. 241.

tusion of the soft parts, are rarely dangerous; but, as it is always very difficult to keep the ends of the fragments in apposition, the parts generally unite by a ligamentous substance.

Reduction.—Before commencing the reduction the patient is to be placed upon a chair, and the arm is to be raised against the inferior surface of the acromion, in which position it is to be held firmly by an assistant. The surgeon then takes a cushion, somewhat thicker below than above, and places it between the chest and the inferior part of the humerus, in order to relax the fibres of the deltoïd muscle, and to maintain the ends of the broken bone in contact. The elbow being now carried a little backwards, is to be secured to the chest by means of a bandage extending over the opposite shoulder. The fore-arm is to be supported in a sling, and every thing is to be obviated that may have a tendency to displace the parts.

The apparatus is to be kept on for about four weeks, care being taken to tighten it as often as the circumstances of the case may require.

Remark.—Professor Delpech, aware of the great difficulty of keeping the head of the humerus constantly applied against the lower surface of the acromion, is of opinion that the best mode of treating this fracture is to keep the patient quietly in bed, with the arm considerably raised upon a pillow, so as to relax the deltoïd muscle, and enable the fibres of the trapezius to bring the external fragment to a level with the clavicle.(*a*)

Treatment after the reduction.—When the fracture is reduced, a compress, dipped in cold water and vinegar, or a weak solution of the acetate of lead, is to be placed over the situation of the injury; or, if there be much contusion of the soft parts, a bread and milk poultice will probably be more beneficial. The rest of the treatment is to be regulated according to the indications of the case.

(*a*) Delpech's Precis. Elém. Des Mal. Chir. T. 1. p. 242.

§ II. FRACTURES OF THE NECK OF THE SCAPULA.

Causes.—The same as in the preceding case.

Symptoms.—The head of the humerus can be distinctly felt in the axilla; a depression is perceived under the acromion; and the shoulder is so much flattened as to give the accident the appearance of a dislocation of the shoulder-joint. The nature of the case, however, may generally be readily distinguished by the facility with which the parts may be replaced; by the immediate return of the symptoms when the limb is left to itself; and by the crepitus which is felt at the extremity of the coracoïd process, on rotating the arm.(*a*)

Prognosis.—Fractures of the neck of the scapula are kept reduced with difficulty, and are said to be often followed by stiffness of the shoulder-joint, atrophy, and paralysis of the arm, and other disagreeable symptoms.

Reduction.—The ends of the fragments are restored to their natural relations by raising the arm and glenoïd cavity, and pushing the head of the humerus outwards. The parts are then to be maintained in this position by means of Desault's apparatus, or by that recommended by Dr. Brown, which has been already noticed in one of the preceding articles.

Treatment after the reduction.—The patient may be allowed to walk about during the cure, which usually requires from ten to twelve weeks, and no particular attention is necessary to diet or regimen, except during the first few days after the reception of the injury.

§ III. FRACTURES OF THE INFERIOR ANGLE OF THE SCAPULA.

Direction.—Transverse or oblique.

Causes.—According to Desault, the usual causes of this

(*a*) Sir Astley Cooper, op. cit. p. 327.

accident are falls on the side, or blows, or other violence applied directly to the part.

Symptoms.—Fractures of the inferior angle of the scapula are always characterized by severe pain at the injured part; and by an inequality and unnatural position of the bone, in consequence of the displacement of the fragments. If there be any doubt, however, as to the nature of the injury, it may soon be dispelled by placing the fingers upon the lower angle of the scapula, and drawing the shoulder backwards: if it follows the motions of the rest of the bone, there is no division; but if, on the contrary, it remains stationary, there can be no doubt of its being fractured.(*a*)

Prognosis.—In this, as in the preceding case, the fracture, after being set, is extremely liable to be displaced, by the action of the serratus major anticus muscle; and the patient seldom recovers without some degree of deformity.

Reduction.—The fracture is reduced by placing the patient upon a high stool, putting the fore-arm in the half-bent posture, and carrying the lower part of the humerus forwards upon the anterior part of the breast. By this manœuvre the body of the scapula is pushed downwards and forwards, and brought into contact with the inferior fragment, which is drawn in that direction by the serratus major anticus muscle. In order to retain the parts in this position, a thick wet compress is to be placed in front of the fragment,(*b*) and there secured by means of a roller passed round the body, so as to include both the chest and the arm of the injured side. Compresses should be interposed between the bandage and the anterior and posterior parts of the arm, and the hand and fore-arm should be sustained in a proper sling.

Treatment after the reduction.—The after treatment is to be conducted precisely upon the same principles as in the two preceding cases: the patient may be either confined to

(*a*) Desault's Treatise on Fractures and Dislocations, p. 73.

(*b*) Gibson's Institutes of Surgery, vol. i. p. 406.

bed, or allowed to walk about during the cure, care being taken to keep the arm as quiet as possible.

Remark.—In fractures of the coracoïd process of the scapula, the shoulder is to be kept downwards and forwards, a compress dipped in spirits of wine and water is to be bound under the broken part, and the arm is to be slightly elevated and confined to the antero lateral part of the chest with a bandage and sling. By this means, the pectoralis minor, the short head of the biceps, and the coraco-brachialis are relaxed, and the ends of the broken pieces are more easily maintained in contact.

DESCRIPTION OF THE STERNUM.

The sternum is a flat, elongated, symmetrical bone, situated at the antero-superior and middle part of the thorax. It is directed obliquely downwards and forwards, and presents two surfaces, two borders, and two extremities.

The anterior surface is subcutaneous, irregularly convex, and marked by four transverse lines, indicating its original separation into five pieces. The posterior surface corresponds to the mediastinum, and is somewhat hollowed for enlarging the cavity of the thorax.

The superior extremity is broad and thick, inclined backwards, slightly excavated in its middle, and presents at each corner a cartilaginous surface for the reception of the sternal end of the clavicle.

The inferior extremity, also called the xiphoïd or ensiform cartilage, is thin and elongated, and generally remains in a cartilaginous state until an advanced period of life. Its form varies considerably in different individuals, being sometimes bent forwards, sometimes in the opposite direction, sometimes bifurcated, and often pierced by a hole in its centre.

The sternum belongs to the class of mixed bones, being cellular within, and covered by a very thin external plate, especially on its internal surface.

Attachments of muscles.—The sternum gives attachment to the sterno-cleido-mastoïdeus, the sterno-hyoïdeus, the sterno-thyroïdeus, the sterno-costalis, the pectoralis ma-

jor, the diaphragm, and the rectus, transversalis, and internal oblique muscles of the abdomen.

FRACTURES OF THE STERNUM.

Seat and direction.—The sternum may be broken in almost any part of its extent, but the fracture most commonly happens near its middle, and its direction is almost always transverse, seldom oblique or longitudinal.

Causes.—Fractures of the sternum are usually produced by gun-shot violence, the kick of a horse, heavy blows upon the chest, and similar causes. It has also been known to arise from falls from a considerable height, in which the spine was bent violently backwards.

Symptoms.—The accident may in general be easily distinguished by the pain and crepitus at the injured part; by the elevation, or depression of the broken pieces; by the inability to lie upon the back; and by the difficulty of respiration, accompanied often with more or less cough, spitting of blood, and palpitation of the heart. In many instances, the fracture may be readily seen through the solution of continuity of the soft parts, or it may be immediately recognized by the constant grating of the fragments upon each other, caused by the respiratory efforts, and which is sometimes so remarkable as to be heard at a considerable distance.(*a*) In some cases, also, especially when the bone has been fractured by gun-shot violence, the accident may be complicated with emphysema, and the pulsations of the heart may be distinctly seen through the bony aperture.(*b*)

Prognosis.—The prognosis of fractures of the sternum varies according to the mildness or severity of the injury, and the cause by which it is produced. In most cases, however, the accident is attended with more or less danger, on

(*a*) Gibson's Institutes of Surgery, vol. i. p. 393.

(*b*) Flajani's Collezione d'Ossero. de Chir. T. 3. p. 214. Roma, 1802. Levéillé's Nouvelle Doctrine Chir. T. 2. p. 244.

account of the injury of the thoracic viscera, and the severe consequences to which it often gives rise, such as inflammation of the lungs, extravasation of blood, abscesses in the anterior mediastinum, and caries and exfoliation of the bone itself.

Reduction.—In fractures of the sternum, attended with depression of the bone, the symptoms are generally so urgent as to require immediate attention. The first object of the surgeon, therefore, should be to restore the ends of the broken bone to their proper situation, and thus remove the pressure of the thoracic viscera. To accomplish this, some of the older writers recommended placing the patient on his back upon a barrel or drum, in order to extend the spine, and thereby enable the fragments to rise to their natural level, care being taken at the same time that the patient take a deep inspiration. As this mode of reduction, however, is evidently attended with considerable injury to the lungs (inasmuch as they are by this means pushed forcibly against the depressed portion of bone,) we have been advised by some of the modern surgeons to make an incision down upon the part beaten inwards; and if it can not be raised with an elevator, or a pair of forceps, to remove it either with a trephine, a lenticular knife, or Hey's saw. In this case, however, it is to be feared that the remedy would be worse than the complaint, on account of the irritation which would necessarily result to the lungs; and I am, therefore, inclined to believe that none of the operations just mentioned should ever be resorted to. Indeed, I feel confident, that it would be far better to leave the reduction to the efforts of nature than to adopt any such severe measures; measures which, if had recourse to, must often be followed by the most serious consequences.

The best mode of proceeding in these cases is to extend the spine by placing thick pillows under the loins, and then, while the patient holds his breath, the depressed portion of bone is to be elevated by gently pressing upon the ribs on

each side of the sternum. If this attempt, however, be unsuccessful, the bone may be readily raised by means of an instrument constructed upon the principle of a cork-screw. For this purpose an incision is to be made through the skin, and the instrument, which should be strong and narrow, is to be cautiously screwed into the substance of the bone. When the fragment has been thus raised, the edges of the wound are to be brought into contact, and retained by strips of adhesive plaster.

Remark.—If the symptoms are very urgent, and the surgeon has no particular instrument at hand, an attempt may be made to raise the bone with a common cork-screw.

Treatment after the reduction.—As soon as the parts have been replaced, a broad roller is to be applied lightly round the chest, to impede the action of the intercostal muscles; the patient is to be confined quietly in his bed in a sitting posture; and recourse is to be had to the most rigorous antiphlogistic treatment.

Should matter collect beneath the sternum, it should be cautiously evacuated with the crown of a trephine, care being taken not to make the opening larger than is absolutely necessary. When the bone becomes affected with caries, the diseased part, if requisite, may be cut away by means of a lenticular knife, or Hey's saw.

DESCRIPTION OF THE RIBS.

The ribs are the bony arches which are situated between the sternum and the vertebral column, and contribute to the formation of the anterior and lateral parts of the thorax. They are generally twelve in number on each side,(*a*) and are divided into true and false, or into vertebral and sterno-

(*a*) I say generally, because sometimes there are only eleven, and sometimes as many as thirteen.—Riolan's Comment. de Ossibus, cap. 19, —Marchetti, cap. 9.—Cowper's Explicat. Tab. 93-4.

vertebral. They are elongated and semi-circular, concave internally and convex externally. Their breadth gradually diminishes from above downwards, and all their bodies, except that of the first, are twisted on themselves, so that their two extremities can not be made to rest at the same time upon a plane surface.

The true ribs are seven in number, and are extended from the vertebral column to the costal cartilages, through the media of which they are united with the sternum. The false or vertebral ones are only five in number, and do not, like the others, completely encircle the thorax.

All these bones present two surfaces, two borders, and two extremities.

They are smooth and concave internally, but convex externally. Their superior border is smooth and rounded, and gives attachment to the intercostal muscles; the inferior is marked by a groove for the lodgment of the intercostal vessels and the anterior branch of the dorsal nerves, and also affords attachment to the intercostal muscles.

The anterior extremity is elongated from above downwards, and hollowed at its tip into an oval depression, for its articulation with the costal cartilages.

The posterior extremity presents a small head, which is divided by a middle ridge into two plane or hollow surfaces, and articulates with the vertebral column. The head is supported by a small, concave, unequal surface, or neck, terminated externally by a tubercle, which is divided into two portions, the internal of which is convex, and articulates with the transverse process of the dorsal vertebræ; the external is rough, and gives attachment to the costo-transverse ligament. Between the tubercle and the most convex part of the body of each rib, is an oblique, prominent line, marking what is called its angle. The ribs then become gradually broader, until they reach the costal cartilages.

Several of the ribs present individual peculiarities, but to describe these would be foreign to my present purpose.

The ribs belong to the class of mixed bones, being composed of a spongy cellular substance, covered by a very thin bony lamella.

Attachments of muscles.—The muscles which are attached to the ribs are the intercostal, the scaleni, the pectoralis major and minor, the rectus abdominis, the obliquus externus and internus, the transversalis, the diaphragm, the serratus posticus superior and inferior, the sacro-lumbalis, the lattissimus dorsi, the serratus major anticus, and the levatores costarum. All these muscles, except the intercostal, are attached only to some of the ribs, and do by no means extend throughout the whole series.

FRACTURES OF THE RIBS.

Seat and direction.—The ribs are generally fractured near their middle, and the direction of the fracture may be either transverse or oblique. It may be proper to observe, also, that the middle ribs are more frequently broken than the upper and lower, owing to the guarded situation of the former beneath the clavicle and shoulder, and to the great moveableness of the latter.(*a*)

Causes.—The ribs are usually broken in consequence of blows or falls, or by the trunk being violently pressed between two hard and resisting bodies, as between a wall and the wheel of a carriage.

Symptoms.—As the ribs are very superficial, their fractures are often readily detected by placing the hand on the part where the violence appears to have been inflicted, and requesting the patient to cough. The ribs will thus necessarily be obliged to undergo a sudden motion, and if there be any fracture it will generally be evinced by the occurrence of a crepitus. A fixed, acute pain is also felt in the part, and is exasperated by the movements of breathing; in some cases, owing to the contusion of the internal organs,

(*a*) Delpech, op. cit. T. 1. p. 235.

or to the lungs being wounded by spiculæ of depressed bone, the patient suffers great oppression, and coughs up blood. If air has been effused into the cavity of the chest, the respiration becomes gradually more difficult, the pulse slow and oppressed, and a tumour may be felt at the injured part, which crackles under the finger, and is at once indicative of the nature of emphysema.

The ribs being strongly connected to the sternum and the vertebral column, it is impossible for them to become shortened, or for the fractured portions to overlap or pass each other. Derangement, however, may take place in almost every other direction, though the angular is by far the most frequent, and it may be either outwards or inwards, according to the nature of the case.

Prognosis.—Simple fractures of the ribs commonly assume a mild appearance; but when they are complicated with injury of the thoracic viscera, they are always more or less dangerous.

Reduction.—When the fracture is outwards, the ends of the broken bone are to be pushed back with the thumbs, and be maintained in their natural position by means of a compress and a piece of paste-board, softened with vinegar. A broad linen roller is then to be passed tightly round the chest, so as to force the patient to perform respiration chiefly by the descent and elevation of the diaphragm, and render the injured bone or bones as motionless as possible. As a roller, however, is extremely apt to become slack, many surgeons prefer a piece of strong linen, sufficiently large to encircle the chest, and laced firmly with pack-thread. When the fracture is inwards it will be necessary, in order to force the extremities of the broken bone outwards, to apply a compress upon each end of the rib, and to secure it in the manner just stated.

Remark.—In some instances, especially in very corpulent persons, there is great difficulty in ascertaining the nature of the injury; but in

all these cases the thorax should be bandaged as if the rib were really broken.

Treatment after the reduction.—In all fractures of the ribs, it will be necessary, as soon as the proper dressings have been applied, to place the patient in bed in the half-sitting posture, and to have recourse to general bleeding, and to a strictly antiphlogistic method of treatment. If there be any tickling cough, it is to be relieved as speedily as possible by opiates, combined with the spermaceti, or some other mucilaginous mixture.

Should there be any effusion of air or blood within the cavity of the chest, and the patient experience much inconvenience, the treatment is to be conducted upon the same principles as in wounds of the thorax, for an account of which the reader is referred to the regular treatises on surgery.

Remark.—1. Contrary to the generally received opinions of modern surgeons, experience has proved that it is not always necessary for the costal cartilages to be ossified before they can be fractured. The accident usually results from the same causes as in the preceding case, and if it take place near the sternum the internal fragment is commonly carried forward across the external; while the contrary happens when the fracture occurs near the ribs. These phenomena are to be attributed to the action of the corresponding digitations of the sterno-costalis muscle, and to their insertion into the one or the other of the two fragments.

2. The injury may always be readily detected by a careful examination; but to reduce the fragments and keep them in their proper situation is by no means so easy. By a careful observance, however, of the rules laid down in speaking of fractures of the ribs, the surgeon may generally succeed in accomplishing a cure. The union between the two ends of the broken cartilage is always effected through the medium of a hard, osseous substance, and not, as might be supposed *a priori*, through the medium of any thing like a cartilaginous or fibrous tissue.(*a*)

DESCRIPTION OF THE VERTEBRAL COLUMN.

The vertebral column is situated at the posterior part of the trunk, between the condyles of the os occipitis and the

(*a*) Delpech, op. cit. T. 1. p. 238.

superior part of the sacrum, and consists of twenty-four moveable bones called vertebræ, from the Latin verb *verto*, to turn. Each of these bones has a body and seven processes, which I shall now proceed to describe.

The body is convex in front, concave behind, and in most instances flat on the superior and inferior surfaces, by which it is connected to the contiguous bones. It is perforated by numerous small foramina, for the passage of blood-vessels and the insertion of the ligamentous fibres which connect these bones with each other.

The bodies of the vertebræ are smaller and more solid above than below, and are connected to each other, throughout the whole series, by a very strong, elastic, yellow, fibrous substance.

The processes, as has been already stated, are seven in number, of which four are called articular, two transverse, and one spinous. The articular processes, so named from their use, stand out obliquely, two above and two below, from the body of the vertebra, and are tipped with cartilage for their articulation with the corresponding processes of the contiguous vertebræ. The transverse processes pass out at right angles, or transversely, from the body of the bone; and appear to be so many long and powerful levers for moving and turning the spine. The last or spinous process is that which projects directly backwards, and may be felt immediately beneath the integuments on the mesian line of the back. The junction of the spinous with the other processes is effected by means of two bony arch-like lamellæ, which complete the large central foramen. As the different vertebræ are connected to each other, their foramina form a continuous canal, which varies both in size and shape in the different regions of the vertebral column, and affords secure lodgment to the spinal marrow.

On each side of each vertebra are two notches, or excavations, one on the superior, the other on the inferior border, which are so adapted to each other that the union of each

pair forms a rounded aperture communicating with the vertebral canal, and giving passage to the spinal nerves.

FRACTURES OF THE VERTEBRAL COLUMN.

Seat.—The vertebræ may be fractured either at their bodies or at their spinous processes.

Causes.—Fractures of the vertebral column are generally produced by severe blows, gun-shot violence, or by the patient falling from a very considerable height against some hard projecting body.

Symptoms.—The symptoms of fractures of the vertebræ differ according to the particular situation of the bone injured. When the fracture takes place above the fourth cervical vertebra, or the principal origin of the phrenic nerve, the diaphragm is paralysed, respiration is stopped, and death suddenly follows. If, on the contrary, the injury be seated below the fourth cervical vertebra, there is usually more or less paralysis of the superior extremities, difficulty of breathing, inability to retain the feces; or discharge the urine, with great distention of the abdomen. In this case, death generally follows in about four or five days, sooner or later, according to the severity of the injury.

In fractures of the lumbar vertebræ the lower extremities are so completely paralysed that they are insensible to the most powerful stimulus; the power of volition over the muscles is destroyed; the feces pass away involuntarily; and the bladder is unable to contract and expel its contents. In most cases the patient dies in about five or six weeks; but sometimes, though rarely, he survives a much longer time.

Fractures of the dorsal vertebræ are usually attended with paralysis of the lower extremities, great torpor of the intestines, and excessive distention of the abdomen, owing to the large quantities of air contained within the bowels. The paralytic disorder generally extends higher up than in frac-

tures of the lumbar vertebræ, and the patient seldom lives longer than two or three weeks; though in some instances life may be prolonged till six or seven months after the reception of the injury, as has been satisfactorily proved by the observations of Sir Astley Cooper and of some of the late German writers.

Fractures of the spinous processes of the vertebræ are seldom followed by any serious mischief, unless they are attended with concussion or other severe injury of the spinal marrow. They may generally be detected by an inequality along the mesian line of the back, and by a more or less distinct crepitus on moving the detached process.

Morbid appearances.—On dissection, the spinous process of the displaced vertebra is commonly found depressed, the body of the bone being broken through, and pushed forwards. The articular processes are fractured, blood is extravasated between the vertebræ and dura mater, and the spinal marrow is either compressed or bruised, or more or less lacerated by the bony arch of the spinous processes.(*a*)

Prognosis.—From what has been just said it is evident, that the prognosis of fractures of the vertebral column is always of the most unfavourable nature, and that patients thus affected are almost invariably doomed to certain destruction; though the period of this occurrence will, as has been already stated, depend, in great measure, upon the seat of the injury and the violence by which it is produced.

Reduction.—In fractures of the spinous processes of the vertebræ, the fragments should be gently pushed into their natural situation, and should be kept in this position by applying a thick, long compress, dipped in vinegar or a mixture of spirits of wine and water, along each side of the spine, and securing it with a circular roller and a scapulary. If the fragments, however, are so much shattered or splintered as to preclude the possibility of uniting them, they should be carefully extracted, either through the wound, or

(*a*) Sir Astley Cooper on Dislocations, p. 513.

by making a proper incision through the superincumbent integuments. (*a*)

In fractures of the bodies of the vertebræ, any attempt at reduction would not only be useless, but extremely dangerous. The same remark is applicable to the operation of cutting down upon the injured part, and removing the displaced portion of bone by means of a trephine or Hey's saw. This method of treatment, which is founded upon the principle of removing the pressure which is exerted upon the spinal marrow by the displaced pieces of bone, was first proposed and put in practice by Mr. Henry Cline, of London, and though it has since been repeated by Mr. Tyrrell and other european surgeons, and once in this city by Dr. John R. Barton, it has, I believe, in no instance been attended with success. According to Mr. Charles Bell, whose surgical knowledge no one, it is presumed, will attempt to call in question, such an operation "would not only increase the swelling and thickening of the involving membranes of the spinal marrow, but it would probably give rise to such direct inflammation and mischief as to cut off the patient suddenly." In all cases where the patient has survived the immediate shock of the accident, no time should be lost in resorting to the employment of general and local bleeding, with a view of preventing inflammation within the sheath of the spinal marrow. The urine, if requisite, should be drawn off with the catheter; and great care should be taken to keep the patient perfectly at rest, and, if possible, in one position. After the lapse of three, four, or five weeks the back and limbs should be frequently rubbed with stimulating liniments, and recourse should be had to blisters, issues, the repeated application of leeches, and even the actual cautery.

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(*a*) Heilkunst der Krankheiten, Erster Theil, p. 284. Gotha, 1816.

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DESCRIPTION OF THE OS INNOMINATUM.

The os innominatum is the large, irregular bone, which is situated at the anterior and lateral parts of the pelvis. It is divided into two surfaces and four borders.

The external surface, at its posterior part, is alternately convex and concave, and is marked by two curved lines running from before backwards, the superior being the longer. At its anterior part it presents a deep rounded socket, about two inches in diameter, called the acetabulum or cotyloïd cavity. It is directed outwards and forwards, and is covered with cartilage for its articulation with the head of the os femoris. In front and below this cavity is the thyroïd or obturator hole, which is rounded in the male, triangular in the female, and is filled up by a strong fibrous membrane.

The internal surface is divided into three parts; one of which is directed inwards, and presents at its posterior part a rough, oval surface for its articulation with the sacrum; the other, directed outwards, is large, smooth, and concave, and is called the iliac fossa; while the third and last is quadrilateral and corresponds with the bladder.

The superior border, also called the iliac crest, is unequal, convex, and contorted somewhat like an italic *s*. The anterior border, depressed and excavated, descends from behind forwards towards the symphysis pubis, and at its junction with the former it is marked by a prominent point, called the antero-superior spinous process. About an inch,

or a little more, below this is another small projection, called the antero-inferior spinous process.

The inferior border contributes to the formation of the arch and symphysis of the pubes, and, like the others, it gives attachment to muscles. The posterior border presents two notches, separated by a bony eminence, called the postero-inferior spinous process; above which is another prominent point, termed the postero-superior spinous process.

The os innominatum belongs to the class of broad or flat bones; and in early life it is divided into three parts, the ilium, os pubis, and ischium.

Attachments of muscles.—The muscles which are attached to the os innominatum are extremely numerous, but they are not of sufficient importance to be enumerated on the present occasion.

FRACTURES OF THE OS INNOMINATUM.

Seat and direction.—The haunch-bone is liable to be broken in almost every part of its extent, though most frequently the accident takes place in the upper expanded portion of the bone. The direction of the fracture is extremely variable, and can not be described in a general manner.

Causes.—The fractures of this bone are generally produced by falls from a great height, by the pelvis being violently jammed between two bodies, as between a cart-wheel and a wall or post, by the kick of a horse, by gun-shot violence, and similar causes.

Symptoms.—When the os innominatum is fractured through the cotyloïd cavity, the accident may always be recognised by the circumstance of the head of the femur being drawn upwards, and the great trochanter somewhat forwards, so that the leg is diminished in length, and the knee and foot are turned inwards. In fractures of the body and ramus of the pubis and ischium, the limb is somewhat shorter than the other; the fragments are pushed either directly

downwards, or forwards towards the femur, or backwards towards the cotyloïd cavity; the patient is unable to stand up or walk; and by placing one hand upon the ilium and the other upon the pubes, the surgeon is able to perceive a distinct crepitus.(*a*)

Fractures of the crista of the ilium, according to Creve, may be readily ascertained by placing the patient upon his back, and moving the thigh of the affected side outwards; a distinct crepitus will thus be produced. A depression or separation may also be felt between the fragments, by pressing upon the upper and posterior part of the bone.(*b*)

Besides these symptoms there is always more or less contusion of the soft parts, on the outside of the pelvis; and if the violence has been very great, the pelvic viscera may be so severely bruised, crushed, or lacerated, as to give rise to complete loss of motion, paralysis of the inferior extremities, retention of urine, and other distressing symptoms.(*c*)

Remark.—Fractures of the hip-bone may be distinguished from dislocations of the ilio-femoral articulation, by the crepitation which may be felt on placing the hand upon the crista of the ilium, and moving the thigh.

Prognosis.—When the os innominatum is broken, the violence which is inflicted upon the soft parts is often so severe as to prove fatal in a very short time, or to destroy the patient at a more or less remote period after the reception of the injury. A cure, however, may sometimes be effected, especially when the pelvic viscera have not suffered much disturbance: but this is rare.

Reduction.—In fractures of the os ilium, if there be a displacement of the fragments, the reduction is to be effected by placing the patient upon his back, elevating his breast,

(*a*) Kunst die Aüserlichen und Chir. Krankheiten der Menschen zu Heilen, E. Theil.—Sir A. Cooper on Dislocations, p. 82–4.

(*b*) Werke Von den Krankheiten des Weiblichen Beckens.

(*c*) Boyer's Traité des Mal. Chir. T. 3. p. 154.

and bending the thigh of the affected side, at the same time that it is carried a little outwards. When the muscles about the pelvis have thus been relaxed, the hand is to be placed upon the hip, and the crest of the ilium is to be pushed downwards and inwards towards that of the opposite side. In a case of fracture of the upper part of the os ilium, in which the fragment was pressed inwards towards the cavity of the pelvis, Boyard effected the reduction by putting the patient in the recumbent posture, and placing a towel below the false ribs, the ends of which were drawn tightly together by two assistants, while another assistant was requested to make pressure upon the abdomen immediately above the pubes. By this means the viscera of the abdomen were pushed down towards the cavity of the pelvis, the abdominal muscles were put upon the stretch, and the fragment was easily restored to its natural situation. The towel was then kept on until the cure was completed, having been prevented from slipping by means of a scapulary.(*a*)

In all other fractures of the os innominatum, the broken pieces are to be gently pressed into their natural situation, a compress is to be placed over the seat of the injury, and a roller applied round the pelvis. When there is no displacement, however, the roller may be dispensed with; all that is necessary is to keep the patient quietly at rest upon his back, to elevate his shoulders, and to flex his thighs, so as to relax the muscles about the pelvis.

Treatment after the reduction.—In all cases of fractures of the hip-bone, whether attended with displacement or not, the grand indication is, after the parts have been thoroughly examined, to obviate the consequences of inflammation of the pelvic and abdominal viscera, by rest, copious and repeated blood-letting, fomentations, antimonial medicines, external irritants, and low diet. Great attention should also be paid to the state of the bladder, and if the patient be

(*a*) Kunst die Aüszerlichen und Chir. Krankheiten zu Heilen, E. Theil, p. 287.

unable to pass his urine, it should be frequently drawn off with the catheter.

When the parts have sustained so much injury that the patient can not move or empty his bowels without suffering the most excruciating pain, it will be necessary to confine him in a bed constructed upon the principles suggested by by the late Sir James Earle, (*a*) or to adopt the ingenious method recommended by Professor Boyer, which consists in passing a piece of strong girth web under the pelvis, and securing its corners, collected into one, to a pulley suspendee from the top of the bed. By this means the patient is said to be enabled to raise himself with very little effort, and to a sufficient height to admit of a flat vessel being readily placed under him. (*b*)

Should there be any collection of matter in the pelvis, notwithstanding the most vigorous and persevering employment of antiphlogistic measures, they should be opened as soon as there is the least perceptible fluctuation.

DESCRIPTION OF THE SACRUM.

The sacrum is the symmetrical triangular bone situated at the supero-posterior part of the pelvis, beneath the last lumbar vertebra, above the os coccygis, and between the ossa innominata. It is convex behind, concave in front, and divided into two surfaces, two borders, and two extremities.

The anterior surface is flat from side to side, concave from above downwards, and marked by four transverse lines. On each side it presents four foramina, which are directed outwards, and are intended to give passage to the anterior sacral nerves.

The posterior surface is concave, and presents along the mesian line, four or five horizontal eminences, which may be considered as the rudiments of the spinous processes. Be-

(*a*) Observations on Fractures of the Lower Limbs, London, 1807.

(*b*) Boyer on the Bones, p. 66—7.

neath these is a small triangular hole, marking the termination of the sacral canal. On each side are two superficial grooves, pierced by the posterior sacral foramina which are considerably smaller than the anterior, and transmit the posterior branches of the sacral nerves.

The borders of the sacrum are marked, above, by a large irregular surface, which is covered with cartilage for its articulation with the hip-bone; and, below, by inequalities which give attachment to the sacro-sciatic ligaments. Each border is terminated by a small excavation, which, with the corresponding extremity of the os coccygis, forms a notch for the passage of the last sacral nerve.

The superior extremity, or base, presents upon the mesian line, an oblique, oval surface, which is encrusted with cartilage, and articulates with the last lumbar vertebra, and, on each side, an articulated process, which is directed backwards and inwards, and receives the inferior articular process of the vertebra just mentioned.

The inferior extremity, or apex, is directed downwards, and has an oval convex surface, for its articulation with the base of the os coccygis.

The sacral canal becomes gradually smaller as it passes from above downwards, and affords lodgement to the cauda equina, or the termination of the spinal marrow.

The sacrum appertains to the class of mixed bones, is extremely spongy, and is much lighter, in proportion to its bulk, than any other bone in the body.

Attachments of muscles.—The muscles which are attached to the sacrum are the following, viz: the pyriformis, the coccygeus, the glutæus maximus, the sacro-lumbalis, and the latissimus dorsi.

FRACTURES OF THE SACRUM.

Seat and direction.—The same as in fractures of the os innominatum.

Causes.—The sacrum may be broken by falls from a great height, by severe blows, gun-shot violence, and similar injury.

Symptoms.—The injury may always be detected, especially when there is a displacement of the fragments, by mere manual examination, while the patient is placed upon his abdomen. It is generally attended with severe pain at the affected part, great difficulty in walking, and sometimes, owing to the lesion of the sacral nerves, with paralysis of the lower extremities, retention of urine, and involuntary discharge of the feces.

Prognosis.—The danger attending this accident is always considerable, on account of the great violence that is usually done to the sacral nerves. Even where the patient has survived the immediate shock of the injury, he not unfrequently falls a victim, at a more or less remote period after the occurrence of the fracture, to the severe and almost unavoidable effects of the inflammation of the pelvic viscera.

Reduction.—When the fragments are displaced inwards, towards the cavity of the pelvis, the reduction is to be accomplished by introducing the finger of one hand into the rectum, while by the co-operation of the fingers of the other hand on the outside, the parts are pushed back into their natural relations. A compress, wet with the lotio plumbi acetatis, or a mixture of spirits of wine and water, is to be placed over the situation of the injury, and a roller or T-bandage is to be put round the pelvis.

Treatment after the reduction. When the fracture is set, the patient is to be kept quietly in bed, with the precaution not to lie upon his back, and the most vigorous measures must be adopted for the prevention of inflammation.

DESCRIPTION OF THE OS COCCYGIS.

The os coccygis is the small triangular bone, situated at the postero-inferior part of the pelvis. It is curved forwards,

and is divided into two surfaces, two borders, and two extremities.

The anterior surface is concave, the posterior convex, and unequal. The borders are rounded, and afford attachment to ligaments and muscles.

The superior extremity or base, presents, in front, a concave surface for its articulation with the sacrum; behind, the cornua of the os coccygis; and laterally, two small, notched eminences, for the passage of the fifth pair of the sacral nerves.

The inferior extremity, or apex, consists of a rough point, which is covered with cartilage, and gives attachment to some of the fibres of the levator ani muscle.

In early age the os coccygis consists of four pieces, but as we advance in life they become gradually united, and frequently one continuous whole with the os sacrum.

Attachments of muscles.—Three muscles are attached to the os coccygis, the glutæus maximus, the coccygeus, and the levator ani.

FRACTURES OF THE OS COCCYGIS.

Causes.—The os coccygis may be broken by a fall, or kick upon the buttock.

Symptoms.—Mobility of the fragments; acute pain on moving the thighs,(*a*) and crepitation on introducing the finger into the rectum.

Prognosis.—Fractures of the os coccygis require prompt attention; for if they are neglected, they often give rise to abscesses, caries, and other disagreeable consequences.

Reduction.—If there be any displacement of the fracture, one of the fingers is to be passed up the rectum, and the reduction is to be brought about in the same manner as in the preceding case. A compress dipped in a solution of the acetate of lead is then to applied over the seat of the in-

(*a*) Boyer's Traité des Mal. Chir. T. 3. p. 160.

jury, care being taken to keep it in its place by means of a tight roller, or a T-bandage.

Treatment after the reduction.—The patient must avoid lying upon his back, or sitting down, and recourse must be had to a strictly antiphlogistic treatment, especially to general and local bleeding.

Article 2.—*Of Fractures of the Bones of the Superior Extremities.*

DESCRIPTION OF THE HUMERUS.

The humerus is the long and irregularly cylindrical bone, which is situated between the scapula and the fore-arm; it is divided into a body and two extremities.

The body is thick and rounded above, somewhat broad and triangular below, and is divided into two nearly equal surfaces by two longitudinal lines, which arise from the external and internal condyle, and gradually dissappear as they proceed upwards.

The superior extremity of the bone is marked by a large, rounded, hemi-spherical eminence, which is tipped with cartilage, and articulates with the glenoïd cavity of the scapula. It is directed backwards and inwards, and is called the head of the humours. Somewhat externally to this are two smaller eminences, which, from their relative size, are named the greater and lesser tuberosities; and between these, and the insertion of the pectoralis major, the latissimus dorsi, and the teres major, is situated that portion of bone, which, in chirurgical language, is called the neck of the humerus.

The inferior extremity is smooth and flattened, and larger from side to side than from before backwards. It presents externally a projection, called the outer condyle, which af-

fords attachment to the humero-radial ligament, and to the superficial muscles of the posterior and external regions of the fore-arm. Internally is situated another projection, considerably larger than the preceding, and named the internal condyle. It is inclined backwards, and gives attachment to the humero-ulnar ligament, and to the superficial muscles of the anterior region of the fore-arm. Between these two condyles, or tuberosities, is placed a pulley-like surface, having two lateral eminences, and a smooth cavity. It is encrusted with cartilage, and enters into the composition of the humero-ulnar articulation. At the anterior part of the inferior extremity, immediately above the trochlea, or pulley-like surface, is a small superficial depression which receives the coronoïd process of the ulna during flexion, and posteriorly a more considerable fossa, which lodges the olecranon during the extension of the fore-arm.

Attachments of muscles.—The mucles, which either arise or are inserted into the os humeri, are the supra and infra spinati, the teres major and minor, the latissimus dorsi, the sub-scapularis, the deltoïd, the pectoralis major, the triceps, the coraco-brachialis, the brachialis anticus, the pronator radii teres, the flexor carpi ulnaris, the flexor carpi radialis, the palmaris longus, the flexor digitorum sublimis, the anconeus, the extensor carpi radialis longior and brevior, the extensor communis digitorum, the extensor carpi ulnaris, and the supinator radii brevis.

FRACTURES OF THE HUMERUS.

The humerus may be fractured either at its body, or at its superior or inferior extremity, and the direction of the fracture may be either transverse or oblique.

§ I. FRACTURES OF THE SUPERIOR EXTREMITY, OR NECK OF THE HUMERUS.

Causes.—The most common causes of fractures of the superior extremity, or neck of the humerus, are falls upon the

point of the shoulder, violence applied directly to the part, or falls upon the elbow or hand, while the arm is separated from the trunk, or the hand is instinctively extended to protect the body from the severity of the accident.

Symptoms.—The patient experiences great pain at the moment of the accident, and is suddenly deprived of the power of moving his arm; the limb hangs motionless along the side, and every attempt to move it, although easily accomplished, is attended with the most excruciating suffering; a depression is felt at the supero-external part of the arm; and, on placing one hand upon the head of the bone, and moving the lower fragment with the other, the upper piece will remain motionless, and a more or less distinct crepitus will be perceived in consequence of the friction of the two divided ends.

When the fracture is transverse, and the ends of the bone remain in contact, as is sometimes found to be the case, the diagnosis is often rendered extremely difficult, especially to the young practitioner. In most cases, however, there is a displacement of the fragments, a circumstance furnishing sufficient evidence of the nature of the injury.

When the parts are displaced, the lower fragment, according to Petit, is usually drawn inwards or outwards, and is prevented from overlapping the upper by the weight of the limb, which powerfully resists the action of the muscles. Hence, in most instances, there is but little displacement in the longitudinal direction of the bone, unless the fracture be very oblique, and the muscles contract with increased power in consequence of their being preternaturally irritated.

Fractures of the neck of the humerus may be distinguished from dislocations of the scapulo-humeral articulation, by the immobility of the head of the bone, by the crepitus produced on moving the elbow, and by the depression beneath the acromion being situated lower down than in the latter accident.

Prognosis.—The consolidation may generally be effect-

ed in about four or five weeks. If the fragments are suffered to become deranged, deformity is the inevitable consequence, and this may amount to such an extent as to impede some of the motions of the shoulder-joint.

Reduction.—Having placed the patient upon a chair or the edge of a bed, an assistant is to be requested to make counter-extension by taking hold of the wrist of the sound side, and extending the arm in a direction perpendicular to the axis of the body, while another assistant grasps the fore-arm of the injured limb, previously placed in a semi-flexed position, and makes extension. The trunk being thus fixed, and the muscles of the arm relaxed, the surgeon places the ends of the fragments in even contact, and takes a roller, about six or seven yards in length, and invests the whole limb by circular and reversed turns, commencing at the palm of the hand and extending as high up as the shoulder. The bandage is then to be carried twice under the opposite axilla, and after having been again brought to the top of the injured shoulder, it is to be committed to the care of an assistant. Three strong splints, each about two inches wide, are next to be placed along the arm. The first is to extend from the olecranon to the margin of the axilla; the second from the bent of the arm as high as the acromion; and the third from the external condyle to the same height. Having secured these with moderate tightness by the remainder of the roller carried towards the elbow and fore-arm, the surgeon takes a pad or cushion, constructed upon the same principles as that used in fractures of the clavicle, and places it between the arm and trunk, taking care to put the thick end upwards, if the lower fragment be drawn inwards, but downwards, if this should be drawn outwards. The arm is then to be brought towards the trunk, and fixed upon the cushion by means of a second roller, somewhat longer than the preceding, and applied round the arm and chest precisely in the same manner as the second roller used in fractures of the clavicle, except that the turns ought to be tight above,

and loose below, if the fracture be displaced outwards, and vice versâ.

The fore-arm is then to be supported in a sling, and the different turns of the rollers are to be secured by pins or stitches, or the whole apparatus may be surrounded by a piece of linen.(*a*)

A very excellent apparatus for fractures of the neck of the humerus was devised by Brünninghausen, of Germany, about the close of the last or beginning of the present century. It is highly spoken of by some of the continental surgeons, but it has never, I believe, been employed in this country. It is extremely simple, and is applied in the following manner. A pad, about four inches long, and stuffed with hair, is to be placed under the axilla, and secured by means of four tapes, the upper two of which are tied on the opposite shoulder, and the lower two around the middle of the arm. A compress, dipped in spirits of wine and water, is then to be applied to the antero-external part of the scapulo-humeral articulation, and the lower part of the arm is to be pressed towards the trunk. A carved, or hollowed splint, having the exact shape of the limb, and extending from the elbow to the shoulder, is next to be applied along the arm, and secured by means of two straps, which are attached to each of its extremities, and buckled on the opposite side of the trunk. Its internal surface is lined with wool or cotton, which is covered with linen, so as to project about a fourth of an inch beyond the border of the splint, and prevent it from excoriating the soft parts. In addition to the two straps already mentioned, it is furnished with three or four smaller ones, which are buckled round the arm, and keep it firmly in its place. On the external surface of the splint, in the direction of its length, is placed a strip of morocco leather, which is fastened at intervals of one or two inches, and is intended to receive the small straps to which I have just referred.

(*a*) Desault's Treatise on Fractures, by Caldwell, p. 86.

When the splint is applied, all that remains to be done is to put the fore-arm in a sling, and keep it perfectly at rest.(*a*)

Remark.—With regard to the comparative merits of the apparatus of Desault and Brünninghausen, experience has not yet enabled me to decide; but I am inclined to believe that that of the former will be found more convenient in private practice, especially as the materials of which it is composed may always be readily obtained.

Treatment after the reduction.—The after treatment must be regulated according to the circumstances of the case, and the age and constitution of the patient. In general, no particular attention is necessary to diet, and the patient may be permitted to walk about during the cure. The apparatus must be frequently examined, and re-applied whenever it becomes relaxed, or appears to act too feebly; for, if this precaution be neglected, there will be great danger of producing derangement of the fragments. As soon as the fracture has been sufficiently consolidated, the scapulo-humeral articulation should be gently and frequently moved to prevent anchylosis or stiffness.

Remark.—The possibility of the head of the humerus being fractured within the capsular ligament, which was formerly a subject of so much dispute amongst surgeons, appears to be fully confirmed by the observations of Bichat,(*b*) Dorsey,(*c*) Sir Astley Cooper,(*d*) Gibson,(*e*) and various other writers. I have myself seen a case of this kind, which was mistaken for a fracture of the acromion, and was not detected until several years after the occurrence of the accident, when the individual died of another disease, and the surgeon had an opportunity of examining the parts. The fracture had extended obliquely through the head of the bone, and, though it had become perfectly united, there were several rough, bony eminences, which indicated the former separation,

(*a*) Brünninghausen über ein Neuen Chirurgischen Apparat. Erlangen, 1801.

(*b*) In Desault, op. cit. p. 77.

(*c*) Elements of Surgery, vol. i. p. 163.

(*d*) Treatise on Dislocations, p. 409.

(*e*) Institutes of Surgery, vol. i. p. 408.

and always impeded, to a considerable extent, the motions of the scapulo-humeral articulation.

The difficulty of distinguishing fractures of the head of the os humeri is always considerable, especially in very muscular subjects. Hence, whenever the surgeon has reason to suspect the existence of such an injury, he should always proceed upon the same principles as in the preceding case, apply the same apparatus, and pursue the same mode of treatment.

§ II. FRACTURES OF THE BODY OF THE HUMERUS.

Causes.—Fractures of the body of the humerus, usually result from severe blows, and other violence applied directly to the part.

Symptoms.—The nature of the case is always rendered sufficiently obvious by the inability to raise the limb, the flexibility of the arm at the injured part, the severe pain, the angular derangement, and the crepitus which is produced upon moving the ends of the fragments. When the fracture is transverse, there is commonly no great derangement, but when it is oblique, the limb may be considerably shortened, and altered in its shape by the action of the muscles.

Prognosis.—These kinds of fractures, if neglected or badly managed, are extremely apt to give rise to deformity, and preternatural or accidental articulations; but under proper treatment a cure may generally be effected in about twenty-eight or thirty days.

Reduction.—In order to effect the reduction, the patient is to be seated upon a chair or the edge of a bed, and counter-extension is to be made by an assistant with his arms round the chest, while extension is made by another assistant who takes hold of the upper part of the fore-arm, and bends it so as to relax the biceps muscle. The surgeon then

places the ends of the fragments in contact, and takes a single headed roller, about seven yards in length, and two inches and a half in width, and invests the whole limb by circular and reversed turns, extending from the palm of the hand to the shoulder. The bandage is then to be given to an assistant, while the surgeon applies four splints, varying in length and breadth, according to the size of the limb, to the inner, outer, anterior, and posterior parts of the arm, and secures them with the remainder of the roller carried down below the elbow. The hand and fore-arm are to be placed across the chest, and kept quietly in a sling.

Remark.—The splints must generally be about two inches and a half wide, and may be made either of thin wood, or strong paste-board, such as is used by binders for covering books.

Treatment after the reduction.—No particular treatment will be necessary after the reduction, and the patient will generally be able to walk about during the cure, which, as has been already stated, is commonly complete in about four weeks. The dressings are to be removed in about eight days, and the part examined, in order that the surgeon may be able to rectify any displacement that may have taken place, before they are re-applied.

§ III. FRACTURES OF THE INFERIOR EXTREMITY, OR CONDYDES OF THE HUMERUS.

Direction.—When both condyles are fractured a longitudinal fissure usually extends for some distance along the centre of the bone, and then terminates by a transverse or oblique division of the lower part of the body of the humerus. In some instances, however, there is merely a separation of one of the condyles, and when this is the case, the fracture is generally directed obliquely from above downwards, and terminates at the humero-ulnar articulation.(*a*)

(*a*) Desault's Treatise on Fractures, &c. p. 99—100.

Causes.—The cause of these fractures are external violence, such as falls upon the point of the elbow, or the wheel of a cart passing over the lower part of the arm.

Symptoms.—When the internal condyle is detached from the rest of the bone, the ulna projects backwards, but upon extending the limb it resumes its natural situation; the condyle forms a protuberance at the back part of the humerus; a distinct crepitus can be felt at the situation of the injury on bending the fore-arm; and when the arm is extended, the inferior extremity of the os humeri advances upon the ulna, and the head is inclined inwards towards the side of the body. (*a*)

Fractures of the external condyle are characterized by great difficulty of moving the humero-ulnar articulation, a supine position of the hand, crepitation on rotating the radius, and a slight degree of displacement of the fragment backwards, especially if the portion broken off be large. In both cases there is pain and swelling at the injured part, and a constant semi-flexion of the limb. (*b*)

When the condyles of the humerus are broken off just above the humero-ulnar articulation, the fore-arm is slightly bent, the radius and ulna project backwards, and there is a depression or hollow at the back part of the arm, immediately above the elbow. The accident is extremely apt to be mistaken for a dislocation of the radius and ulna backwards; but the case may generally be known by the crepitus produced on rolling the fore-arm upon the humerus, and by the disappearance of the symptoms which mark the latter accident on extending the fore-arm.

Prognosis.—Fractures of the condyles of the humerus, although by no means so dangerous as was supposed by some of the older surgeons, are not unfrequently followed by violent inflammation, anchylosis, and deformity of the

(*a*) Sir Astley Cooper on Dislocations, &c. p. 414.

(*b*) Desault, op. cit. p. 101.—Sir A. Cooper, op. cit. 348.

whole arm. Five or six weeks is the time usually required to accomplish a cure.

Reduction.—In case both condyles are broken off just above the elbow, the reduction is to be effected by placing the patient upon a chair, and bending the fore-arm, care being taken at the same time to draw it a little forwards. While the fore-arm is held in this position, a roller is to be applied in the usual way, extending from the wrist to the shoulder, and two angular splints are to be placed along the limb, one on the inside, the other on the outside, and secured by the remaining part of the bandage. These splints are made of paste-board or wood, about two inches broad, and one long enough to extend from the shoulder to the elbow, and from the elbow to the ends of the fingers, so as to prevent the motions of the hand. The arm is to be kept perfectly at rest in a sling, and the bandage is to be carefully tightened as often as it becomes relaxed.(*a*)

This apparatus, which was first devised and successfully employed by Dr. Physick, is equally applicable to fractures of the external and internal condyles; and as the manner of applying it has just been described, we shall not again revert to it.

Treatment after the reduction.—After the expiration of about twelve or fourteen days, the apparatus is to be removed, and the humero-ulnar articulation is to be gently bent and extended, in order to prevent anchylosis. This operation is afterwards to be repeated about once every forty-eight hours, until the end of the third or the beginning of the fourth week, when the rectangular splints are to be taken off, and two obtuse ones substituted in their place. These are to be worn until the cure is effected, care being taken not to forget frequently to move the joint.

(*a*) Dorsey's Elements of Surgery, vol. i. p. 167.—Sir Astley Cooper on Dislocations, p. 342.

DESCRIPTION OF THE RADIUS.

The radius, so called from its imaginary resemblance to the spoke of a wheel, is situated at the external side of the fore-arm, between the humerus and the carpus. It is somewhat arched in its form, broader below than above, and divided into a body and two extremities.

The body of the bone is triangular, and presents three surfaces, bounded by three angles or margins. The anterior surface is marked at its middle by a longitudinal depression, superiorly by the foramen for the medullary vessels, and inferiorly by a flat surface corresponding with the pronator quadratus. The external surface is round and convex, and marked by a rough impression for the insertion of the pronator radii teres; while the posterior surface is convex in the greater part of its extent, and grooved at its central third, for the origin of the extensor muscles of the thumb.

The superior extremity presents three parts for our consideration, the head, the neck, and the bicipital tuberosity. The head is circular, and excavated for its articulation with the round convex part of the inferior extremity of the humerus and the small sigmoïd cavity of the ulna. The bicipital tuberosity is the rough tuberous process, which gives insertion to the biceps muscle, and bounds the lower part of that narrow and constricted portion of bone which is intermediate between it and the head, and is called the neck of the radius.

The inferior extremity of the radius is much larger than the superior, and is nearly quadrilateral in its form. On its inner side is situated a small oval cavity, which is encrusted with cartilage, and articulates with the inferior extremity of the ulna. On the external side, next to the thumb, the bone presents a small sharp projection; it is usually denominated the styloïd process, and affords attachment to the radio-carpal ligament. The articular surface is divided from

before backwards into two unequal portions, and is covered with cartilage for its articulation with the carpal bones.

Attachments of muscles.—The flexor longus pollicis, the pronator radii teres, the supinator radii brevis, the flexor sublimis, the pronator quadratus, the pronator teres, the supinator radii longus, the biceps flexor cubiti, and the extensors of the thumb.

FRACTURES OF THE RADIUS.

Seat and direction.—The radius may be fractured either at its body, or at its superior or inferior extremity, and the direction of the fracture may be either oblique or transverse.

Remark.—The bone is more frequently broken at or towards its inferior extremity than at any other part.

Causes.—The chief causes of fractures of the radius are falls or blows on the palm of the hand or the fore-arm.

Symptoms.—The symptoms vary according to the situation of the injury. If the bone be broken at its body or inferior extremity, a more or less perceptible depression is felt at the external side of the fore-arm; the patient is unable to perform the motions of pronation and supination; and on rotating the bone the superior fragment remains stationary, and gives rise to a distinct crepitus. In fractures of the superior extremity, the symptoms are generally more faintly developed, on account of the great number of muscles in which the bone is imbedded, and the diagnosis is consequently more difficult. In these cases, J. L. Petit recommends placing one hand upon the upper end of the radius, at the same time that the fore-arm is rotated with the other. By this means the existence of the fracture, if there be one, will be rendered evident by the head of the bone remaining stationary.

In whatever part of the radius the fracture may be situated, the fragments can never overlap or pass each other,

though they may be displaced in the direction of the diameter of the bone.

Prognosis.—The cure may be effected in about twenty-one days, sometimes sooner. According to Galen, Ambrose Paré, and others, the accident is often followed by stiffness and anchylosis of the fore-arm; in modern days, however, these circumstances have seldom been known to occur.

Reduction.—Having placed the patient upon a chair, and bent the elbow so as to relax the muscles of the arm, the surgeon is to incline the hand of the injured side towards the ulna, and adjust the fragments by making pressure against the interosseous space of the fore-arm. Two long and quadrated compresses are next to be applied along the anterior and posterior parts of the limb, and secured by a roller, commencing at the hand and extending a short distance above the elbow. Over this are placed two splints, long enough to reach from the humero-ulnar articulation to the ends of the fingers, and fastened by the remainder of the bandage. The fore-arm and hand being now put in a sling, and kept in such a position that the thumb shall look directly upwards, the dressing is completed.

Treatment after the reduction.—When the fracture is set, no particular attention will be necessary to diet or regimen; the patient may be allowed to walk about during the cure.

DESCRIPTION OF THE ULNA.

The ulna, so named from its resemblance to a measure used amongst the ancients, is situated at the internal side of the fore-arm, and is somewhat longer than the radius. It is considerably larger above than below, and is divided into a body and two extremities.

The body of the bone is of an irregular, triangular form, and, like that of the radius, it presents three surfaces, an anterior, an internal, and an external.

At the superior extremity of the ulna are two eminences which are so situated as to bound the articular cavity; they are called the olecranon and coronoïd processes. The olecranon is nearly on a line with the body of the bone, and terminates in an obtuse point, which is lodged, during the extension of the arm, in the fossa olecranoïdea at the inferior extremity of the humerus. It is smooth and concave in front, flat and triangular behind, and gives attachment to the triceps extensor muscle. The coronoïd process is a pointed prominence, which is received, during the flexion of the fore-arm, in the anterior depression on the humerus, and affords attachment to the brachialis anticus and the humero-ulnar ligament. On its inner border is a smooth depression incrusted with cartilage for its articulation with the head of the radius, and denominated the smaller sigmoïd fossa. Between these two processes is a large semi-circular cavity, which, when viewed in profile, presents a striking resemblance to the letter C. It is divided into two parts, by a middle angular ridge, is covered with cartilage, and is usually known by the name of the great sigmoïd cavity or fossa.

The inferior extremity is quite small, and presents two eminences, of which the internal is elongated and slender, and is named the styloïd process. The external eminence is larger and rounded, covered with cartilage, and called the head of the ulna.

Attachments of muscles.—The triceps extensor, the anconeus, the brachialis anticus, the pronator teres, the flexor digitorum profundis, and pronator quadratus, the extensor carpi ulnaris, the supinator radii brevis, the extensor indicis, the extensors of the thumb, and the flexor carpi ulnaris.

Remark.—The radius and ulna are connected together by a strong fibrous membrane, called the interosseous ligament.

FRACTURES OF THE ULNA.

Fractures of the ulna may with propriety be divided into those which take place at the body, and inferior extremity of the bone, and those which occur at the olecranon and coronoïd processes.

§ I. FRACTURES OF THE BODY AND INFERIOR EXTREMITY OF THE ULNA.

Direction.—Either transverse or oblique.

Causes.—Accidental violence, as blows or falls on the internal side of the fore-arm.

Symptoms.—The fracture is evinced by the depression at the ulnar side of the fore-arm; by the pain at the injured part; by the mobility of the fragments; and by the crepitus produced on rotating the hand. The derangement of the fracture is commonly less than in the preceding case, and the upper fragment, according to J. L. Petit, remains stationary.

Prognosis.—The prognosis is the same as in fractures of the radius.

Reduction.—The fracture is set by making extension, inclining the hand towards the radial side of the fore-arm, and making pressure along the interosseous space. The ends of the fragments are to be maintained in contact by means of the apparatus used in fractures of the radius.

Treatment after the reduction.—The same as in the preceding case.

§ II. FRACTURES OF THE CORONOID PROCESS.

Fractures of the coronoïd process of the ulna are extremely rare; and the only well-authenticated cases with which I

am acquainted are those which have occurred in the practice of Dr. Physick and of Sir Astley Cooper.

Causes.—Falls upon the hand or elbow, and accidents of a similar nature.

Symptoms.—Great pain at the time of the accident; inability either to bend or completely extend the elbow; and a remarkble projection of the ulna backwards, which disappears on pulling the fore-arm forwards, and bending the limb.

Prognosis.—The parts always unite by a ligamentous substance, and the limb is long in regaining its former strength.

Reduction.—To reduce the fracture, the elbow must be bent and the ulna drawn forwards. A compress is then to be placed over the coronoïd process, the arm is to be enveloped with a roller, and two angular splints, constructed upon the same principles as those recommended by Dr. Physick, for fractures of the condyles of the humerus, are to be applied, the one along the anterior, the other along the posterior part of the limb. The fore-arm is to be sustained in a sling, and kept perfectly at rest for about three weeks.

Treatment after the reduction.—The after-treatment must be conducted upon the same principles as in fractures of other parts of the body. In about twenty-four days, the apparatus should be removed, and the articulation gently bent and extended, to prevent anchylosis.

§ III. FRACTURES OF THE OLECRANON.

Direction.—The division is generally transvere, but sometimes oblique.

Causes.—The olecranon is commonly broken by blows or falls upon the elbow, and sometimes by the inordinate action of the triceps extensor muscles.

Symptoms.—The symptoms of a fractured olecranon are,

pain at the injured part; impossibility of extending the fore-arm; a depression at the posterior part of the joint, facility of moving the upper fragment from side to side; the situation of the olecranon above the condyles of the humerus; the tendency of the limb to remain in the semi-flexed position; and great difficulty in bringing the upper fragment down to its natural situation.

The characteristic marks of the accident are the impossibility of extending the limb, and the interspace between the two fragments, which is sometimes no less than two inches in extent, and may always be augmented or diminished at will by flexing or extending the fore-arm. According to Sir Astley Cooper, the rotation of the radius upon the ulna is still preserved, and there is seldom any crepitation, unless the separation of the bone is extremely slight. (*a*)

Prognosis.—The fracture generally unites through the medium of ligamentous matter, probably on account of the difficulty of keeping the fragments in apposition. The consolidation is usually completed in about forty-five or fifty days, but owing to the circumstance just mentioned, the arm for a long time remains weak, and sometimes never recovers its former strength.

Reduction.—Having seated the patient upon a chair, and extended the limb, the surgeon takes a roller several yards in length and about three inches in width, and applies it by circular and reversed turns as high up as the elbow, when it is to be committed to the care of an assistant until the fragments are brought to their natural relations. A compress, about two inches long and half an inch thick, is then to be placed against the upper fragment, and secured by several turns of the bandage carried round the joint in the form of a figure-of-eight. The bend of the arm is next to be filled with lint or cotton, and over this is to be placed a firm

(*a*) Desault's Treatise on Fractures, p. 175-6.—Sir Astley Cooper on Dislocations, p. 344.—Boyer's Lectures on the Bones, p. 90.

splint, long enough to reach from the middle of the arm to near the wrist, and fastened by the rest of the roller.

By this mode of treatment the arm is maintained in the extended posture, the triceps and anconeus muscles are relaxed, and the fragments are kept in due apposition.(*a*)

Treatment after the reduction.—When the fracture is reduced, the patient's arm is to be placed upon a pillow, and kept perfectly quiet for about four or five weeks, when the splint is to be taken off, and the joint gently moved, to prevent anchylosis.

FRACTURES OF BOTH BONES OF THE FORE-ARM.

Causes.—The radius and ulna may be broken conjointly by a counter-stroke, as is, in fact, most frequently the case, or by violence inflicted directly upon the fore-arm, as a heavy blow, or the passage of the wheels of a cart.

Symptoms.—Crepitus on rotating the hand; inability to perform the motions of pronation and supination; pain at the seat of the injury; a semi-flexed position of the fore-arm; a depression felt at the fractured part; mobility of a part of the limb, which was before inflexible; and a projection of the ends of the broken bones under the integuments.(*b*)

When the fracture is situated near the wrist, and presents the appearance of a dislocation of the radio-carpal articulation, the nature of the injury may in most cases be decided by moving the hand, and observing whether the styloïd processes of the radius and ulna follow its motions. If this is found to be the case, there can be no doubt of the existence of the fracture.

Prognosis.—Fractures of both bones of the fore-arm are seldom dangerous; but if they are neglected or unskilfully

(*a*) Kunst die Aüsserlichen Krankheiten zu Heilen, &c. E. Theil, p. 226.

(*b*) Boyer's Lectures on the Diseases of the Bones, p. 84-5.—Desault, op. cit. p. 154.

treated, the ends of the fragments may become united together by a common callus, and produce such a degree of deformity as to diminish or obliterate the interosseous space, and impede or entirely destroy the motions of pronation and supination. Under ordinary circumstances, however, the patient experiences little inconvenience, and generally recovers in about thirty or forty days.

Reduction.—The fracture is set by bending the elbow to a right angle with the arm, and placing the hand midway between pronation and supination. The extension and counter-extension are to be made by two assistants, one of whom is to take hold of the patient's hand, and the other of the lower part of the arm, while the surgeon pushes the fragments outwards or in a lateral direction, by compressing the muscles which are situated between the two bones. When the fracture has been thus reduced, two graduated compresses, three inches wide, and long enough to extend from the elbow to the ends of the fingers, are to be placed on the palmar and dorsal regions of the limb, and fastened with a roller, the application of which is to begin at the hand and reach a short distance above the humero-ulnar articulation. Two firm splints are then to be applied, one along the inside, the other along the outside of the fore-arm, and secured in the usual way. They should be equal in length and breadth to the compresses, and be fastened with sufficient tightness to prevent the motions of the hand and keep the fleshy parts confined in the interosseous space.(*a*)

Treatment after the reduction.—If the fracture be simple, and there is little or no contusion of the soft parts, the patient will generally be able to walk about and attend to his business, care being taken to support the arm in a sling, and to tighten the dressings whenever they become relaxed.

(*a*) Gibson's Institutes of Surgery, vol. i. p. 418.—Boyer, op. cit. p. 86.

DESCRIPTION OF THE BONES OF THE CARPUS.

The bones of the carpus are eight in number, and are situated between the fore-arm and the metacarpus. They are disposed in two rows, a superior and an inferior, the former of which consists of the scaphoïdes, the semi-lunare, the cuneiforme, and pisiforme, the latter of the trapezium, the trapezoïdes, the os magnum, and os unciforme. The dorsal surface of the carpus is convex, the palmar concave and irregular, and marked by four processes, across which is stretched the annular ligament, so as to form a canal or kind of gutter for the passage of the flexor tendons of the arm.

The carpal bones are of a spongy texture, and are wedged together with extreme firmness.

FRACTURES OF THE BONES OF THE CARPUS.

Causes.—The carpal bones are seldom broken except by gun-shot violence, or by a stone, a piece of timber, or other heavy body falling upon the dorsal surface of the hand.

Symptoms.—Inability to move the radio-carpal articulation, great pain and difficulty in flexing or extending the fingers, severe contusion of the soft parts, and sometimes a more or less distinct crepitus, are the usual characteristic marks of fractures of the bones of the carpus.

Prognosis.—The fracture is always difficult to heal, and the symptoms which accompany it are sometimes so severe and troublesome as to require the removal of the hand by amputation.

Reduction.—The reduction, although difficult, may generally be effected by making extension and counter-extension, and by gentle and graduated compression upon the dorsal and palmar regions of the hand. When the parts have been thus restored to their natural relations, the hand

is to be placed in a carved splint, and recourse is to be had to general and local bleeding, to cold or emollient applications, and to a strictly antiphlogistic regimen, in order to prevent the effects of the violent inflammation which is almost always the necessary consequence of these injuries. If no carved splint be at hand, it will be necessary to make use of two common paste-board or wooden splints, long enough to extend from the elbow to the ends of the fingers, and secured to the limb by means of a roller. The hollow in the palm of the hand should always be carefully filled with soft compresses, and the limb should be supported in a sling.

DESCRIPTION OF THE BONES OF THE METACARPUS.

The bones of the metacarpus, five in number, are situated between the carpus and the phalanges of the thumb and fingers. They are placed parallel with each other, are slightly concave on the palmar surface, convex on the dorsal, larger at their extremities than at their bodies, and terminated, inferiorly, by a rounded head, superiorly, by an unequal eminence.

FRACTURES OF THE BONES OF THE METACARPUS.

Causes.—These accidents are produced by a variety of causes, but in general they are the result of blows or falls.

Symptoms.—The characteristic symptoms are, acute pain at the seat of the fracture, and crepitus produced on moving the finger which corresponds to the broken metacarpal bone.

Prognosis.—The parts generally unite much sooner than in the preceding case, and the accident in itself is not dangerous; but becomes so when attended with great contusion or laceration of the circumjacent parts.

Reduction.—The fracture is to be reduced and treated upon the same principles as in the preceding case.

FRACTURES OF THE BONES OF THE THUMB AND FINGERS.

The phalanges of the thumb and finger are fourteen in number, and like the bones of the metacarpus, they are each divided into a body, a base, and a head.

Causes.—External violence.

Symptoms.—The symptoms of the fracture are very obvious, great pain at the time of the accident; mobility of the fragments; deformity or change of shape in the injured organ; and crepitus on moving the fractured bone.

Prognosis.—The prognosis is commonly favourable; the reunion being usually effected in about three or four weeks.

Reduction.—The fracture is set by fixing the hand, and pulling at the extremity of the finger. The reduction is to be maintained by a narrow roller, and four strong pasteboard splints, two of which should be applied along each side of the finger, and the others should be sufficienty long to extend as high as the wrist. If the finger, however, be badly bruised, it will be better to apply but little dressing, and to place the hand in a carved splint, care being taken to keep the fore-arm and hand well supported in a sling.

ARTICLE 3.—*Of Fractures of the Inferior Extremities.*

DESCRIPTION OF THE FEMUR.

The femur, the longest bone in the skeleton, is situated between the os innominatum and the tibia, and is divided into a body and two extremities.

The body of the bone is cylindrical, strong and thick, and broader towards its extremities than at its centre. Its anterior surface is convex and smooth, the posterior rough and irregular, and presents a prominent line, called the linea as-

pera which affords attachment to some of the muscles of the thigh. The two lateral surfaces of the bone are somewhat flat and compressed, but the external is broader than the internal, especially towards its superior part.

The superior extremity consists of three eminences, which in size, form, and direction, are worthy of the particular attention of the surgical student. The most elevated of these forms about two thirds of a sphere, is tipped with cartilage for its articulation with the cotyloïd cavity of the os innominatum, and is called the head of the femur. A little below its most prominent point is a small, rough pit for the attachment of the inter-articular ligament of the ilio-femoral articulation. The other two eminences are distinguuished by the names of trochanter major and minor, and intended to give origin and insertion to some of the muscles of the thigh and pelvis. The trochanter major, the larger and outermost of the two, is continuous with the external surface of the bone, and is nearly in a line with its axis. It is of a quadrilateral form, rough and convex on its external surface, and hollow and irregular on its internal. At its superior or internal border it is flat and straight, and at its posterior aspect it presents an oblique and prominent line, which is directed downwards and inwards towards the trochanter minor, and is denominated the inter-trochantreal line.

The trochanter minor projects from the postero-internal part of the body of the bone, is of a rounded pyramidal form, and gives attachment to the tendon of the psoas and iliacus internus muscles.

Between the head and the trochanters major and minor is a constricted, elongated portion of bone, which projects upwards, inwards, and somewhat forwards, and is termed the neck of the os femoris. It forms an obtuse angle with the axis of the bone, and is marked by two oblique lines, an anterior and a posterior, into which is inserted the capsular ligament of the hip-joint.

The inferior extremity of the bone is much thicker and broader than the superior, and terminates in two large eminences, called the condyles of the femur. The internal condyle descends a little lower down than the external, and on its outer surface it presents a tuberosity, which gives attachment to the femoro-tibial ligament and to the tendon of the adductor magnus. Both are covered with cartilage, and are united in front, so as to form a pulley-like surface for the articulation of the patella. As they pass backwards they gradually diverge, and at the posterior surface of the bone, they are separated by a deep unequal fossa, to which are attached the crucial ligaments of the knee-joint.

Attachments of muscles.—The glutæus maximus, medius, and minimus, the pyriformis, the gemelli, the obturator internus and externus, the quadratus femoris, the psoas magnus, the iliacus internus, the pectinæus, the triceps extensor, the adductors and short head of the biceps flexor, the gastrocnemius, the plantaris, and the popliteus.

FRACTURES OF THE FEMUR.

Seat and direction.—The femur may be fractured either at its body, or at its superior or inferior extremity, and the direction of the fracture may be either oblique or transverse.

§ I. FRACTURES OF THE BODY OF THE FEMUR.

Causes.—Fractures of the body of the os femoris are the effect either of falls upon the foot or knee, or of the action of bodies striking against it.

Symptoms.—The symptoms are severe local pain at the moment of the accident; sudden inability to move the limb, or stand on the foot of the affected side; mobility at the fractured part; crepitus produced on pressing the ends of the fragments against each other; and more or less deformity and shortening of the limb.

The diminution in the length of the limb depends, in great measure, upon the seat and direction of the fracture, the age of the patient, the position in which the limb is placed at the reception of the injury, and a variety of other causes.

Transverse fractures of the body of the femur are generally less liable to displacement than oblique ones, because the ends of the fragments are still maintained in contact, and are thus enabled to counteract the action of the muscles.

In childhood and decrepitude there is usually less displacement than at any other period of life, a circumstance which may be attributed to the want of muscular power, and to the direction of the fracture being most commonly transverse.

When the body of the femur is fractured immediately above the condyles, the inferior fragment is drawn backwards by the combined actions of the gastrocnemius, plantaris, and popliteus muscles; if, on the contrary, the fracture be seated near the superior extremity of the bone, immediately below the trochanter minor, the upper fragment will be drawn upwards and forwards by the psoas and iliacus muscles.(*a*) It may be stated, moreover, as a general rule, that the higher the fracture is situated the greater will be the overlapping, on account of the greater number of muscular fibres which are employed in producing the retraction.(*b*)

Prognosis.—Fractures of the body of the os femoris were formerly looked upon as accidents of a very serious nature, and were we deprived of the privilege of thinking for ourselves, we should still be compelled to believe that all such cases would necessarily be followed by more or less deformity of the limb. Fortunately, however, for our patients, and for the honour of modern surgeons, consequences of this kind are at present of comparatively rare occurrence, and

(*a*) Boyer on the Diseases of the Bones, p. 97.

(*b*) C. Bell's Operative Surgery, vol. ii. p. 344.

when they do take place, they are in most instances to be attributed either to the ignorance or neglect of the practitioner, or to the employment of improper apparatus. In all cases, therefore, we should pay the most unremitting care and attention to our patient, and neglect nothing that may in anywise contribute to a favourable termination.

Under ordinary circumstances, the consolidation is affected in about six or eight weeks, but in very old persons it generally requires a much longer time.

Remark.—Transverse fractures generally unite much sooner than oblique ones, and are much more easily retained in their natural situation.

Reduction.—Before commencing the reduction, it will be necessary to prepare the patient's bed, and to arrange the apparatus with which the fracture is intended to be kept in its proper place. In almost every hospital there are beds constructed for the purpose, and when they can be procured they should always be employed; but in private practice, and especially in the country, these advantages can seldom be obtained, and we are then obliged to make use of such contrivances as are best suited to the circumstances of our patients. A common bedstead, about three feet wide, and covered with boards or wooden slats, will generally answer extremely well. It should be furnished with a firm and even mattress, a sheet, and a pillow. Over this sheet are to be laid, at intervals of eight or ten inches, five or six pieces of tape, about one inch in width and one yard in length. A piece of muslin, a yard and a half long and a yard wide, is next to be placed upon the tapes. Over the middle of the splint-cloth, near its upper edge, is laid a strong paste-board splint, nine inches long, two wide, and above and across the splint a many-tailed bandage. This consists, as has been already stated in one of the preceding sections, of a number of separate strips, made of a common roller, about three inches wide, and long enough to surround the limb. The first strip should be laid near the upper edge of the splint,

and should be somewhat longer than the rest, on account of the greater thickness of the superior part of the thigh. They should be arranged in such a manner that each succeeding strip should overlap about one-half of that which precedes it, and should be continued in regular succession until a sufficient number is laid down to cover the whole thigh. Two bags, filled with chaff or finely cut straw, four inches wide, and long enough to extend from the hip to the foot, are next to be provided. A strong silk handkerchief, about a yard long, is then to be placed at the upper part of the splint-cloth for making counter-extension, and a similar one is to be procured for making extension at the ankle. All that now remains to be done is to prepare the wooden splints, the first of which should be equal to the length of the thigh, the second should be long enough to extend from the perineum to six or eight inches below the foot, and the third, which is that of Desault, modified by Dr. Physick and the late Dr. Hutchinson, should be long enough to reach from the axilla to the same distance below the foot as the preceding. At its upper extremity it is formed and padded like a crutch, and a little above its lower one it is furnished with a small block, which projects inwards so as to form a right angle with the splint. It is provided with two mortise holes, one above and the other below, and large enough to admit the ends of the extending and counter-extending bands. (*a*)

Every thing being thus prepared, the patient is to be conveyed to bed, and the injured limb is to be carefully placed upon the middle of the apparatus. The counter-extending band is then passed between the scrotum and the upper part of the thigh, and after its ends have been carried before and behind the pelvis, they are to be committed to the care of an assistant. The extending band is next to be passed around the ankle and instep, tied under the foot, and given to another assistant. The assistants being now requested to make

(*a*) Dorsey's Elements of Surgery, vol. i. p. 184.

the necessary extension, the surgeon restores the ends of the fragments to their natural situation, and then applies the many-tailed bandage by commencing at the strip which is nearest the knee and proceeding upwards to the groin. The two long splints are next to be folded in the splint-cloth, and placed neatly along the sides of the limb, the bags of chaff are to be carefully interposed, so as to fill up the inequalities between the thigh and leg, and the extending and counter-extending bands are to be passed through the holes in the external splint, and tied. In this step of the application of the apparatus, great care should be taken not to draw the bandages too tight, or to relax them so much as to permit the fragments to pass each other. The short wooden splint being now placed along the anterior part of the thigh, and and the paste-board one along the posterior, all that remains to be done is to tie the different tapes, and to pass a bandage or handkerchief around the pelvis, so as to prevent the motions of the trunk.

Remark.—As the object of this apparatus is to keep up permanent extension, it is necessary frequently to examine the extending bands, and to tighten them as often as they become relaxed.

Another method of treating fractures of the body of the os femoris, quite different from the preceding, was suggested about twenty years ago by Mr. Charles Bell, of London, and is at present extensively employed in some of the European hospitals. It consists in placing the limb upon two firm cushions, which rest upon two inclined boards, ten or eleven inches in breadth, and long enough to reach from the back part of the heel to the tuberosity of the ischium. They are secured by a horizontal board, and are joined together at such an angle under the ham, that, when the patient lies upon his back, the ilio-femoral and femoro-tibial articulations will be in an easy and relaxed position. Near the edge, on each side of the inclined boards, are five or six holes, into which is fitted an equal number of wooden pegs.

The limb is then laid over the cushions, and the fracture is to be set by gently extending the knee, and adjusting the ends of the fragments.

Two splints are next to be placed along the outer and inner side of the thigh, and secured by the eighteen-tailed bandage. The external splint should be long enough to extend from the hip to the knee; the internal, of course, must be shorter. In order to keep the limb firmly in its place, and prevent the foot from rolling, the edges of the cushion are to be folded up, and fixed to the pegs. This object, however, may be more easily effected by attaching a foot-board to the horizontal piece of the inclined plane, and securing the foot to it by means of a gaiter or roller.

Treatment after the reduction.—After the fracture is properly set, it is generally necessary to bleed the patient, and to keep him for a short time upon a strictly antiphlogistic regimen. During the first few days after the accident, the extending bandages should always be moderately loose, the limb should be frequently examined, and its length compared with its uninjured fellow.

§ II. FRACTURES OF THE SUPERIOR EXTREMITY OF THE FEMUR.

Fractures of the superior extremity of the os femoris may be divided into three classes—into those which happen at the neck of the bone, either internally or externally to the capsular ligament, and into those which occur at the trochanter major.

1.—FRACTURES OF THE NECK OF THE OS FEMORIS WITHIN THE CAPSULAR LIGAMENT.

Differences according to age and sex.—Fractures of the neck of the thigh bone, within the capsular ligament, gene-

rally occur between the fiftieth and eightieth year of age, and are more frequent in women than in men.(*a*)

Causes.—The most frequent causes, are falls upon the knee, or the trochanter major,(*b*) or a powerful twist of the thigh-bone.

Symptoms.—In fractures of the neck of the os femoris, within the capsular ligament, there is more or less pain at the supero-internal part of the thigh; the leg is one or two inches shorter than the other; the foot and knee are turned outwards; the heel on the injured side rests in the depression between the ankle and the tendo-achillis of the other leg; the trochanter major is drawn upwards towards the ilium; the thigh can not be bent upon the pelvis without great difficulty; the limb can be easily restored to its natural length, but reascends as soon as the extension is discontinued; and, on rotating the thigh upon its axis the great trochanter will be found to turn, as it were, upon a pivot. In addition to these symptoms, which are always strongly characteristic of this accident, the surgeon is generally able, by drawing down the limb, and then rotating it, to perceive a more or less distinct crepitus, and if the patient be requested to stand up, the prominence of the hip will be destroyed, the heel of the injured limb will be raised from the ground, and every attempt to bear upon the foot will produce severe pain.(*c*)

Diagnosis.—As some of the symptoms which have just been enumerated, are common to fractures of the thigh-bone generally, it will be necessary, when called to a case of this kind, to bear in mind that fractures of the neck of the femur, usually occur in old age; that they are more common in women than in men; that there is little local swelling or change of appearance in the soft parts; that the trochanter

(*a*) Sir Astley Cooper on Dislocations, p. 96–136.

(*b*) Hagedorn's Abhandlung über den Bruch des Schenkel beinhalses, &c. Leip. 1808.

(*c*) Sir Astley Cooper, op. cit. p. 90.—Boyer on the Bones, p. 108–9.

major is more elevated than usual; that the ilio-femoral articulation still admits of flexion and extension; and that no crepitation can be perceived, unless the limb is extended and then rotated.

It sometimes happens that the foot, instead of being turned outwards, is turned inwards; but this is merely an exception to the general rule, and is owing to a want of action in the rotator muscles of the thighs.

Prognosis.—It appears from the investigation of Sir Astley Cooper and Dr. Colles,(*a*) the eminent professor of Surgery in the University of Dublin, that fractures of the neck of the thigh-bone, within the capular ligament, rarely, if ever, unite by bone, but in almost all cases through the medium of a fibro-ligamentous substance. Hence, the ilio-femoral articulation almost invariably remains weak and deformed, and never regains so much strength as to be able to support the full weight of the body. This imperfect reproduction is owing chiefly to the want of apposition of the ends of the fragments, to the preternatural accumulation of the synovial fluid within the joint, and to the want of ossific action, in consequence of the laceration of the periosteum and reflected membrane of the neck of the os femoris.

Although there are few, if any, who will deny the possibility of a cure by bony union in cases of fractures of the neck of the thigh-bone, within the capsular ligament, yet as the mass of evidence is decidedly opposed to such a recovery, the young practitioner should always be careful not to injure his reputation by prognosticating what he can seldom, if ever, realize. I am fully aware there is a great discrepancy of opinion upon the subject, especially amongst the French and English Surgeons, but I am persuaded that those who will carefully examine the cases which are upon record, will perfectly agree with me in stating, that a bony reunion, although not absolutely impossible, must be regarded as an accident of very rare occurrence.

(*a*) Dublin Hospital Reports, vol. 2. p. 336, et seq.

Reduction.—The best mode of treating fractures of the neck of the os femoris, within the capsular ligament, consists in extending the patient's limb upon a firm mattress, and confining the feet by gaiters or rollers to a foot-board, which is fastened to two splints, five feet and a half in length, half an inch thick, and formed at the upper extremities like the head of a crutch. The lower end of each splint is straight, about an inch and a half or two inches wide, and has six or eight holes, equi-distant from each other, and large enough to admit a stout peg. The foot-board is made of strong wood, one inch thick, twelve inches long, and nine broad. It has eleven perforations, nine of which are intended for the reception of gaiters, straps or bandages which secure the feet to the board, and the other two for the reception of the lower ends of the splints. The gaiters are made of quilted linen or soft leather, and have each four straps, two near the heels and two near the insteps. The remainder of the apparatus consists of three cushions, two of which are of the same length and breadth as the splints, and the other long enough to reach from the perineum to the foot, a splint cloth, similar to that of Desault, and six or eight broad tapes or pieces of roller for the purpose of securing the splints round the limbs, pelvis, and thorax.

The apparatus is now to be arranged upon a firm mattress, as in fractures of the body of the femur, the patient is to be placed upon it, and the ends of the bones are to be carefully adjusted by making extension and counter-extension. The splints, previously covered with their cushions, are next rolled up in the splint-cloth, and brought closely in contact with the body and limbs. The surgeon then fixes the gaiters to the ankles, and secures the feet, placed upon two small cushions, to the foot-board by passing the straps through the holes, and tying them on the outside. All that now remains to be done, is to interpose the third cushion between the thighs, to tie the tapes, so as to secure the whole apparatus, and to fasten the straps which are attached to the

crutch-like extremity of each splint, round the shoulders, to prevent the patient from removing his arm-pit.(*a*)

The above apparatus is the invention of Dr. Gibson, Professor of Surgery in the University of Pennsylvania, and is intended as an improvement on that of Hagedorn. It is at present pretty extensively employed in the United States, and is perhaps the best contrivance that has ever been suggested for fractures of the os femoris.

Remark.—The original machine of Hagedorn consists of an excavated splint, between three and four feet long, a foot-board, four or five leather straps, two gaiters, and a long pad.

Boyer's apparatus for fractures of the neck of the os femoris consists of three splints, a sole or slipper, and a padded belt or thigh-strap.

The principal splint is made of firm wood, about five lines thick, four feet long, and three fingers-breadth wide. A groove, half an inch broad, the extremity of which is covered with iron, runs along the splint from its inferior extremity to near its middle. To this groove is adapted a screw, which extends through its whole length, and has one of its extremities resting against the plate of iron, covering the end of the groove, and its other fixed to a key, by means of which it is to be turned. The superior part of the splint is received into a pocket at the external side of the thigh-strap; and at the infero-internal side a contrivance for holding up the sole or foot-support, is fastened to the screw.

The thigh-strap is made of strong leather, covered with soft morocco, and well stuffed with wool or cotton. It consists of two parts, one of which is only three inches in length, and terminates in a buckle, while the other is long enough to pass obliquely round the upper part of the thigh, and terminates in a perforated strap. At the place where the two ends are buckled on the limb, is a small leather pocket, de-

(*a*) Philadelphia Medical Journal, edited by Dr. Chapman, vol. iii. p. 231. et seq.

signed for the reception of the upper extremity of the splint already described.

In applying this apparatus, the upper part of the thigh is to be surrounded with a soft linen or muslin band, and over it is to be buckled the padded belt or thigh-strap. The foot and lower part of the leg are to be protected with tow or cotton, to prevent the ill effects of pressure, and the sole or slipper is to be applied to the foot. The upper part of the splint is next to be fixed in the pocket at the external side of the belt, and the sole is to be secured at the proper place to the remainder of the apparatus. Pads or other soft materials are then to be interposed, so as to fill up irregularities and prevent excoriation of the skin; and the two other splints are to be applied, one along the anterior, the other along the internal side of the limb, and secured in the ordinary manner. The screw in the groove is now to be turned by the key or handle, to bring down the sole and foot, and push up the superior part of the splint; and in this way the limb is to be gradually extended, and the extension increased as often as may be necessary.(*a*)

The mode of treatment recommended by Sir Astley Cooper, consists in extending the limb upon a long pillow, and keeping it in this position for about two weeks, until the pain and inflammation, which usually follow the accident, have subsided. The patient is then to leave his bed, and sit in a high chair, or walk about upon crutches, care being taken to bear at first gently upon the foot, until the ligamentous union has acquired sufficient firmness, and the muscles have regained their former strength. In about five or six weeks the patient may use a high-heeled shoe, and exchange his crutches for a stick.(*b*)

A new apparatus for fractures of the neck of the thigh-bone has lately been proposed by Mr. Amesbury, a distinguished

(*a*) Boyer on the Bones, p. 125.—Traité des Maladies Chirurgicales, T. 3. p. 299.

(*b*) On Dislocations and Fractures, p. 118.

surgeon of London, and is deserving of particular attention, both on account of its simplicity and the success which has already attended it in practice. "It consists of a frame, which has a joint near its middle, and which is made to support four pieces of board, long enough, when connected, for an adult to rest upon in the extended position; of a foot-board, pelvis-strap, mattress, and a convenience for receiving the feces. The two pieces of board which form the middle plane are made to slide upon each other, so that this plane may be adapted and fixed by screws attached to it, with the greatest accuracy, to the natural length of the patient's thigh. In this place there is an opening of a form and size to receive the receptacle for the feces. When the receptacle is in the hole, it is retained in its proper position by a shelf, which shuts up so as to close the opening when the receptacle is removed. This plane is connected to the upper and lower planes by rule-joints, which allow the three planes to be placed in connexion upon the frame at any angles that may be required. The joint formed by the middle and upper planes rests upon the middle of the frame when the bed is used. The upper plane may be kept raised from the frame, so as to incline towards the foot of the bed, by means of a supporter appended to its under surface. The loose ends of this supporter are received in racks formed in the upper end of the sides of the frame. At the lower part of this plane, the pelvis-strap is attached. The lower end of the lower plane is received in racks, formed in the sides of the lower end of the frame, which supports it so as to make it form with the middle plane any angle that may be deemed advisable. The foot-board which is connected to the lower end of this plane answers the double purpose of retaining the foot in its proper position, and of keeping the bed-clothes from pressing unpleasantly on the toes. The mattress consists of two portions, which are sewn together, so as to form a joint like that of a paillasse. The part upon which the

trunk rests is double the thickness of that upon which the lower extremities are placed."(*a*)

In using the "fracture-bed," three boards should be laid across a common bedstead, upon the middle of which the joint of the frame should be made to rest. The upper plane should be raised to an easy position, and the lower and middle ones should be placed so as to form a double inclined plane. The foot-board is to be fixed in the hole made in the lower plane, corresponding to the injured side, and the whole is to be covered with a mattress, a perforated blanket, and a sheet.

When the fracture-bed has been thus arranged, the patient should be placed upon it, with his limbs over the middle and lower planes. Both limbs should then be carefully measured, from the antero-superior spinous process of the ilium to the base of the patella, and if they be found to be of the same length, the plane should be firmly fixed at its proper degree of elongation by the retaining screws which pass through the two portions of it. The injured limb, being previously invested with a spiral bandage from the toes to the knee, is now to be fixed with the foot between the legs of the foot-board, by means of a roller carried two or three times round the ankle and instep, and tied at the bottom, so as to keep the leg and thigh firmly fixed upon the respective planes of the bed. Compresses should be interposed wherever they may seem necessary to prevent pressure; and a padded splint, sufficiently long to extend from the knee to the pelvis, should be placed on the outer side of the thigh. This is to be secured at is lower end by a piece of bandage, and at its upper by the pelvis-strap, which passes round the body immediately below the antero-superior spinous processes of the ilium, and is to be buckled with a degree of tightness regulated by the particular state of the fracture.

The chief indications which the fracture-bed of Mr.

(*a*) Amesbury on Fractures of the Thigh-bone, p. 133–4. London, 1829.

Amesbury is calculated to fulfil are, to keep the limb in the bent position, and of exactly the same length as the other; to prevent eversion or inversion of the foot; to keep the trochanter major slightly elevated; and to maintain the fractured surfaces in due apposition.

Treatment after the reduction.—The after-treatment must depend upon the age and constitution of the patient, and the mildness or severity of the symptoms which attend the accident.

2.—FRACTURES OF THE NECK OF THE OS FEMORIS, ON THE OUTSIDE OF THE CAPSULAR LIGAMENT.

Differences according to age.—Fractures of the cervix femoris on the outside of the capsular ligament, may happen at any period of life, but in general they occur before the fiftieth year of age.

Causes.—These fractures, unlike those which take place within the capsular ligament, are commonly the result of severe violence, as blows or falls, or the passage of a carriage wheel over the pelvis.

Symptoms.—The injured limb is about half an inch or three quarters shorter than the sound one; the foot and toe are everted; great pain is felt at the hip and at the supero-internal part of the thigh; the ilio-femoral articulation has lost its natural rotundity; impossibility of performing the motions of flexion and extension, ecchymosis and swelling at the injured part; preternatural roundness of the buttock; and crepitus upon the slightest motion of the limb.

Diagnosis.—To form a correct diagnosis in cases of fractures of the cervix femoris, on the outside of the capsular ligament, which is often attended with considerable difficulty, the practitioner should remember that the accident is almost always produced by severe violence; that it generally occurs under fifty years of age; and that it is accompanied with great discolouration of the integuments; severe consti-

tutional disturbance, and crepitation on the slightest rotatory motion of the limb.(a)

Prognosis.—When the neck of the thigh-bone is broken on the outside of the capsular ligament, the union is general effected through the medium of bony matter, as in fractures of other parts of the osseous system; but the consolidation of the broken pieces always requires a long time, and some degree of deformity or shortening of the limb is not unfrequently the consequence.

Reduction.—The fracture is easily reduced by making extension and counter-extension, and is kept in this position by placing the limb over the fracture-bed of Mr. Amesbury, on the double inclined plane of Mr. C. Bell, or Sir Astley Cooper, or by applying the apparatus of Hagedorn, Gibson, Boyer, or Desault.

Treatment after the reduction.—When the fracture is set, recourse should be had to venesection and the employment of antiphlogistic measures. The patient should keep his bed for about eight or nine weeks, and every possible care should be taken not to disturb the fracture.

§ II. FRACTURES OF THE TROCHANTER MAJOR.

Seat and direction.—The fracture is sometimes transverse, sometimes oblique, and may take place either at the base or at the summit of the trochanter major.

Causes.—Falls upon the hips, or bodies striking directly against the part.

Symptoms.—In fractures of the trochanter major, the limb often retains its natural length, but sometimes it is a little shorter than the other; the foot is benumbed; the broken portion of the trochanter is drawn either towards the ilium, or towards the tuberosity of the ischium; a depression is felt at the situation of the injury; the toes are turned out; the patient is unable to sit or turn in his bed, and every

(a) Sir A. Cooper on Dislocations and Fractures, p. 119.

attempt to do so is productive of much pain; the upper fragment is fixed, while the rest of the trochanter follows the motions of the os femoris; and more or less grating is sometimes perceptible on rotating the limb. (*a*)

Prognosis.—These fractures generally unite with sufficient firmness, and where there is no comminution, the consolidation may be effected with little or no deformity of the limb.

Reduction.—The fracture is reduced by moving the thigh a little outwards, and by pushing the broken portion of the trochanter in the direction opposite to that of its displacement. To retain it in this position, the limb should be kept perfectly at rest in the horizontal posture by means of a long splint, by attaching the feet to a foot-board, by placing a large pad immediately under the trochanter major, and by applying a broad bandage round the pelvis.

Treatment after the reduction.—The apparatus should be kept on for about five or six weeks, after which it may be taken off, and the patient be allowed to walk about upon a crutch or stick.

§ III. FRACTURES OF THE INFERIOR EXTREMITY OF THE FEMUR.

Seat and direction.—Fractures of the inferior extremity of the femur may be situated either immediately above the condyles, so as to separate them from the body of the bone, or they may affect the condyles themselves, so as to extend into the femoro-tibial articulation. In the former case, the direction of the fracture is either transverse or oblique, in the latter oblique or longitudinal, or both at the same time.

Causes.—The condyles of the os femoris may be broken, either by a counter-stroke, as a fall upon the feet, or by the immediate action of external bodies.

Symptoms.—Swelling and deformity of the femoro-tibial

(*a*) Sir A. Cooper, op. cit. p. 128.

articulation; great difficulty or utter inability of moving the leg; and crepitus on pressing the ends of the fragments against each other. The knee is wider and flatter than usual, and if the patella be pressed backwards, the condyles may be considerably separated. "Where only one condyle is detached, it can be felt moving under the fingers, and producing crepitation when rubbed against its fellow."

Prognosis.—Fractures of the condyles of the femur are always dangerous, and are often followed by deformity or loss of power in the femoro-tibial articulation. The retention of the fragments is unusually difficult, and six or seven weeks are commonly required for their complete consolidation.

Reduction.—After the broken pieces have been replaced to their proper situation, which may always be readily done by flexing the leg and making a slight degree of lateral pressure, a roller is to be passed round the knee, and the limb is to be placed in a tin box over a double inclined plane, or recourse may be had to the apparatus of Desault or Hagedorn, as improved by Dr. Physick and Dr. Gibson.

Treatment after the reduction.—The patient should be put upon the usual antiphlogistic remedies; and as soon as the parts have become sufficiently united, the limb is to be gently and repeatedly moved, to prevent stiffness or anchylosis of the knee-joint.

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DESCRIPTION OF THE PATELLA.

The patella is the short, irregular bone, situated at the anterior part of the femoro-tibial articulation, in the substance of the tendon of the extensor muscles of the leg. It is compressed and somewhat triangular in form, convex in front, and somewhat concave behind, where it is covered with cartilage for its articulation with the condyles of the os femoris, and is divided into two unequal parts by a vertical line. The superior extremity is broad and rounded, the inferior narrow and pointed.

The patella belongs to the class of short bones, and bears a striking resemblance to the olecranon. It is cellular within, and covered by very thin but firm plates, so that, in proportion to its bulk, there is scarcely a stronger bone in the body.

Attachments of muscles.—The rectus femoris, the cruralis, and the vastus internus and externus.

FRACTURES OF THE PATELLA.

Fractures of the patella may be divided into two classes —into oblique and longitudinal, each of which will require separate consideration.

§ I. TRANSVERSE FRACTURES OF THE PATELLA.

Causes.—The chief causes of these fractures are falls or blows upon the knee, or the inordinate or spasmodic action of the extensor muscles of the leg. (*a*)

Symptoms.—The fracture may be known by the inability to extend the leg or support the weight of the body upon the injured limb; by the depression between the two portions of bone; and by the mobility and elevated situation of the superior fragment. The interspace between the two fragments varies according to the extent of the laceration of the ligamentum patellæ, and is always greatly increased by bending the knee. In some instances it amounts to only about half an inch, but in others to three, four, or even five inches. The accident is seldom attended with acute pain, but it is generally followed by a considerable degree of ecchymosis, inflammation and swelling of the anterior part of the knee-joint, and by more or less constitutional disturbance. In consequence of the wide interspace which frequently exists between the broken surfaces, we are seldom able to perceive any thing like a distinct crepitus, though this may usually be produced by extending the leg and bending the thigh, so as to approximate the two fragments.

Prognosis.—In transverse fractures of the patella, the consolidation is generally effected through the medium of a

(*a*) Ambrose Paré, lib. xv. cap. 22.

fibro-ligamentous substance, seldom by bone. The possibility of a bony union, however, is universally admitted by the best American and European surgeons; and instances of the kind have come under the observation of Chopart, Lallemand, Fielding, Larrey, Wilson, and other practitioners. The cause of this imperfect reproduction is nearly the same as in fractures of the neck of the os femoris, within the capsular ligament, and is chiefly attributable to the difficulty of keeping the fractured pieces in accurate apposition; for it has been satisfactorily shown by the experiments of Sir Astley Cooper, that ossific union may be produced, if the ends of the fragments be maintained in due contact.

Fractures of the patella are often attended with lameness, especially if the broken pieces be suffered to be more or less separated from each other.

Reduction.—As the accident is generally followed by violent pain and inflammation, it will be proper before attempting the reduction, to elevate the thigh and leg, so as to make the limb form an angle with the body, and to direct the employment of leeches, cold evaporating lotions, and a strictly antiphlogistic regimen. In about two or three days, when the violence of the symptoms will generally have subsided, the fractured surfaces are to be carefully approximated, and retained in contact by means of a piece of folded linen, placed around the circumference of the patella, and Schmalz's knee-box. This box is made of wood, and is excavated in its middle so as to receive the whole patella. At its anterior part is an opening, with a corresponding door, for the purpose of examining the injured part; and at each of its extremities are two projections or cornua, about an inch and a half long, to which are attached four pieces of broad tape, for securing it round the limb.(*a*)

The knee-box of Schmalz has long been extensively em-

(*a*) Schmalz's Seltene Chirurgische und Medicinische Vorfälle, Leips. 1784.

ployed in Germany, and is by many considered as the best apparatus that can be used in the case before us.

The method of treatment proposed by the late Dr. Dorsey, and which is merely a modification of that of the venerable and distinguished Boyer, consists in placing the patient upon a firm mattress, and extending the leg and thigh upon a padded splint, two or three inches wide, and long enough to reach from the tuberosity of the ischium to the heel. Near the middle of this splint are two bands of strong doubled muslin, about a yard in length, and nailed at a distance of five or six inches from each other.—The limb is now to be elevated by an assistant, who is to take hold of the heel, while the surgeon takes a long roller, and carries it by circular and reversed turns as high as the knee. The upper fragment is then to be brought down into contact with the lower, and a compress is to be placed above it, and secured by several turns of the bandage, passed obliquely around the joint in the form of a figure-of-eight. The roller is next to be carried as far as the upper part of the thigh, and down over the splint as far as the knee, when it is to be committed to the care of an assistant, until the fragments have been more completely fixed by passing muslin bands obliquely round the upper and lower parts of the joint. (*a*)

Sir Astley Cooper's method of treating fractures of the patella consists in investing the limb with a common roller, and buckling a leather strap round the thigh, above the upper fragment. Another strap is to be applied to the middle of the foot, and its two ends, being carried along each side of the limb, are to be buckled to the circular strap above the knee. The longitudinal strap may be fastened to the leg and foot by means of tapes. (*b*)

Treatment after the reduction.—The limb should be maintained perfectly at rest until the fourth or fifth week,

(*a*) Dorsey's Elements of Surgery, vol. 1. p. 203.

(*b*) Sir A. Cooper, op. cit. p. 164.

when the apparatus is to be taken off, and, after the femoro-tibial articulation has been gently and carefully moved, it is to be re-applied. The motion should be daily renewed, and the dressings kept on for about seven weeks.

If the case has been neglected or badly treated, and there is a permanent retraction of the rectus muscle, with a considerable separation of the fragments, the extensor muscles of the leg may gradually be made to regain some of their former energy by placing the patient frequently upon a high seat, and directing him to swing his leg backwards and forwards.

§ II. LONGITUDINAL FRACTURES OF THE PATELLA.

Causes.—Longitudinal fractures of the patella are almost invariably produced by falls or blows upon the anterior part of the knee.

Symptoms.—The symptoms of a longitudinal fracture of the patella are sometimes so very obscure, especially when there is much swelling of the soft parts, that it is difficult to form a correct diagnosis. In general, however, the nature of the case may be ascertained by the fixed pain and difficulty or inability of moving the knee-joint, and by pushing the two sides of the patella in opposite directions.

Prognosis.—These fractures, according to the observations of Dupuytren,(*a*) and Sir Astley Cooper, are more frequently united by bone, and are less liable to be followed by lameness or stiffness in the knee-joint, than transverse ones.

Reduction.—After the violent pain and inflammation, which usually follow this accident, have in some measure abated, the parts are to be gently approximated, the limb is to be enveloped with a roller, and a laced-knee-cap, having two straps, is to be buckled round the knee, above and below the patella with a pad, on each side to keep the fragments in even contact.

(*a*) Annuaire Med. Chir. de Paris, p. 98.

Treatment after the reduction.—Similar to that in the preceding case.

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DESCRIPTION OF THE TIBIA.

The tibia is situated at the antero-internal part of the leg, and is divided into a body and two extremities.

The body of the bone is of a triangular form, and is slightly twisted, so that the internal malleolus inclines forwards, and the internal tuberosity backwards. It is thicker above than below, and presents three surfaces and three borders. The external surface is somewhat concave, the internal convex and subcutaneous; the posterior, on the contrary, is divided at its upper-third into portions by an oblique line, extending upwards and outwards to the external tuberosity of the tibia. The part above this is triangular, and gives attachment to the popliteus muscle, and that below it to the tibialis anticus and flexor digitorum. The external border is somewhat sharp, and gives insertion to the interosseous ligament. The anterior border is prominent and subcutaneous, particularly towards its middle, and is called the

crista or spine of the tibia; while the internal is thick and rounded, and affords attachment to the soleus and flexor communis digitorum pedis.

The superior extremity is thick and expanded, and broader from side to side than from before backwards. Its circumference is slightly hollowed behind, but somewhat rounded in front and at the sides. At the anterior part is situated a small projection for the insertion of the ligamentum patellæ; and above this on each side, are two rounded eminences, termed the external and internal tuberosities of the tibia. The former is somewhat smaller than the other, and is marked by a flat surface, which is encrusted with cartilage and articulates with the head of the fibula. At the superior aspect of these eminences are two smooth cartilaginous surfaces, which sustain the condyles of the os femoris, and are divided by a rough irregular protuberance, called the spinous process of the tibia.

The inferior extremity is much smaller than the upper, and is nearly quadrilateral in its form. At its external surface it is slightly excavated, and tipped with cartilage for its junction with the lower end of the fibula; and at its internal surface is a large triangular process, which projects obliquely downwards and inwards, and is called the internal malleolus. The lower articular surface of the tibia is slightly concave from before backwards, for the reception of the head of the astragalus, and is sometimes divided into two lateral halves by a gently elevated line.

Attachments of muscles.—The sartorius, the gracilis, the semi-tendinosus, the semi-membranosus, the extensor longus digitorum pedis, the tibialis anticus, the soleus, the tibialis posticus, the popliteus, the flexor longus, and the united tendon of the extensor muscles of the leg.

FRACTURES OF THE TIBIA.

Seat and direction.—The tibia, like all the other long

bones, may be fractured either at its body or at its superior or inferior extremity, and the direction of the fracture may be either transverse or oblique.

Causes.—Blows or falls on the leg, and similar causes.

Symptoms.—The symptoms vary according to the direction of the fracture, its situation, and the causes by which it is produced. If the fracture be oblique, the foot is generally inclined inwards or outwards, and a crepitus can be distinctly felt upon rotating or bending the tibio-tarsal articulation. In transverse fractures, however, the symptoms are more obscure, and the case is sometimes not discovered until a considerable time after the reception of the injury. Whenever there is reason to suspect this affection, a careful examination with the fingers will in general enable the surgeon to detect an inequality at the situation of the fracture, and to perceive a more or less distinct grating noise, by forcibly pressing the fragments in opposite directions. In both cases there is a fixed pain in the leg, and the patient walks with difficulty, or is altogether unable to support the weight of the body upon the affected limb.

Prognosis.—A cure may generally be accomplished in about forty or forty-five days, and the case is seldom followed by lameness or deformity, except sometimes when the fracture extends into the knee or ankle-joint.

Reduction.—The treatment consists in pushing the fragments in the direction opposite to that in which the derangement has taken place, and in applying a roller, or a many-tailed bandage, from the toes as high up as the knee. Two wooden splints, long enough to extend from the knee to some distance below the ankle, and having each a foot-piece, are to be placed on each side of the leg, and secured by the remainder of the bandage. Compresses or soft materials should be interposed between the limb and splints, wherever they may seem to be useful, and when the apparatus is applied, the leg should be placed in such a position as to form an angle with the thigh, and rest upon the heel and gastrocnemius muscle.

Treatment after the reduction.—The patient should be confined upon a firm mattress, and recourse should be had to such measures as the circumstances of the case may seem to indicate.

Remark.—In oblique fractures of the head of the tibia, extending into the knee-joint, the limb should be kept in the straight position, and the splints should be long enough to reach from the middle of the thigh to the foot. In fact, our treatment should be conducted upon the same principles as in fractures of the condyles of the femur.

DESCRIPTION OF THE FIBULA.

The fibula is the long, slender bone, situated on the outside of the leg, oppositely to the external angle of the tibia. It is strongly twisted upon itself, and is divided into a body and two extremities.

The body of the fibula is much narrower and weaker than that of the tibia; but, like it, it presents three surfaces and three borders. It is of an irregularly triangular form, and is bent slightly inwards and backwards.

The superior extremity is rounder, and smaller than the other, and at its internal and terminal part is a small oval surface, which is tipped with cartilage, and articulates with the corresponding part of the external tuberosity of the tibia. The remainder of the head of the bone is rough and unequal, and gives attachment to the biceps flexor cruris, and to some of the ligaments of the femoro-tibial and fibulo-tibial articulations.

The inferior extremity terminates in the malleolus externus, which is longer and more prominent than the internal, and is convex on one side, smooth and irregularly concave on the other.

Attachments of muscles.—The extensor communis digitorum pedis, the extensor proprius pollicis, the peroneus longus and brevis, the biceps flexor cruris, the tibialis posticus, the soleus, and flexor longus pollicis.

FRACTURES OF THE FIBULA.

Seat and direction.—The same as in fractures of the tibia.

Causes.—The fracture is generally occasioned by a violent twist of the foot, or by a blow, or the fall of a heavy body on the outside of the leg.

Symptoms.—A fixed pain at the situation of the injury; inability of placing the foot flat upon the ground, or of supporting the weight of the body upon the affected limb; a noise or sort of crack heard by the patient at the time of the fracture; and a sensation of crepitus perceptible on placing the finger upon the part, and moving the foot from side to side, or from before backwards. If the fracture be situated near the lower end of the bone, there is often a dislocation of the foot outwards, or backwards; an angular depression at the infero-external part of the leg; a facility of bringing the lower part of the fibula towards the tibia by pressure; mobility of the whole foot transversely or horizontally; and more or less swelling about the ankle, especially at the malleolus externus. (*a*)

Fractures of the fibula may be complicated with laceration of the internal lateral ligaments, separation of the internal malleolus, and fracture of the inferior extremity of the tibia.

Prognosis.—The fracture commonly unites in about three or four weeks, and, if well managed, is seldom followed by any unpleasant consequences.

Reduction.—The best apparatus for treating fractures of the fibula is that recommended by Professor Dupuytren, the elegant and distinguished teacher of surgery at the Hôtel Dieu at Paris. It consists of a cushion or pad, two bandages, and a splint. The cushion, made of linen or some

(*a*) Dupuytren, Annuaire Méd. Chir. de Paris, p. 68.—Sir A. Cooper, op. cit. p. 258.

other soft material, should be two feet and a half in length, four or five inches in breadth, three or four inches thick, and stuffed with hair or chaff. The splint is made of wood, and should be two feet in length, and three inches broad. Each of the rollers should be from four to five yards in length, and about two inches and a half in breadth.

When every thing is properly arranged, the surgeon folds the cushion in the form of a wedge, and places it along the internal surface of the leg, taking care that its base shall rest upon the inner malleolus, and its summit upon the internal tuberosity of the tibia. The splint is then to be applied along the cushion, so as to project about four inches below the internal margin of the foot, and be secured by one of the rollers passed round the upper part of the leg. Great care should be taken not to carry the bandage over the situation of the fracture, or to draw it with more tightness than is absolutely necessary to prevent the parts from becoming painfully swollen; for, if this precaution be neglected, there will be danger of pressing the broken ends of the fibula towards the tibia, and thus counteracting the beneficial effects of the splint. The inner margin of the foot is next to be brought against the lower part of the splint, and secured to it by passing the other roller obliquely over the instep and heel in the form of a figure of eight. The lower fragment of the fibula is thus drawn downwards and inwards along with the foot, while the upper is carried outwards, so as to recede from the tibia and resume its natural situation.

The treatment recommended by Sir Astley Cooper, and which I am inclined to think is not so good as that of Dupuytren, consists in applying a many-tailed bandage, kept constantly wet with spirits of wine and water; in placing a a splint, with a foot-piece, on each side of the leg, so as to keep the great toe in a line with the patella; and in laying the limb upon its side, in the semi-flexed position.

Treatment after the reduction.—The same as in fractures of the tibia.

FRACTURES OF BOTH BONES OF THE LEG.

Seat and direction.—Fractures of both bones of the leg usually occur about the middle of the limb, and may be either oblique or transverse.

Causes.—The causes of this accident are falls upon the feet, or force applied directly to the part, as a heavy body falling upon the leg, or the wheel of a carriage passing over it.

Symptoms.—The symptoms are severe pain at the seat of the fracture; deformity of the leg; impossibility of moving the limb, or of putting the foot flat upon the floor; mobility of the fractured pieces; and crepitation on the slightest movement of the foot. When the fracture is transverse, the fragments can only be deranged in the direction of the diameter of the limb; but when it is oblique, they almost always pass beyond each other; and in the majority of cases the upper ends project under the skin of the anterior part of the leg, while the inferior ones are drawn backwards and outwards, by the action of the posterior muscles of the calf.

Prognosis.—Oblique fractures of both bones of the leg are sometimes very difficult to manage, and are generally attended with much more irritation than transverse ones. The prognosis always less favourable when the fracture is situated near the knee or ankle, because under these circumstances it is often impossible to effect a cure without lameness, or some degree of deformity. The parts unite in about six or seven weeks, sooner or later according to the circumstances.

Reduction.—The reduction is easily accomplished by making extension and counter-extension at the foot and lower part of the thigh, while the surgeon applies his hands to the situation of the injury, and coaptates the ends of the fragments. If the fracture be transverse, it may be readily maintained in its proper situation by means of the apparatus

described in treating of fractures of the tibia, or by that recommended by Dr. Gibson, which consists of two splints, three inches wide, and somewhat longer than the leg, a splint-cloth, a yard and a half long and eighteen inches wide, a many-tailed bandage, five or six pieces of tape, and two long pads or cushions. The limb should be placed upon a firm pillow, and the foot should be supported by a bandage passed round the sole and instep, and secured to the splint-cloth on each side of the upper part of the leg. The weight or pressure of the bed-clothes should be sustained by the segments of two hoops, which are to be tied together at the centre, and their ends placed upon the mattress.

When the leg is fractured obliquely, and the ends of the broken pieces overlap each other, so as to create a shortening of the limb, it will be necessary, in order to maintain the fragments in contact, to employ permanent extension. This indication may be readily fulfilled by the apparatus contrived by the late Dr. Hutchinson, while a student in the Pennsylvania Hospital. It consists of two wooden splints, about four inches wide, and long enough to reach from the knee to some distance below the foot. At the upper extremity of each splint are four small holes, and at the lower a mortise, into which is fitted a piece of wood about eight inches long. This block should be perforated at each of its extremities with four or five small holes, and be provided with two strong pegs, to keep the lower ends of the splints firmly applied against the inner and outer margins of the foot.

In applying this apparatus, the patient is to be placed upon his back, and a pillow, upon which is arranged a many-tailed bandage, is to be laid under the leg. Extension and counter-extension are then to be made as in the preceding case, and two pieces of tape are to be placed on each side of the leg, immediately below the knee, and secured by a roller passed several times round the limb. The ends of the tapes are to be passed through the holes at the upper extremity of each splint, and tied on the outside. A silk handkerchief,

placed round the ankle and instep, is then to be secured to the cross piece connecting the two splints, and the operation is finished by applying the many-tailed bandage.(*a*)

When the fracture is situated near the knee, it will be requisite to apply the two long splints of Desault, as modified by Dr. Physick, instead of the apparatus of Dr. Hutchinson.

Treatment after the reduction.—The patient should be confined for three or four days upon low diet, and if there be any incidental symptoms, they are to be combatted by appropriate remedies.

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FRACTURES OF THE BONES OF THE FOOT.

DESCRIPTION OF THE OS CALCIS.

The os calcis is the largest bone of the foot, and is situated at the postero-inferior part of the tarsus. It is compressed laterally, and projects considerably backwards to form the heel. It presents six surfaces; the anterior and superior of which articulate with the astragalus and os cuboïdes, the internal gives passage to the plantar vessels and to the tendons of the tibialis posticus and flexor muscles of the leg, and the posterior, insertion to the tendo-achillis.

(*a*) Philadelphia Medical Museum, by Dr. Coxe, No. 2.

FRACTURES OF THE OS CALCIS.

Causes.—The violent action of the gastrocnemii and soleus muscles, and falls upon the feet.

Symptoms.—The existence of the accident is discovered by a noise or crack heard at the moment of the fracture, by an evident inequality under the heel, a sensible elevation of the posterior fragment, impossibility or great difficulty of standing or walking, severe pain, more or less swelling at the heel, and mobility of the broken pieces, attended with crepitus. (*a*)

Prognosis.—The prognosis is generally favourable; and if the case be properly managed, a cure may be effected in about thirty-five or forty days. The symptoms are seldom so violent as to endanger the life of the patient, as was asserted by Ambrose Paré and some of the older writers.

Reduction.—In reducing this fracture, the leg should be flexed upon the thigh, and the foot extended upon the leg, so as to relax the gastrocnemii muscles, and enable the fractured surfaces to be brought in apposition. The parts are to be retained in this position by means of a compress, a roller, and a curved splint. The compress should be about ten or twelve inches in length, and thick enough to fill up the hollow between the calf and the upper part of the os calcis. The roller should be about an inch and a half in width, and be carried round the foot as far as the ankle, over which it is to be passed in the form of a figure of eight, care being taken to fill up the depressions between the os calcis and the external and internal malleolus by appropriate compresses. The bandage is then to be continued by circular and reversed turns as high up as the middle of the leg, where it is to be held by an assistant until the surgeon has applied the cur-

(*a*) Desault's Treatise on Fractures, by Caldwell, p. 363.—Boyer on the Bones, p. 153.

ved splint to which I have just alluded. This splint, made of thin flexible wood, should extend from the middle of the anterior part of the limb to the end of the toes, and be secured by the rest of the roller. Three or four pillows are then to be placed under the ham, so as to form a double inclined plane, and thus keep the limb in the position first given to it.

This apparatus, which, I believe, was first suggested by some of the French surgeons, keeps the foot permanently extended, prevents the motions of the ankle-joint, and keeps the upper fragment perfectly in contact with the lower.

The common method of treating fractures of the os calcis consists in keeping the foot extended by means of the slipper invented by J. L. Petit, for ruptures of the tendo-achillis, or by applying a compress or roller on the instep, and carrying it over the toes, under the sole of the foot and heel, along the posterior surface of the whole limb, and securing it by means of a roller passed round the foot, leg, and thigh.

Treatment after the reduction.—The same as in fractures of other parts of the body.

Remark.—Fractures of the other bones of the foot are generally complicated with severe contusion or laceration of the soft parts, and require the vigorous employment of antiphlogistic measures. The broken pieces may be readily restored to their natural relations, and be maintained in contact by applying a compress and splint along the sole of the foot, and securing them by means of a common roller.—See the article on Fractures of the Bones of the Hand.

CHAPTER III.

OF THE DISEASES OF THE BONES.

SECTION I.

OF CARIES.

ARTICLE 1.—*General Observations on Caries.*

Synonyma: Gangræna caries; ulceration of the osseous tissue; sphacelus; teredon or tredon; phagedenic inflammation.

Definition.—Caries is a disease of the bones exactly analogous to ulceration of the soft parts; it was first accurately described about the year 1740, by Dr. Alexander Monro, of Edinburgh, and though it has since received considerable attention from some of the most distinguished members of the profession, a good description of the different kinds of caries is still a desideratum.

Seat.—Every part of the osseous system is liable to caries; but the bones most frequently attacked are those which form the parietes of the thorax and pelvis, the bones of the tarsus and carpus, and the articular heads of the long bones of the extremities.

Division.—Caries has been divided into different species, according to the nature of its causes, or the appearance of the diseased bone: 1. into caries from local or constitutional causes; 2. worm-eaten caries, or caries which penetrates the whole substance of the affected bone, and gives it a perforated appearance; 3. carnous caries, or caries attended with

large fleshy granulations. Caries may be distinguished into superficial and deep-seated; a division of far more practical importance than any that has hitherto been offered.

Differences according to age.—The disease is most generally met with in young persons, being seldom observed in old age or decrepitude.

Causes.—Ulceration of the osseous tissue may be owing either to local injury, or it may result from constitutional indisposition, such as syphilis, scrofula, scurvy, or a deficiency of nutrition in consequence of old age or deleterious food. Occasionally, also, the disease may be produced by the pressure of an aneurismal tumour, or it may be caused by the imprudent application of astringent or escharotic substances.

Symptoms.---The disease is usually first ascertained, where there is no external ulcer, by an obtuse and more or less deep-seated pain, which appears to issue from the bone; a swelling or protuberance of bone or periosteum in the part affected; tenderness to the touch; a red inflammatory appearance of the skin; and a loose or flabby feel of the superincumbent integuments. On being laid bare, the bone commonly presents a foul and corroded aspect, and emits a very fœtid, dark-coloured or grayish sanies. After some time, pale fungous granulations sprout out between the interstices formed on the surface of the diseased bone; and the osseous tissue becomes so much softened that it crumbles away upon the slightest touch.

Prognosis.—Although caries may generally be regarded as a dangerous and obstinate disease, yet experience has shown that a cure is often effected by the absorption of the diseased part, or with the proper assistance of surgery. As a general observation it may be stated that caries is more dangerous and less likely to have a favourable termination when it attacks the vertebræ, and the articular extremities of the long bones, than when it makes its appearance in any other part of the skeleton; except in the carpal and tarsal

bones, in which the disease is sometimes so extremely obstinate as to require the removal of the limb by amputation. The prognosis is less favourable in old than in young subjects, and in the sickly and debilitated, than in the robust and healthy.

Treatment.—When caries arises from a syphilitic, scrofulous, or scorbutic taint of the system, or from any other constitutional cause, it will be necessary to exhibit such remedies as are calculated to remove the original disease. For this purpose, the patient should be kept upon a vegetable diet, and recourse should be had to an alterative course of treatment, consisting of mercurial preparations, sudorific medicines, or of some of the mineral acids. In all cases, whether the disease be owing to a constitutional or local cause, great care should be taken to combat inflammation, to keep the parts perfectly at rest, and to remove any fragments of diseased bone as soon as they are completely detached.

In commencing the local treatment, the first object should be to allay the irritation of the soft parts by means of leeches, fomentations, or emollient poultices; and when this has been accomplished, the diseased part should frequently be washed with soap and warm water, a decoction of the thymus vulgaris, or the leaves of the common walnut tree, or with a solution of soda or the carbonate of potash. These lotions should be continued for a considerable time, and should be aided by counter-irritants, as blisters, issues, or tartar emetic ointment, or by local stimulants, as the tincture of myrrh, aloes, or benzoin, camphorated alcohol, concentrated vinegar, a weak solution of the argentum nitratum, or of chloride of lime or of soda, diluted nitric or muriatic acid, or the gastric juice of some of the inferior animals, as recommended by Dr. Physick.

These applications, it must be remembered, are to be used only when the disease is superficial or confined to the outer laminæ of the bone; for in cases of deep-seated caries no

benefit whatever can be expected from their employment, except that which results from their antiseptic properties.

When the disease has invaded a considerable part of a bone, the surgeon should endeavour either to extract the fragments as fast as they become detached, or to disorganize them completely with the actual cautery. The choice of these two methods must be regulated by the seat and extent of the disorder, by its state of simplicity or complication, and by a variety of other circumstances.

In applying the actual cautery, the patient should be placed upon a bed or table, and be firmly held by three or four assistants. The bone should then be exposed and carefully separated from the soft parts, either by simply enlarging the fistulous orifice, or by making an incision proportioned to the extent of the diseased part. The flaps of the wound should next be dissected up, and be protected from the action of the instrument with a piece of cloth, or pasteboard, or with a metallic tube, according to the circumstances of the case. Bearing in mind these precautions, the surgeon takes the iron in his right hand, and keeps it in contact with the diseased portion of bone until it has completely destroyed it.

When the operation is completed the parts should be covered with a soft bread and milk poultice, to promote the separation of the bony eschar, and if afterwards there arise any fungous granulations they should be speedily destroyed by the reapplication of the hot iron.

If the caries be situated at a great depth, the action of the cautery should be promoted by the removal of the most superficial parts of the bone, by the proper use of trephines, gouges, saws, perforators, scoops, and cutting-forceps.

When the disease is so extensive that it can not be removed by any of the means just referred to, and the suppuration is so copious as to give rise to profuse night-sweats, marasmus, and colliquative diarrhœa, the amputation of the limb,

or the excision of the articular extremity of the affected bone, will afford the only chance of saving the patient's life.

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ARTICLE 2.—*Of Caries of Particular Bones.*

§ 1. CARIES OF THE BONES OF THE CRANIUM.

Caries of the bones of the cranium, usually depends upon a syphilitic taint of the system, and is characterized by pain and swelling of the parts, and by the discharge of a small quantity of thin, sero-purulent matter.

When the disease is superficial and of moderate extent, a cure may generally be effected by simply applying irritating substances, particularly the balsamic tinctures; but when it is deep-seated and extends through the whole substance of

the bone, there can be no other resource than to remove the diseased part with a knife, the crown of a trephine, or a pair of cutting-forceps. When the operation is finished, the parts should be dressed like a common suppurating wound; and if it be found that there remain any diseased portions of bone, they should be immediately detached with the knife, or their exfoliation should be promoted by detergent irritating applications.

After the wound has healed, the parts should be covered with a piece of tin or paste-board, to protect the brain from external violence.

In caries of the mastoïd portion of the temporal bone, recourse should be had to the actual cautery, which should be repeated until the disease is completely eradicated. In no other instance, however, should this remedy be employed; for should its action extend too far, inflammation of the brain or its investments would, in all probability, be the consequence.

§ II. CARIES OF THE BONES OF THE FACE.

Caries of the bones of the face is commonly owing to internal causes, and generally disappears under the employment of proper constitutional remedies, and the application of the actual cautery, either alone, or conjointly with the means to which I have just referred in speaking of caries of the bones of the cranium.

In caries of the maxillary sinusor antrum Highmorianum, all that is necessary is to give free vent to the accumulated matter, or dead fragments of bone, by perforating one of the alveolar processes of the superior maxilla, and making use of astringent injections, such as a weak solution of the sulphate of zinc, the nitrate of silver, or the chloride of soda.

§ III. CARIES OF THE STERNUM.

Caries of the sternum is usually ascertained by the red inflammatory appearance of the superincumbent integuments, by the formation of abscesses, and by the discharge of small quantities of thin purulent matter. The disease is often complicated with an effusion of pus into the anterior mediastinum, a thickening of the pleura, and sometimes, though rarely, with a destruction of a part of the pericardium.

In caries of the sternum the best plan is to expose the part by means of a crucial incision, to cut out the diseased portion of bone, and to dress the wound with pledgets of simple cerate. This operation, however, should never be attempted, unless the disease is superficial and has resisted the employment of proper constitutional remedies; or is old and deep-seated, and unaccompanied by any chronic lesion of the thoracic viscera. If all the diseased part can not thus be removed, it will be necessary to perforate the lower portion of the sternum with the crown of a trephine, in order to afford a free passage to the matter which has collected in the anterior mediastinum.

After the wound has completely healed, the part should be protected with a piece of copper, tin, paste-board, or leather, as circumstances may indicate.

Remark.—If the internal mammary artery should happen to be divided during the operation, the hemorrhage may be easily arrested by the application of the ligature, or by compressing the vessel with one of the fingers against the adjacent parts.

§ IV. CARIES OF THE RIBS.

When the disease attacks the ribs it generally originates from cancerous affection of the breast, and may be easily known by the symptoms which have been enumerated in the general observations on caries.

Caries of the posterior extremities of the ribs should be treated upon the same principles as caries of the vertebræ; but when it is seated in any other part of their extent, the only remedy from which the surgeon can expect to derive any benefit, is the knife. As the operation of excision, however, is one of much danger and delicacy, it should never be resorted to unless the disease is of long standing, has resisted the employment of proper constitutional means, and is progressing so rapidly as to threaten the patient with a more or less speedy dissolution.

Operation.—The operation for removing portions of carious ribs was first performed by Cittadini of Italy, in 1813; it has since been done by the celebrated Richerand of Paris, by Dr. M'Dowell of Virginia, and by my distinguished friend, Professor M'Clellan of Philadelphia. It consists in exposing the diseased rib, in carefully detaching the intercostal muscles with a probe-pointed bistoury, and in cutting out the carious part, either with a small saw or a scalpel. If the pleura be healthy and still adherent to the rib, it should be detached with the finger or the handle of a knife; but if it be thick and indurated, the disorganized parts should be carefully removed with a pair of curved scissors, and the opening which is thus made should be immediately closed with a piece of linen, spread with simple cerate, to prevent the admission of air into the cavity of the thorax.

When the operation is finished, the wound should be covered with pledgets of lint and one or two compresses, and the whole should be secured with a roller, carried moderately tight around the chest.

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§ V. CARIES OF THE VERTEBRÆ.

Synonyma: Gibbosity; caries of the spine; vertebral disease of Pott. (*a*)

Seat.—The disease generally occurs in the dorsal, and sometimes, though rarely, in the lumbar and crucial vertebræ.

Differences according to age.—Caries of the vertebræ is most frequently observed amongst infants and young children, though adults are by no means exempt from it.

Causes.—The remote causes of this disease are sprains and contusions of the vertebral joints; a scofulous or syphilitic taint of the system; malformation or irregular growth of the osseous tissue; cerebral affections; masturbation; careless and habitual malposition of the body; rachitis; muscular debility; relaxation of the ligaments; pressure from aneurismal or other tumours; ulceration of the inter-vertebral cartilages; unequal length of the lower extremities, and partial or total paralysis of the muscles of the back.

The immediate or proximate cause of caries of the vertebræ is a morbid alteration or softening of the bony fabric and of the inter-vertebral cartilages.

Symptoms.—Long before there is any curvature or distortion, the disease is evinced by obtuse pain in the affected part; a numbness or uneasy sensation in the lower extremities; languor and fatigue after exercise; liability to stumble in walking; great listlessness, and want of inclination to move about; weakness in the knees, and involuntary crossings of the legs; pain and twitchings in the thighs; flatulence and sickness at the stomach; derangement of the digestive organs; and a peculiar tightness and unpleasant feeling at the scrobiculus cordis. After these symptoms have continued for a few weeks or months, the spine becomes gradually distorted, the lower extremities paralysed, and the patient is obliged to confine himself to his bed.

(*a*) Ollivier de la Moelle Epinière, p. 213.

When the curvature occurs in the neck, the patient often experiences great pain and inconvenience from the weight of his head; deglutition is difficult; the circulation in the carotid and vertebral arteries is impeded; the mind and general powers of motion are impaired or weakened; and the arms are benumbed, palsied, and affected with spasms.

If the derangement is seated between the shoulders, the chest becomes straightened; and the patient is harassed with laborious respiration, obstinate cough, night-sweats, and the endless train of symptoms which characterize consumption.

When the protrusion is in the back, the abdominal viscera are more or less displaced; the hepatic or portal circulation retarded; the face pale and sallow; the belly tumid; the bowels constipated; the urine is voided with difficulty; and the lower extremities, becoming gradually more weak, are at length completely paralyzed.

Morbid alterations.—On examining the parts after death one or more of the vertebræ will generally be found destroyed by caries, and the vacuity thus produced will be so great as to cause the spine to give way. The osseous tissue is perforated by numerous foramina, preternaturally softened, and bathed with a thin, fœtid, purulent matter. In some instances the inter-vertebral cartilages are either partly or completely absorbed, the bodies of the vertebræ still remaining sound; but in cases of long standing, both are commonly very much diseased. The superincumbent integuments are always considerably attenuated, sometimes ulcerated or distended with collections of matter. When the disease involves several of the vertebræ, the secretion of pus is sometimes so great as to be extensively effused into the abdomen, and to form externally a very perceptible tumour.

Prognosis.—Persons suffering from caries of the vertebræ seldom recover without permanent deformity, and many die from the effects of constitutional irritation.

Treatment.—General means.—The general treatment

of this disease differs according to the nature of the remote or exciting cause. In the first or forming stage of the disorder, it is often necessary to resort to venesection, and to the employment of purgative medicines; but after some time has elapsed recourse should be had to tonic remedies, such as sulphuric acid, muriate of barytes or lime, and sulphate of quinine; and to mild aperients, as jalap and cream of tartar, given in adequate doses to produce daily a free evacuation of the bowels. The patient should be subjected to absolute rest upon a firm and comfortable bed; his strength should be supported by a proper and nourishing diet; and, if his digestive organs are much impaired, he should be put upon an alterative course of treatment, and take large doses of the carbonate of potash, magnesia, or soda. The room in which he is confined should be well ventilated, and whenever circumstances permit he should exercise in the open air, on a mattress laid upon a small carriage or wagon.

Local means.—The local treatment consists chiefly in the employment of topical bleeding, and the application of blisters, issues, or setons. The quantity of blood taken away must vary according to the intensity of the disease, and the age and constitution of the patient. In general, from fifteen to twenty leeches will be sufficient; or from ten to twelve ounces of blood may be removed by cupping, care being taken to repeat the operation as often as circumstances may seem to indicate. In using blisters, the vesicated surface should always be stimulated by the application of tartar emetic or savine ointment, so as to keep up a continual discharge or counter-irritation, and give nature an opportunity to effect a salutary change in the diseased parts, and thereby establish a complete and permanent cure.

Although topical bleeding and vesicating substances are generally found highly serviceable in the early stage of the disease, little reliance can be placed upon them when the disorder has progressed so far as to occasion distortion of the vertebral column. In this circumstance no time is to be

lost, and the plan of treatment is to be immediately adopted which was recommended by the late Mr. Pott, and which consists in procuring a free discharge of matter from the integuments, and in maintaining such discharge until the patient shall have recovered his health and the use of his limbs. For this purpose a large issue should be made on each side of the spine, and in the immediate vicinity of the diseased vertebræ; and as soon as the eschars admit of being removed, a row of beans or peas, connected together with thread, should be laid on the sore, and be confined there with a strip of adhesive plaster. The issue may be made either with a piece of caustic potassa, or of potassa cum calce, the moxa, or the actual cautery, and its size should vary from one to four inches, according to the extent of the disease. The peas or beans should be bound down with a thick compress, containing a piece of paste-board or tin, and the whole should be confined with a roller. The discharge which is thus produced must often be continued for months or even years, and should always be promoted by the application of tartar emetic and savine ointment. If the issue have a tendency to close, the re-application of the actual or potential cautery becomes indispensable; and if the granulations rise too high they should be repressed by sprinkling the surface of the sore with some mild escharotic powder. When the patient begins to recover the use of his limbs, and there is reason to suppose that the diseased bone has been absorbed, and its place supplied with new osseous matter, he should be allowed to take gentle exercise, and his body and head should be supported by the machine of Eagland, the stays and steel rod invented by Levacher,(*a*) or the spine supporter contrived by Jukes and Moginie.(*b*)

When abscesses form in the neighbourhood of the affected part, the absorption of their contents should be promoted

(*a*) Mémoires de l'Academie de Chirurgie, T. 3. p. 600.

(*b*) Bampfield on the Spine, p. 267.

by the repeated application of blisters or the moxa, and by rubbing the parts with the unguentum antimonii tartarizati. But if these means prove ineffectual, and incapable of arresting the ulceration of the bones, the tumour should be carefully punctured so as to allow the matter to be discharged in a slow and gradual manner, in order that the parietes of the abscess may be enabled to contract, in proportion as the fluid escapes, and thus prevent the admission of air. In no instance should the surgeon wait for the spontaneous discharge of the matter; for in so doing he will not only greatly diminish the chances of effecting a cure, but actually endanger the life of the patient.

The opening of a spinal abscess may be effected by means of a small trocar or the point of a straight bistoury. The instrument should be passed obliquely through the integuments, or in such a manner as to make a kind of valvular orifice; and after a small quantity of matter has been discharged, the parts should be covered with a few pledgets of lint and an emollient poultice. This operation should be daily repeated until the parietes of the abscess are completely obliterated, care being taken at the same time to support the patient's strength by a nourishing and easily digestible diet and the use of tonic medicines.

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§ VI. CARIES OF THE EXTREMITIES.

As the causes, symptoms, and treatment of caries of the articular extremities of the bones will be fully pointed out in a subsequent part of this work, I shall at present merely speak of the operations which are required when the disease has attained such a degree of intensity as to preclude all hope of effecting a cure, or of arresting its progress.

These operations, as has been already stated, consist in amputating the limb above the disease, and in cutting out the caries articular surfaces. The former is always prefera-

ble when the disease extends to the surrounding soft parts; the latter when it is confined wholly to the substance of the bone.

GENERAL OBSERVATIONS ON EXCISION.

Apparatus.—The apparatus which is required for removing the articular extremities of the bones, consists of a tourniquet, two or three strong scalpels, a small amputating saw, or the chain-saw constructed by Dr. Jeffray, of Glasgow, a pair of strong scissors, a gouge and mallet, a few pieces of paste-board or lead, ligatures, compresses, lint, bandages, sponges, and warm water.

Operation—In performing the operation, the patient should either be seated upon a chair or placed upon an operating table, and be held firmly by a few assistants. The surgeon should then divide the superincumbent integuments, bring the bone fairly into view, and saw off the diseased part. In making the incisions through the soft parts the utmost care should be taken not to interfere with any of the vessels, nerves, or principal tendons; and in dividing the bone it should be held perfectly firm, to prevent the saw from breaking it, or producing any disagreeable jarring motion in the limb.

When the operation is completed, the edges of the wound should be carefully approximated, and kept in contact by a sufficient number of strips of adhesive plaster. The parts should be maintained perfectly at rest, and be put in the most favourable position for the formation of anchylosis; or if it be intended to make an artificial joint, the limb should be gently and frequently moved.

EXCISION OF THE SCAPULO-HUMERAL ARTICULATION.

The operation for removing the articular extremity of the humerus was first performed in 1769, by Mr. White, of

Manchester; though a nearly similar operation had been executed as early as the year 1740, by M. Thomas, a surgeon at Pezenas, in Languedoc.

Method of Mr. White.—This method, which is more peculiarly applicable in cases of comminuted fractures of the head of the humerus, consists in making an incision from the acromion process of the scapula to the middle of the arm, in forcing the upper extremity of the bone out of its socket, and in removing the diseased part with a common amputating saw, care being taken to protect the soft parts with a compress or piece of paste-board.

Method of the elder Moreau.—The method of Moreau should always be preferred when the disease is of long standing, and is accompanied with swelling and enlargement of the bone. Before the operation is commenced, the patient should be seated upon a firm chair, and the subclavian artery should be compressed either above or below the clavicle. The arm is then to be elevated in a horizontal direction, and an incision, commencing near the top of the coracoïd process, and extending as far as the bone, is to be carried along the outer edge of the bicipital groove to the distance of about three inches. On the back part of the joint, another incision is to be made parallel with the first, and extending from the posterior extremity of the inferior edge of the acromion as far as the arm. These two wounds should then be connected by a transverse incision, which should be directed immediately across the acromion, about half an inch below the upper attachment of the deltoïd muscle. The flap which is thus formed is about four inches in breadth and three in length, and should be dissected up and folded down on the arm. The head of the bone is then to be separated from the surrounding parts, pushed through the wound, and sawn off.

After the diseased part has been carefully removed, the rest of the bone should be replaced, and the edges of the wound should be approximated, and kept in contact by means of a few sutures and strips of adhesive plaster.

If the caries extend to the acromion or coracoïd process of the scapula, it will be necessary to prolong the anterior incision, and to remove every particle of the disease with the gouge and mallet.

Method of Baron Larrey.—The operation of Baron Larrey is performed by placing the patient upon a chair, and making an incision through the centre of the deltoïd muscle, parallel with its fibres, care being taken to carry the knife as far down as possible. The edges of the wound are then to be separated by an assistant, while the surgeon detaches the tendons which are inserted into the upper part of the humerus, disengages the extremity of the bone, pushes it through the wound in the deltoïd, and divides it with the saw.

Sabatier proposed making a V incision at the upper part of the arm, extirpating the flap, dividing the inner head of the biceps and the capsular ligament, dislocating the articular extremity of the bone, and detaching it with the saw.

EXCISION OF THE HUMERO-ULNAR ARTICULATION.

The method most commonly recommended for cutting out the humero-ulnar articulation is the one which was first suggested and successfully practised by the elder and younger Moreau, of Bar-sur-Ornain, and which has lately been modified and improved by Professor Dupuytren, of Paris. In performing the operation, the patient should be placed on his abdomen, upon a table covered with a mattress, and the tourniquet should be applied round the upper part of the arm, to guard against the unnecessary loss of blood, as well as to deaden the sensibility of the parts to be operated upon. With a dissecting-scalpel the surgeon then makes an incision parallel with the sharp edge or spine of the inner condyle of the humerus, commencing about two inches above its tuberosity, and extending as far down as the bend of the arm. A second incision, of the same length, should be

made along the spine of the external condyle, and be connected with the first by a third, which should be carried transversely through the skin and the tendon of the triceps extensor cubiti, immediately above the olecranon. The rectangular flap thus formed is now to be raised from below upwards, and held out of the way by an assistant.

The muscles which adhere to the front of the bone, above the condyles, are then to be detached; and after having protected the soft parts with a wooden spatula, carried below the bone, the diseased part is to be carefully sawn off. In order to avoid injuring the ulnar nerve, Dupuytren recommends bringing the instrument in front of the internal condyle of the humerus, where it is to be held by an assistant until the operation is completed. This precaution is of the utmost importance, and should always be carefully borne in mind by the surgeon.

If the superior extremities of the bones of the fore-arm participate in the disease, the carious part should be carefully removed by prolonging the two longitudinal incisions to the extent of about two inches, so as to form a flap of the same size as the one above. The bones should then be separated from the surrounding parts, and after being brought fairly into view, they should be cut off with the saw, care being taken not to interfere with the brachialis anticus and biceps muscles.

When every part of the caries has been removed, the tourniquet should be relaxed, the arteries secured, and the flaps brought into contact with a few sutures. The wound should be dressed with pledgets of lint, and the limb should be placed in the semi-flexed position, and covered with the bandage of Scultetus.

EXCISION OF THE RADIO-CARPAL ARTICULATION.

The operation for removing the radio-carpal articulation was first performed by the younger Moreau, and is thus described by Professor Roux of Paris. "The surgeon being

armed with a scalpel, and taking care not to interfere with the vessels and nerves of the fore-arm, makes two longitudinal incisions along the antero-external part of the radius and the antero-internal margin of the ulna, and terminates them inferiorly on a level with the joint of the wrist. The next thing to be done, is to make two transverse incisions, which are to extend backwards from the inferior part of the fore-arm to the sides of the bundle of the extensor tendons which cover the posterior surface of the joint. The flaps of the wound are then to be dissected up, and the inferior extremities of the radius and ulna are to be separated from the adjacent parts, and sawn through. If the disease extend to the bones of the carpus, care should be taken that the carious parts be removed with the knife, or the gouge and mallet.

EXCISION OF THE FEMORO-TIBIAL ARTICULATION.

This bold and difficult operation was first performed in 1762 by Mr. Filkin of Norwich; in 1781 by Mr. Park of Liverpool; in 1792 by the elder Moreau of Bar-sur-Ornain; in 1809 by Mr. Mülder of Groningen, and in 1823 by Mr. Crampton of Dublin.

Method of Mr. Park.—In performing the operation of Mr. Park, the patient should be placed in the recumbent posture, and be held by three or four assistants. A tourniquet should be secured round the upper part of the thigh, and an incision should be made through the integuments, beginning about two inches above the superior extremity of the patella, and extending about as far below its lower end. Another crossing this at right angles, is to be made immediately above the patella, through the extensor tendons down to the bone, and nearly half round the limb, the leg being in an extended state. The angles of the wound are then to be raised, the patella taken out, and the head of the femur separated from the soft parts, by passing a small catling across its posterior surface, immediately above the

condyles. The parts are then to be guarded with an elastic spatula, and the head of the femur being sawn off, is to be carefully dissected out. All that now remains to be done is to push out the head of the tibia, and to separate it with the saw, care being taken to cut away a considerable part of the capsular ligament, and to avoid injuring the popliteal vessels and nerves.

When the operation is finished, the edges of the wound should be kept in contact with a few sutures, the parts should be covered with light and superficial dressings, and the limb should be placed in a tin-case, long enough to reach from the tuberosity of the ischium to the ankle.

Method of the elder Moreau.—The patient being placed upon his back, and secured by proper assistants, the surgeon makes a longitudinal incision on each side of the joint, between the vasti and flexor muscles of the leg, commencing about two inches above the condyles of the femur and terminating at the upper part of the tibia. These two incisions are to be connected by a third, which is to pass transversely below the patella, and extend as far as the bone. The flap which is thus formed is then to be raised, the patella dissected out, and the condyles of the femur, being separated from the surrounding parts, are to be sawn through.

If the superior extremities of the bones of the leg participate in the affection, the diseased parts should be carefully excised, by prolonging the external lateral excision, and making another, about eighteen lines long, on the spine of the tibia.

EXCISION OF THE TIBIO-TARSAL ARTICULATION.

The operation of excising the tibio-tarsal articulation, which was first performed in 1792 by the elder Moreau, consists in making a longitudinal incision on each side of the leg, beginning at the infero-posterior part of the external and internal malleolus, and extending from three to four

inches along the inner border of the tibia, and the outer margin of the fibula. These incisions are to be united by two transverse cuts; one of which is to extend from the inferior end of the external lateral incision to the edge of the tendon of the peroneus brevis; the other from the same point of the internal lateral incision to the tendon of the tibialis anticus.

Having dissected up the edges of the wound, the surgeon should separate the fibula from the tendons and ligaments by which it is surrounded, and remove it with the gouge and mallet. The tibia should then be detached from the soft parts, and a wooden spatula passed under its posterior surface. The blade of a narrow saw being now passed beneath the anterior muscles of the leg, and fixed to its handle, the bone is to be divided from before backwards, and detached from the tarsus by turning the foot outwards. If the astragalus be affected, the diseased part should be removed with the chisel.

When all the diseased parts have been removed, the flaps should be brought together, and secured by a stitch at each of their points; the wounds should be covered with pledgets of lint, a compress, and the bandage of Scultetus; and the leg should be kept perfectly at rest by means of two lateral splints and a foot-board.

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SECTION II.

OF NECROSIS.

Synonyma: Dry caries; gangræna caries; spina ventosa; mortification of the osseous tissue, osteo-necrosis.(*a*)

Definition.—The term necrosis is derived from the Greek νεκρω, to destroy, and is used to denote that affection of the bones, by which the osseous tissue is deprived of its vital principle. Necrosis may, therefore, be justly compared to mortification of the soft parts, being like a gangrenous eschar, a foreign body which nature endeavours to separate from the living parts.

Seat.—The parts of the osseous system which are most frequently affected with this disease are the clavicle, the inferior maxilla, and the bones of the extremities, though no bone in the body is perhaps entirely exempt from it.

Division.—Necrosis may be divided into simple and compound; it is simple when confined to one bone; and compound when it attacks several bones at the same time, or several different parts of the same bone. It may also be divided into partial and complete; it is partial when it in-

(*a*) Dr. Cumin's Classification of the Diseases of the Bones, Edin. Med. & Surg. Journal, vol. xxiii. p. 1.

vades merely a part of a bone; complete, when it affects the whole bone.

Remark.—According to the investigations of Mr. Bell, there are three species of necrosis or mortification of the osseous tissue, viz. 1. Superficial necrosis; 2. Internal necrosis; 3. Progressive necrosis. These distinctions, however, are of little importance in practice, and almost equally unimportant in a pathological point of view.(*a*)

Differences according to age.—The disease may occur at any period of age, but it is seldom met with except in children and young persons.

Causes.—The causes of necrocis are either local or constitutional, and are not essentially different from those which give rise to ulcers of the soft parts. The local causes are wounds, blows, contusions, exposure to cold, fractures, comminutions, and acrid or chemical substances; the internal or constitutional causes, on the contrary, are generally referrible to a scrofulous, venereal, or scorbutic taint of the system, to the long-continued use of mercury, or to the effects of protracted and debilitating febrile diseases.

Symptoms.—In the commencement of the disease, the parts are generally affected with more or less deep-seated pain, which gradually extends in different directions of the bone, and is either dull and inconsiderable, or extremely violent and almost insupportable. This symptom is either attended or soon followed by a diffused swelling, extending over a part, or even over the whole morbid bone, and continuing to increase until the matter which it contains is discharged by a spontaneous or artificial outlet. The swelling is usually slow in its progress, but sometimes it is extremely rapid, and soon comes to a crisis. The skin generally retains its natural colour for a considerable time; but at length it becomes inflamed, and exhibits an œdematous, livid, or reddish appearance. The matter which is emitted from the ulcerated openings is either whitish and inodorous,

(*a*) Bell on the Diseases of the Bones, p. 47.

or of a sanious, acrid, and fœtid nature; the discharge is at first considerable, but as the disorder advances, it gradually diminishes, and the fistulous orifices through which it escapes assume a callous aspect, and throw out a great number of fungous granulations. These granulations are sometimes highly painful, and on being slightly touched they bleed; they are generally irregular, and of a yellowish appearance; but sometimes they are of an intensely red colour.

Additionally to the symptoms already enumerated as characterizing necrosis, there is sometimes a discharge of splinters of dark-coloured bone, or some of the dead fragments protrude through the ulcer, or are visible on separating its edges. When these symptoms are present, there can be no doubt of the nature of the disease; but in cases of an opposite character, the diagnosis is sometimes extremely difficult. In this circumstance, the surgeon should make a careful examination with the index-finger of his right hand; or if this be impracticable, either on account of the tortuous course of the sinuses, or on account of the smallness of the ulcerated orifices, he should employ a common probe, with which he should carefully ascertain the state of the diseased bone.

Prognosis.—The prognosis, according to the researches of Mr. Wiedemann, who may be justly regarded as the best writer upon the disease before us, is generally favourable when the disorder is owing to external or local causes; when it is confined to the outer part of a bone; when it is simple and of moderate extent; and when the patient is strong and endowed with a good constitution. On the other hand, the cure is difficult, and the prognosis doubtful, when the disease is extensive and complicated with other affections; when it attacks bones which are of high importance on account of their functions, or situation; when it is situated in the interior of the bone, and affects several parts of it; when it arises from an internal or constitutional cause; when the

patient is enfeebled by age or disease; and more especially when the sinuses extend into the adjacent joints.

The time requisite for the reproduction of a necrosed bone will depend, in great measure, upon the situation and extent of the disease, the age, health, and constitution of the patient, and various other circumstances.

That a part, or the whole, of a necrosed bone may be regenerated, is a fact so well established that it would be needless to adduce any testimony in its support; it is only necessary to remark, that the circumstance has been noticed, more or less, from the time of Albucassis to the present period, and by men of the most distinguished rank in their profession, and of the most undoubted veracity.

Treatment.—In the treatment of this disease, the first and most important object of the surgeon should be to aid nature in her endeavours to expel the dead portion of bone, and thus enable her to effect a complete and permanent cure.

When the disease is confined to the external part of a bone, and is simple and of moderate extent, a cure may sometimes be effected by putting the patient upon a proper regimen, applying blisters or issues in the neighbourhood of the affected part, and dressing the wound with common basilicon, or any other simple digestive ointment. In most instances, however, this mode of treatment will be ineffectual, so that more active measures will be required.

In all cases of necrosis, the practitioner should endeavour to destroy the cause of the disease; combat the general and local inflammatory symptoms; give vent to the matter contained in the affected part, by opening the different abscesses, and enlarging the fistulous orifices; and promote the discharge of the loose bony fragments by proper incisions, or extract those which nature is unable to separate and expel.

When the sequestrum, or dead portion of bone is moveable, and completely detached from the rest of the bone, the surgeon should carefully ascertain its size and form, and by comparing its dimensions with the ulcerated openings in the

soft parts, judge of the possibility of its spontaneous removal, or of the necessity of its extraction by a surgical operation.

Before resorting to the operation for removing the mortified bone, great care should be taken to ascertain that the sequestrum be perfectly loose, and that the new bone shall have acquired sufficient solidity to enable the limb to which it belongs to perform its ordinary functions.

OPERATION FOR REMOVING SEQUESTRA.

Necessary instruments.—A common and straight bistoury, a small saw, the crown of a trephine, a chisel, a mallet, and a pair of dressing and dissecting forceps. In some instances considerable assistance may also be derived from the perpendicular wheel-like saw of Mr. Machell, of London, from Liston's bone-nippers, or from the saw constructed by Professor Graefé, of Berlin.

Operation.—Previously to commencing the operation, the patient should be placed upon a bed or an operating table, and his limb should be firmly held by two assistants. The parts being now carefully examined, and the dimensions of the sequestrum determined, the surgeon should take the convex bistoury, and make two semi-elliptical incisions, which should circumscribe the fistulous opening, and be sufficiently large to admit of the extraction of the dead portion of bone. The flaps are then to be dissected up, and the orifice in the bone is to be enlarged with the crown of a trephine, or one of the saws just referred to. In this step of the operation, care should be taken that the instrument shall embrace a small part of the fistulous aperture, in order to cut away the unhealthy part of the new bone. As soon as a sufficient number of perforations has been made to enable the sequestrum to be easily removed, the interspaces between the foramina should be cut away with a chisel and mallet, and the dead portion of bone should be extracted by means of a pair of dressing forceps.

In perforating the bone, great care should always be taken not to make more apertures than are absolutely necessary; for, if this precaution be neglected, the new bone will not only be rendered weak, but extremely liable to break. If there be some hemorrhage in dissecting up the flaps of the incision, as is sometimes the case, the wound should be properly dressed, and the operation deferred until another time.

Dressing.—When the operation is finished, the cavity in the bone should be filled with dry lint, and the parts should be covered with an emollient poultice, wetted with a small quantity of laudanum. As soon as the inflammation which usually follows the operation has subsided, the wound should be dressed with pledgets of lint, spread with fresh cerate, and this mode of treatment should be continued until the parts have become perfectly healed.

When necrosis is complicated with other diseases, or communicates with the cavity of a large joint, and the patient's constitution is so much deteriorated as to preclude the possibility of its holding out during the time which would be required for the separation of the sequestrum, no time should be lost in removing the limb by amputation.

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SECTION III.

OF OSTEO-SARCOMA.

Synonyma: osteo-sarcosis, osteo-steatoma, osteo-malacia, cancer of the bones, osseous carnification, &c.

Definition.—Osteo-sarcoma is an alteration of the osseous tissue, in which the substance of the bones is converted into a mass, more or less analogous to that of cancer of the soft parts.

Remark.—Dr. Cumin, in his ingenious classification of the diseases of the bones, proposes that the term osteo-sarcoma should be limited to "a degeneration and morbid growth of the lining membrane of the longi-

tudinal canals or cancelli of the bones, accompanied, in all cases, by absorption of the solid parts of the osseous tissue." According to this definition, osteo-sarcoma is a disease peculiar to the long bones, which, however, as will be presently seen, is by no means the case.

Seat.—The disease may occur in any part of the osseous system; but the inferior maxilla and the long bones of the extremities appear to be most frequently affected.

Differences according to age.—The periods of life most liable to this affection are childhood and youth: it seldom occurs in old age.

Causes.—The origin of osteo-sarcoma is involved in much obscurity; but in most cases it may be referred to a hereditary predisposition, or to external violence.

Symptoms.—Osteo-sarcoma presents many of the local and general symptoms of cancer of the other parts of the body. It generally comes on with deep-seated, lancinating pain, which continues a considerable time before there is any evident tumour or swelling. Sometimes, however, the tumour is perceptible from the first, and remains indolent until it has acquired considerable bulk, and taken on inflammation. The pain then becomes extremely acute, and often rapidly impairs the health of the patient; the countenance becomes pale and sallow; the bowels are alternately constipated and relaxed; the strength gradually wastes; respiration becomes difficult; hectic symptoms supervene; and at length the patient falls a victim to the disease.

The form of the tumour is either smooth and circumscribed, or unequal, and, as it were, tuberculated. In most cases the general swelling is studded with inequalities or projections, the apices of which, especially in the advanced stage of the disease, are extremely apt to ulcerate and give rise to the discharge of small quantities of thin, fœtid matter. When examined by the fingers, the tumour feels firm and incompressible, or if there be any fluctuation it is extremely indistinct, and is only evinced at particular spots. In many cases the swelling increases with great rapidity, and

commits extensive ravages amongst the surrounding organs. As it augments in size, the skin gradually assumes a more or less livid or vascular appearance, and the muscles are attenuated and displaced. The pain also increases, and the sufferings of the patient are carried to the highest pitch of intensity.

Morbid alterations.—According to the researches of Professor Gibson, to whom we are indebted for an excellent paper on osteo-sarcoma, the bone is either uniform or regular on its surface, or disposed in lobulated masses; and when it is cut or crushed it exhibits a vast number of irregular cells, containing either a semi-transparent, gelatinous fluid, or a soft, lardy, homogeneous, or medullary substance. These cells or cavities are formed by innumerable spiculæ or bony plates, which are disposed in a variety of forms, and are lined by a very firm, delicate membrane. The lobulated masses "are sometimes extremely regular, of a rounded form, and bear a striking resemblance to a cluster of grapes. At other times several large masses are joined together, and present the appearance of an artichoke, or protuberant potato." The immediate investment of the tumour is formed by the periosteum, which firmly adheres to it, and exhibits a dense, pearly appearance.(*a*)

Prognosis.—Osteo-sarcoma is a highly malignant disease; and although temporary relief may sometimes be afforded by timely amputation, yet, as the complaint almost invariably recurs, the patient generally dies from phthisis pulmonalis, or from the immediate effects of the disease.

Treatment.—The treatment consists in administering the blue pill, or small doses of the muriate of mercury, conjoined with the compound decoction of sarsaparilla, and in applying leeches to the part. Great benefit may also be derived from the application of blisters, especially if the blistered surface be kept open with savin ointment, and from

(*a*) Philadelphia Journal of the Medical Sciences, vol. iii. p. 88.

keeping the parts constantly wet with a solution of the acetate of lead, or a mixture of laudanum and water. The limb should be kept at rest in an elevated position, and be enveloped with a moderately tight bandage. The patient should be put upon low diet, and if there be much pain it must be allayed by the exhibition of anodyne medicines.

When these remedies fail, as is generally the case, it will be absolutely necessary, in order to save the life of the patient, to extirpate the tumour or amputate the limb upon which it is situated.

After the operation has been performed, the disease should be prevented from falling upon the internal organs, by continuing the constitutional treatment, and establishing an issue near the part from which the tumour has been removed.

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SECTION IV.

OF SPINA-VENTOSA.

Synonyma: Spina ventositas; ventum spinæ; flatum spineum; Sideratio ossis; arthrocace; teredo; fungus articuti; gangræna ossis; pœderthrocace.

Definition.—Spina-ventosa is a disease of the osseous tissue, attended with interstitial generation, and an expansion of the attenuated walls of the bone at the seat of the disorder. (*a*)

Remark.—Spina-ventosa was known to many of the earlier pathologists, and was not unfrequently confounded with caries, necrosis, osteosarcoma, and other diseases. The term by which the disease is here designated, was first used by the Arabians, and was applied to a collection of matter originating in the cancellated structure of the bones, and working its way gradually outwards through the skin. The original signification of the term, however, soon fell into disuse, and we accordingly find that spina-ventosa has been applied to a considerable number of diseases which have not the least resemblance to the disorder under consideration.

Seat.—The disease may attack any part of the osseous system, but its most general seat is in the shafts of the long bones, especially in those which enter into the composition of the hand and foot.

Differences according to age.—Spina-ventosa has been observed at all periods of life—in the infant, the adult, and aged person.

Causes.—The causes of the origin of this disorder are still involved in considerable obscurity, and have not yet been precisely ascertained. In some cases it is evidently the result of external violence, while in others it may justly be attributed to a scrofulous taint of the system. (*b*)

(*a*) B. Bell's Treatise on Diseases of the Bones, p. 130.

(*b*) Boyer's Surgery, vol. ii. p. 170.

Symptoms.—The formation of this disease is generally preceded by a very sharp, deep-seated, pricking pain, which continues some time before there is any visible enlargement at the affected part. Sometimes, however, the tumour is formed with little or no pain, there being merely a dull, uneasy sensation, and this appears to be the case more particularly when the disease is connected with a scrofulous state of the system. The parietes of the diseased bone swell out or expand; the soft parts are distended and attenuated; the skin assumes a white pallid aspect; and the superficial veins become engorged, and form a blue net-work on the surface of the swelling.

In process of time the tumour becomes more circumscribed, and is confined either to the middle of the shaft, or to one of the extremities of the bone; the pain becomes more and more severe, darting and burning; the swelling increases in bulk; and if the disorder be not soon arrested, the skin ulcerates, and through the openings thus formed, is discharged an unhealthy-looking ichorous pus.(*a*)

The ulcerations on the surface of the swelling usually degenerate into irritable sinuses, which closely resemble those which are observed in the advanced stage of white-swelling, or scrofulous inflammation of the bones. On introducing a probe into one of these sinuses, it will be found that it communicates with an opening in the wall of the bone, and that the instrument may be pushed forwards, so as to traverse the diameter of the tumour.(*b*)

Prognosis.—Spina-ventosa is generally more obstinate in old than in young persons, and, unless it is situated in the bones of the hand or foot, is seldom regarded by authors as susceptible of being cured, either spontaneously, or by the interference of the healing art.(*c*)

(*a*) Bell on the Diseases of the Bones, p. 127.

(*b*) Bell. op. cit. p. 127–8.

(*c*) Tavernier's Operative Surgery, by Dr. Gross, p. 102.

Morbid alterations.—On inspecting a bone affected with this disease, it is found to consist of a mere osseous shell, remarkably attenuated, and perforated with numerous holes. From its internal surface, which is lined by a very thin delicate membrane, small spiculæ and plates of bone sometimes project. The periosteum is more or less thickened, and parts of the parietes of the expanded bone are frequently absorbed. The contents of the tumour consist either of a thin steatomatous matter, or of a sero-purulent fluid, combined with a gelatinous or cheesy substance.(*a*)

Treatment.—With regard to the treatment of this dangerous and often fatal disease, all that I have to offer may be said in a few words. When it is dependent upon scrofula, alterative medicines, such as blue pill, or minute doses of corrosive sublimate, either alone or in conjunction with the compound decoction of sarsaparilla, are indicated, and may sometimes be useful; but when the disease arises from external injury, as a blow or fall, nothing can be done but to keep the part perfectly at rest in an elevated position, and to make use of sedative applications, as fomentations with a decoction of the leaves of the hyoscyamus, or the heads of the white poppy, or a solution of sugar of lead and opium. If the pain be great and the constitutional excitement considerable, low diet should be enjoined; blood should be drawn from the arm, as well as from the immediate seat of the disease; and the bowels should be opened by saline or mercurial cathartics.

When the disease is seated in the smaller bones, as the phalanges of the toes and fingers, a cure may sometimes be effected by moderate and long continued pressure directly over the tumour; or by making an opening into the cavity of the bone, and by means of stimulating injections, exciting

(*a*) Gibson's Institutes of Surgery, vol. ii. p. 22.—B. Bell's Treatise on the Bones, p. 128.

such a degree of irritation as to cause it to fill up with healthy granulations.(*a*)

Some surgeons advise cutting down upon the bone, and arresting the progress of the disease by the application of the actual cautery; but this method is now generally abandoned, from the fact that the nature of the disease is seldom understood before it has involved the whole circumference of the bone.(*b*)

When the disease is situated in the cylindrical bones, and has produced considerable disorganization, the affected portion of bone should be cut out as speedily as possible, or the limb should be removed by amputation; care being taken, before resorting to this measure, always to ascertain that there is no organic affection in any of the viscera, or an engorgement of the adjacent lymphatic glands; for if this be the case the operation will seldom be successful.

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SECTION V.

OF OSTEO-HYDATIDICAL TUMOURS.

Definition.—The term *osteo-hydatidical* is of Greek derivation, and is applied to those bony tumours, the contents of which essentially consist of hydatids.

(*a*) Gibson, op. cit. vol. ii. p. 23.

(*b*) Tavernier's Operative Surgery, by Dr. Gross, p. 103.

The attention of the profession seems to have been first called to this disease by Mr. Keate, an eminent surgeon of London, about the year 1819; since which it has been noticed by several other writers, particularly by Professor Cruveithier, of Paris, and Mr. Benjamin Bell, of Edinburgh. As the disease is extremely rare, and as there are but three or four well-authenticated cases of it on record, my account of it must necessarily be brief and imperfect.

Seat, causes, and symptoms.—The seat of this disease does not appear to be confined to any particular class of bones, though the long ones are perhaps the most subject to it. Its causes have not yet been satisfactorily investigated; nor are its symptoms such as to enable us, in the present state of our information, to distinguish it from exostosis and other affections of the bones. In the case related by Mr. Keate, the hydatidical tumour was situated in the frontal bone; it resembled an exostosis, and on being cut into, the hydatids were found to be surrounded by a thin, limpid fluid.(*a*) The hydatids are ordinarily of a globular form; they vary greatly in number and size, and are usually found to belong to the *acephalocystic* species.

In the case mentioned by M. Cruveithier, the disease was seated on the anterior part of the tibia, presented the appearance of an indolent steatomatous tumour, with an unequal osseous border, and on being laid open, it gave vent to a thick, inodorous fluid, resembling the dregs of wine.

Prognosis.—The prognosis is generally unfavourable; for the disease is ordinarily extremely obstinate; in the case published by Mr. Keate it was found almost impossible to effect a cure, owing to the great difficulty of destroying the hydatids, they being constantly regenerated.

Treatment.—Whenever the true nature of these tumours is suspected, they should be laid open as speedily as possible, and as much of the membranous parietes of the cavity con-

(*a*) Keate's Obs. in the London Medico-Chir. Trans. vol. x. p. 281.

taining the hydatids, should be removed as can be done with safety to the patient. The sides of the cavity should be seared with the actual cautery, or burnt with some of the more powerful escharotics.

If these measures fail, and the disease involve the whole circumference of the bone, nothing less than amputation will be likely to answer. This was successfully resorted to in a case which came under the care of Mr. Lucas, in one of the London Hospitals.

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SECTION VI.

OF RACHITIS.

Synonyma: Cyrtosis rachia; cyrtonosus; softening of the bones; the English disease; the rickets.

Definition.—The word rachitis was first given to this disease by Glisson, and is said to be derived from ραχις, the spine. It was originally employed to designate a diseased or imperfect state of the spinal marrow; but at present it is generally used to imply a preternatural softing of the osseous tissue, accompanied with an unnatural development of the head and abdomen, crooked spine, attenuated limbs, and more or less debility.

History.—Although there is every reason to believe that this disease must have existed in the earlier ages of the world, it is a singular circumstance that it should not have attract-

ed the attention of surgeons until within a very recent period. The first account which we have of rachitis was drawn up by Whister, an English physician, in 1645, and was soon after followed by the accurate and masterly treatise of Glisson. From these investigations it appears that the disease first took its rise in the western parts of England, about the year 1620, from which it gradually spread over the rest of Europe.

Frequency of the disease and differences according to age.—Rachitis was formerly a very common disease in Europe, and is said to have prevailed to a considerable extent in England during the seventeenth century. It is now, however, comparatively rare, and seldom makes its appearance in the United States. It is most commonly met with in children between the age of six months and two years; though Morand and Wilson state that they have often known it to occur in the more advanced periods of life.(*a*)

Proximate cause.—The immediate or proximate cause of rickets, has given rise to much theoretical speculation. By some it has been attributed to a depraved or deteriorated state of the blood; by others, as Dr. Cullen, to debility of the digestive organs; and by others again, to a deficiency of phosphate of lime, upon which, as is well known, depends the solidity of the osseous tissue. The theory of constitutional diseases, as has been justly remarked by Dr. Gregory,(*b*) is necessarily involved in obscurity, and little can be gained by the display of pathological learning which has been made in the case of rachitis.

Remote cause.—Much labour has been spent by modern writers in endeavouring to ascertain the remote or exciting cause of this disease; but to so little purpose that the knowledge of surgeons in regard to it, is even at present hardly more accurate than that of the world in general. From the

(*a*) Mém. de l'Academie des Sciences, 1753.—Wilson on the Skeleton, p. 162.

(*b*) Practice of Physic, vol. ii. p. 482.

circumstance of its frequently appearing among the children of the same family, it has by many been considered as hereditary. All the older writers agreed in this belief, and the opinion received the sanction of no less a name than that of the immortal Cullen. The disease has also been supposed, and apparently with as little authority, to be connected with syphilis, scrofula, scurvy, and difficult dentition.

With regard to its connexion with scrofula, it may be observed that the disease generally occurs at that period of life at which the marks of a scrofulous diathesis are scarcely manifest.(*a*)

Symptoms.—The symptoms are derangement of the digestive organs; softness and flaccidity of the muscles; swelling of the abdomen; emaciation of the limbs; dryness and discoloration of the skin; wan, sallow countenance; unhealthy appearance of the stools; turbid and lateritious urine. Dentition goes on slowly; the teeth have a black, fuliginous aspect, sometimes becoming loose and carious. The head becomes large, and the forehead prominent. The fontanelles and sutures are more open than in the healthy state; and the whole process of ossification is peculiarly slow and imperfect. In proportion as the disease advances, the bones are rendered soft, and being unable to sustain the weight of the body or to resist the action of the muscles, are strangely and frightfully distorted. The clavicles become more bent and prominent; the spine is curved in various directions, and rendered shorter; the ribs are depressed or flattened at their sides; the bones of the pelvis fall inwards, and the os pubis generally approaches the sacrum; the humerus is distorted outwards; the carpal extremities of the radius and ulna are twisted in the same direction; the thighs are curved forwards or outwards; the knees fall inwards, and the feet are thrown outwards. The epiphyses of the long bones becomes soft, spongy, and enlarged; and if the child has begun to walk,

(*a*) Gibson's Institutes of Surgery, vol. ii. p. 36.

he daily becomes more feeble on his legs; he waddles, and speedily returns to his nurse's arms.

Persons affected with this disease, are usually of a bad, weak constitution, and although their appetite is generally good, their food is but imperfectly digested. It is often remarked, however, that the development of the mental faculties does by no means correspond with this stagnation of the assimilative functions. In many cases the child learns to talk with surprising rapidity, and enjoys an acuteness of intellect much beyond his age. This phenomenon is not, however, of invariable occurrence; for in that highest grade of rachitis, which occurs along the Alps and Pyrennees, and to which the term *cretenism* has been applied, the mind becomes completely imbecile and fatuous.(*a*)

Prognosis.—The prognosis in this disease is almost always unfavourable, there being no remedy within our knowledge which is capable of curing it; and, even in the most favourable cases, it is impossible to prevent deformity. The danger to life is in proportion to the number of bones affected, the more or less rapid progress of the complaint, and the age of the patient. Young children are more liable to die of it than those who are more advanced in years, and those who are born of scrofulous parents, than those who come into the world under happier auspices.

Sometimes the progress of the disease is extremely slow, and the system is allowed sufficient time to arrest its ravages. The same effect is also occasionally produced by the intervention of some of the eruptive diseases, as measles, small pox, scarlet fever, and some of the other infantile complaints.(*b*)

Morbid alterations.—On examining the bodies of those who die of this disease, it is usually found that the muscles are pale and emaciated; the adipose substance is almost entirely

(*a*) Gregory's Practice of Physic, vol. ii. p. 481.—Cooper's Surgical Dictionary, p. 990.

(*b*) Boyer's Lectures on the Diseases of the Bones, p. 193.

removed; the brain is larger and softer than natural, and contains an unusual quantity of fluid; the liver and spleen are flaccid and enlarged; the intestines are pale or whitish; and the lymphatic glands, especially those of the bronchia and the mesentery, are more or less enlarged, and in a state of suppuration.(*a*)

The bones of rickety persons are usually soft, spongy, and compressible; of a red or brown colour, and considerably lighter than in the healthy state. They are pervaded by a great number of enlarged blood-vessels, and are moistened by a kind of sanies. The walls of the long bones of the extremities are very thin, while those of the bones of the skull are more or less enlarged, and of a spongy, reticulated appearance. The medullary cavity, instead of being filled with adipose matter, contains only a reddish serum, or a brownish gelatinous substance, totally devoid of the fat and oily nature of the healthy secretions. The periosteum is somewhat thickened; and the bones, being remarkably elastic, are extremely liable to break if bent beyond a certain point.(*b*)

Occasionally there is a partial ossification of the muscles, arteries, lungs, and testicles. A case is recorded in which the whole muscular system exhibited the ossific diathesis in an extensive degree; it came under the observation of Dr. Henry, an English practitioner. The ossification commenced in the arm, and extended up the shoulder, and then attacked the wrist, so that the patient was at length completely deprived of the use of his superior extremities.(*c*)

Treatment.—Although it is said that "every evil has its remedy," it is melancholy to reflect how little this disease is under the control of medicine; and before I enter

(*a*) Boyer's Lectures on the Diseases of the Bones, p. 192.

(*b*) Boyer's Surgery, vol. ii. p. 184.—Bichat, Anatomie Generale, T. 3.—Stanley's Observations in the Medico-Chirurgical Transactions, vol. vii. p. 404.

(*c*) Gregory's Practice of Physic, vol. ii. p. 484.

upon the principles which are to guide the practitioner in its treatment, I must again repeat that there is no plan of treatment for its effectual cure, which human ingenuity has yet devised, upon which we can place the least reliance.

The first principle which it is of importance to inculcate is, that in rachitis active measures can not be pursued; and that this must be compensated by a strict attention to regimen, cleanliness, and the administration of tonic and purgative medicines. The diet should be mild, nutritious, and unirritating, and should consist either of breast-milk, or of animal food. The body should be frequently washed with salt water, or rubbed with a stiff salt towel; and if the system be not too much reduced, cold or tepid bathing will be found to be highly strengthening and invigorating. Cool, fresh air, and exercise suited to the age and strength of the patient, are to be rigorously enforced. Sordes and acidity of the stomach and bowels should be prevented by an occasional dose of rhubarb and calomel, or of equal parts of rhubarb and of hydrargyrus cum cretâ.(*a*)

Tonic medicines, especially chalybeates, given in small quantities, and not too long continued, are also serviceable. Cascarilla bark, sulphate of quinine, the mineral acids, and carbonate of iron, have long been favourite medicines, and have been much lauded both by the empiric and the enlightened practitioner. Alterative doses of mercury may also be given with advantage, especially when the patient labours under a scrofulous diathesis. Pain should be allayed by opiates; and, if possible, the child should be kept in a healthy situation, and in a salubrious air.

Phosphates of lime and of soda were formerly much employed in cases of this disease, and were by many considered as specifics; but, like all other remedies that have been dignified with this appellation, they are seldom found to

(*a*) Gregory, op. cit. vol. ii. p. 483.—Gibson's Institutes of Surgery, vol. ii. p. 37.

succeed in the hands of the regular practitioner. They may be administered in equal parts, in the dose of a scruple, and be repeated twice or three times during the twenty-four hours.

The beds on which rickety persons lie should be rather firm and unyielding; and, if the patient be young, he should be placed upon his back, so that the weight of the body may have as little influence as possible upon the bones. The clothing should be wide, and should be composed of light and warm materials.(*a*)

In the early stages of the complaint, bandages and stays may not only be regarded as altogether ineffectual, but sometimes even as pernicious; but when the patient has attained a sufficient age, and acquired the requisite strength, the apparatus recommended under the head of caries of the spine may sometimes be advantageously employed, provided proper care be taken not to exert undue pressure upon the hips, chest, or limbs.(*b*)

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(*a*) Boyer on the Bones, p. 194.

(*b*) Gibson's Surgery, vol. ii. p. 37.

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SECTION VII.

OF HYDRO-RACHITIS.

Synonyma: Spina bifida; bifid or cloven spine; hydro-spinalis; hernia of the medulla spinalis; hydrops spinæ; dropsy of the spine.

Definition.—Hydro-rachitis is a congenital deformity, consisting in a mal-conformation or imperfect state of one or more of the vertebræ, and in a protrusion of the membranous lining of the spinal marrow. (*a*)

Seat.—The disorder is usually situated on the lumbar vertebræ, occasionally on the dorsal or cervical ones, and sometimes, though rarely, on the os sacrum.

Causes.—The causes of spina bifida, like those of many other diseases, are still locked up in the bosom of the Creator; for every attempt that has hitherto been made to explain them, is vague, imperfect, and conjectural.

(*a*) This protrusion, which is merely a consequence of the imperfect ossification of the posterior part of the vertebræ, must not be confounded with the original disease.

Symptoms.—Dropsy of the spine, as has been already observed, is a congenital disease, and consequently a complaint of fetal life; occasionally, however, the protrusion of the dura-mater does not take place till some weeks, or even months after birth.(*a*) When the tumour first shows itself, it is sometimes not larger than a pea; but as the disorder progresses it gradually increases, varying in proportion to the deficiency of the vertebræ. In most cases, the swelling is about the size of an orange, but occasionally it exceeds in magnitude the size of the fist, or even that of the patient's head.(*b*) The skin is generally extremely smooth, delicate and thin; sometimes, however, it retains its natural thickness, or it becomes red, rugose and horny. The tumour is either soft, flabby, and fluctuating, or it is full, hard, and shining; when pressed upon, it gradually diminishes, or even quite disappears; but as soon as the pressure is removed, it recovers its former size. The base of the swelling is either round, oval, circular or pyriform; but occasionally it is connected to the spinal cord by means of a small pedicle. The tumour usually consists of one, but sometimes of two distinct cysts,(*c*) which are formed by the continuation of the membranous sheath investing the spinal canal, and are filled with a serous coagulable fluid. In most cases the fluid is limpid and colourless; but sometimes it is turbid and flocculent, or tinged with a yellowish or bloody hue.

The generality of children affected with spina bifida, are of a scrofulous temperament, deficient in strength, and subject to frequent diarrhœa. In many instances the disease is connected with hydrocephalus, and is followed by extreme debility, emaciation, ischuria, involuntary discharge of feces, and complete paralysis of the lower extremities. Sometimes, however, the patients are perfectly healthy, and

(*a*) Good's Study of Medicine, vol. v. p. 273.

(*b*) Jukes on Spina Bifida, in the Medical and Physical Journal, February, 1822.—Cooper's First Lines, vol. ii. p. 368.

(*c*) Breverton in the Edinburgh Medical and Surgical Journal, vol. xvii.

experience no other inconvenience than that arising from the local disorder.

Hydro-rachitis can generally be easily distinguished from other swellings of the spine, by the cleft in the posterior part of the vertebræ, by the transparency, softness, and fluctuation of the tumour, and by its receding within the spinal canal, on being steadily pressed upon.

Morbid alterations.—The portion of the spinal marrow, surrounded by the tumour, is generally softened and converted into a thin mucous substance; the roots of the nerves are displaced or drawn out of the spinal canal by the coats of the dropsical cyst; the preternatural aperture is ordinarily confined to the posterior part of the affected bone, but sometimes it extends through its whole substance, so that the finger may be readily passed into the abdomen, and if the patient has been affected with hydrocephalus, an opening or cavity may often be traced from the tumour along the course of the spinal marrow to the ventricles of the brain.(*a*)

Prognosis.—Of all the diseases with which infants are liable to be afflicted, there are few, if any, which are more afflicting and lamentable, or fatal in their consequences, than spina bifida. It is true, cases of recovery have sometimes been met with, but if we except those recorded by Morgagni,(*b*) Hoffmann,(*c*) Fantoni,(*d*) Keilmann,(*e*) Hochstaetter,(*f*) Warner,(*g*) Sir Astley Cooper,(*h*) Hickman,(*i*) Pearson, Probart, Bozetti,(*j*) and a few other writers, it

(*a*) Bampfield on the Spine, p. 313–15–16.
(*b*) De Sed. et Caus. Morb. Epist. 12. Art. 9.
(*c*) Eph. Cur. Nat. Dec. 2. Art. 6. Obs. 208.
(*d*) In Pacchioni Animadversaria.
(*e*) Prodrom. Act. Havn. p. 136.
(*f*) Diss. de Spina Bifida, Altorf, 1703.
(*g*) Cases in Surgery, p. 136.
(*h*) Medico-Chir. Transactions, vol. ii. p. 326.
(*i*) Bampfield, op. cit. p. 324.
(*j*) London Medical Gazette, vol. i. 1827.

will be difficult to find, in all the records of surgery, an instance in which the disease got well of itself, or was benefited by any mode of treatment. Children afflicted with this complaint, seldom live longer than a year after birth, and sometimes not more than a few days or months. If the tumour be ruptured during parturition, the infant is always still-born;(*a*) or if it be opened after birth, either by accident or design, death usually follows in a few hours.

It may be stated also, as a general observation, that there is no hope of relief when the disease is connected with hydrocephalus, when there is paralysis of the lower limbs, or when the urine and feces are discharged without the efforts of the will.

Treatment.—The treatment of spina bifida may be explained in a few words. When the tumour is small or of moderate size, a cure may occasionally be effected by keeping up constant pressure with a common roller, strips of adhesive plaster, a truss, or a piece of plaster of Paris, hollowed out and lined with soft lint; or by evacuating the fluid repeatedly with a fine needle, as proposed by Mr. Abernethy, and practised with success by Sir Astley Cooper, Hickman, Pearson, and Probart. Mr. Benjamin Bell(*b*) and other surgeons have suggested tying the base of the tumour with a ligature, with a view of removing the swelling, and of preventing the propulsion of the cyst farther outwards; but the results that have been published in favour of this method of treatment are by no means sufficient to warrant us in recommending it to the profession. The same may be said of the operation of opening the tumour with a small trocar, the knife, or the potential cautery, and of the practice of keeping up a constant suppuration in the neighbourhood of the swelling by means of issues, as proposed by Richter.(*c*)

(*a*) Underwood on the Diseases of Children, p. 193.

(*b*) System of Surgery, vol. v.

(*c*) Anfansgrund der Wundarzneykunst, 2 B. p. 240.

After the tumour has been opened with a fine needle, and a part of the fluid discharged, the wound should be closed with a piece of sticking plaster, and, if possible, healed by union of the first intention. The operation should be repeated about every three or four days, care being taken at the same time to compress the tumour as much as the patient can bear, with a compress and roller. When this practice answers, the cavity of the tumour is gradually obliterated by adhesive inflammation, and the disease finally disappears.

When the tumour is very large, this mode of treatment, like every other that has hitherto been suggested, will generally be ineffectual; and in this circumstance all that the surgeon can expect to do is to avert the ulcerative inflammation, which is so liable to take place from over-distention, by protecting the parts from external injury, and bathing them occasionally with spirituous and slightly astringent lotions.

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SECTION VIII.

OF MOLLITIES OSSIUM.

Synonyma: Parostia flexilis; malacosteon; osteo-malacia; osteo-sarcosis; spina ventosa; softening of the osseous tissue; flexibility of the bones.

Definition.—Mollities ossium is a morbid softening of the bones, accompanied with a loss of the natural firmness of the osseous tissue. It was first noticed as a distinct disease in 1688, by Gabriel, though obscure traces of it may be found in the writings of Ghutzi, an Arabian physician, contemporary with Mahomet.

Seat.—The disease sometimes attacks particular bones, such as the vertebræ, for instance; but in most cases it appears to prevail universally. It is almost exclusively confined to adults, and seldom occurs in the male subject. It has occasionally been observed in the inferior animals, as the ox, the lion, and the dog.

Causes.—Mollities ossium is sometimes idiopathic; but in general it is dependent upon external injury, derangement of the digestive organs, or upon some poisonous or acrimonious principle lurking in the circulation, as that of lues venerea, or scrofula: occasionally it is a symptom of porphyra and diabetes.

The proximate cause of the disease consists either in too small a quantity of ossific matter to allow sufficient compactness to the bones; or in a deficiency of phosphoric acid, which is necessary to give it fixation, and in consequence of which it is often carried back into the fluids in a loose

state and thrown out as a recrement by the urine or saliva.(*a*)

Symptoms.—The symptoms of the disease are more or less pain in the loins and lower extremities, or even throughout the whole body; great restlessness and starting during sleep; violent flushes of heat; night-sweats; flexibility and distortion of the different parts of the body; œdema, and sometimes erysipelatous swellings of the limbs; lateritious or calcareous urine; diarrhœa; pale, sallow countenance; more or less fever; difficulty of breathing; spitting of blood; great emaciation; and a gradual diminution of stature, which, indeed, forms the most striking and characteristic mark of the disease.

The discharge of bony or calcareous matter by the kidneys is sometimes considerable, and yields a copious deposite, of a whitish or dark-coloured appearance: in some instances it is transferred to the salivary glands, giving the spittle a dark, discoloured aspect.

Morbid alterations.—On examination by dissection, it will commonly be found that the muscles are more or less soft and pale, and that the thoracic and abdominal viscera have undergone various degrees of alteration. The bones are completely flexible, and may be readily cut with the knife. They are always specifically lighter than in the healthy state, and are sometimes so completely decomposed as to present the appearance of a kind of dark-coloured parenchymatous substance. Occasionally, also, the animal and saline principles are so much diminished as to leave mere shells, containing large cavities, which freely communicate with each other, and are filled with a great quantity of dusky-red or liver-coloured flesh, grumous blood, or oily matter. The periosteum is either uninjured or thickened; the cartilages are sometimes attenuated, at other times sound.

Prognosis.—The prognosis varies according to the ex-

(*a*) Good's Study of Medicine, vol. v. p. 220.

tent of the disease, and a variety of other circumstances, as the age of the patient and the situation of the affected bone or bones. If the disorder is general, little hope can be entertained of effecting a cure; and the same may be said when it attacks the bones of the head or trunk. The patient seldom lives longer than two or three years, sometimes indeed not more than nine or twelve months after the commencement of the complaint.

Treatment.—The progress of mollities ossium can only be arrested by producing a change in the action of the secernent vessels; but as the means of doing this, with any tolerable degree of certainty, have not yet been discovered, all that can be done in the present state of our knowledge, is to endeavour to improve the general health and vigour of the system, by the use of tonics, such as preparations of bark and iron, the cold bath, mild aperients, and a plain, nutritious diet. Calomel has occasionally been employed by some, and carried to the extent of producing salivation, but without success. Phosphate of lime, as having a tendency to supply the deficiency of osseous matter, has also been tried, and apparently with no better benefit.

The patient should be kept perfectly quiet, in a recumbent posture, upon a hard mattress, or slightly inclined plane;(*a*) and if he suffer much pain, anodyne or saline frictions and small blisters will be serviceable. If the disease be seated in the bones of the extremities, and the patient's constitution appears to be sound, the propriety of resorting to amputation will be at once obvious.

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(*a*) Good's Study of Medicine, vol. v. p. 223.

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SECTION IX.

OF FRAGILITAS OSSIUM.

Synonyma: Parostia fragitis; fragile vitreum; fragility or brittleness of the bones.

Definition.—Fragilitas ossium is a morbid brittleness of the bones, in which the osseous texture has a great tendency to break or fall in pieces.

Seat, and differences according to age.—The disease is most frequently found as an attendant upon old age; and is seldom confined to any particular class of bones, though the long ones are, perhaps, most liable to it.

Causes.—The cause of fragility of the bones has been a source of much theoretical discussion. The best writers, however, agree in referring it to a change of nutrition, produced by a diminution of the number and volume of the vessels of the osseous tissue. By Dr. Good it is supposed to consist in a general inirritability of the system, and a tor-

pitude of the absorbent vessels, which, by removing only "the more delicate particles, and suffering the grosser, and especially the calcareous, to accumulate, overcharge the bones with this material." The disease is sometimes symptomatic of other affections, as cancer, small-pox, syphilis, scrofula, and scurvy.

Symptoms.—The symptoms of this disease vary according to the exciting cause, and can scarcely be described in a general manner. Ordinarily there is little or no pain, and the substance of the bones is so brittle as to break upon the slightest exertions. A violent fit of coughing, kneeling upon the floor, or walking across an uneven surface, are often sufficient to produce fracture. Under these circumstances the bones sometimes unite in a very short time; at other times, however, reunion does not take place, or only after a very long time.

Morbid alterations.—Bones affected with this disease are occasionally so completely saturated with oily matter, that it is almost impossible to divest them of it, or render them fit for preparations; but in most instances they are dry and brittle, and crumble or fall to pieces on the most trifling exertions. In the latter stages of scurvy they become often extremely fragile, and if they be boiled, the periosteum soon separates, and the osseous texture divides into numerous lamellæ, or is almost entirely dissolved.

Prognosis.—Fragilitas, like mollities ossium, may generally be looked upon as an incurable disease, especially when it occurs as a symptom of old age.

Treatment.—The treatment consists principally in the administration of anti-syphilitic, anti-scrofulous, or anti-scorbutic remedies; amongst which tonics of the warm and stimulating kind, and the free use of acids, whether mineral or vegetable, are entitled to the most important rank.

Of the vegetable acids, the citric or tartaric will generally be found preferable; of the mineral, the sulphuric or muriatic.

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SECTION X.

OF PERIOSTOSIS.

Definition.—Periostosis is a Greek term (περι οστεου), denoting a swelling or enlargement of the periosteum or lining membrane of the bones, attended with pain and inflammation.

Seat.—The disease is most frequently observed upon the os frontis, the sternum, and bones of the fore-arm and leg, particularly the tibia.

Causes.—Periostosis generally arises from external violence, or in consequence of a syphilitic taint of the system; occasionally it may also occur as a symptom of gout or rheumatism.

Symptoms.—The formation of the disease is usually pre-

ceded by a constant, deep-seated, gnawing pain, which is most severe at night, when the body becomes warm in bed. After it has continued for an indefinite period of time, it is succeeded by a small, hard, incompressible tumour, somewhat tender to the touch. It is circumscribed, immoveable, and insensibly confounded with the bone on which it rests. After the swelling has acquired a certain size, it sometimes becomes indolent, and thus remains for life; sometimes it gradually diminishes, or even quite disappears; at other times again, the skin which covers it ulcerates, and matter is discharged, either of a dull yellow colour, or of a grey anious appearance.

Periostosis is often confounded with exostosis, but may in general be easily distinguished from it by its being larger, softer, and more doughy to the touch.(*a*)

Morbid alterations.—The periosteum and adjacent cellular tissue are thickened, intimately blended together, and confounded with the substance of the tumour. Immediately around the swelling the cellular tissue is slightly infiltrated or injected, imparting to the finger a doughy or œdematous sensation. In the advanced stage of the complaint the substance of the tumour bears a strong resemblance to that of an engorged lymphatic gland, presenting a homogeneous, whitish or grayish appearance.

Prognosis.—Periostosis is often difficult to cure, especially when it is connected with syphilis. It is seldom that it diminishes or disappears, either spontaneously or by the best directed efforts of art; and when it suppurates, the danger is always considerable, inasmuch as the disease then resembles necrosis or mortification of the osseous tissue.

Treatment.—If the disease be dependent upon a syphilitic taint of the system, a mercurial or alterative course of treatment, besides proper local measures, will be of primary mportance; if, on the contrary, it be owing to external violence, local treatment will alone be necessary.

(*a*) Boyer's Surgery, vol. ii. p. 165.

In the commencement of the disease, or while the tumour is small but painful and inflamed, leeches and emollient or anodyne applications will be found highly useful, as well as the means which are usually employed for arresting the progress of phlegmonous inflammation of the soft parts. After the pain and sensibility of the part have subsided, the tumour should be frequently rubbed with mercurial ointment or the salt towel, or the absorbent powers may be invigorated by keeping the part constantly covered with some resolvent plaster, as the empl. ammoniaci cum hydrargyro, or the emplastrum saponaceum. Blisters have been recommended by some; but it is a matter of great doubt whether they are not more hurtful than beneficial, especially when they are applied directly over the tumour. In the early stage of the disease, they may sometimes be serviceable, as also issues and setons, if applied at some distance from the seat of the disorder.

If the disease has been neglected, or if, in spite of the most vigorous antiphlogistic measures, the skin and subcutaneous cellular tissue become soft, fluctuating, and painful to the touch, the matter should be speedily discharged by a free incision, made with a bistoury, and kept open until the mortified tissues, whether fibrous or bony, have sloughed off or exfoliated. The separation of the sloughs should be promoted and the sore improved by injections of warm water and soap, or a weak solution of lunar caustic.

It need scarcely be remarked, that so long as the tumour remains indolent and stationary, and does not interfere with the exercise of some important organ, it should be left entirely to the care of nature; for it must be remembered, that too much officiousness is frequently as injurious as too little, especially in the case before us.

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drin's Histoire Anatomique des Inflammations, T. 1. p. 348–64.—Tavernier's Operative Surgery, by Dr. Gross, p. 86.

SECTION XI.

OF EXOSTOSIS.

Definition.—The term exostosis, strictly speaking, implies a tumour formed by an exuberant growth or inordinate deposition of ossific matter upon the surface of a bone; or, in other words, a tumour or bony excrescence whose structure is analogous to that of the natural parts of the osseous system.

Seat.—The disease is sometimes general, as in the cases referred to by Saucerotte, Abernethy, and Henry; but in most instances it is confined to particular bones, as those of the cranium, the inferior maxilla, the ribs, the sternum, and the long bones of the extremities, particularly the femur, tibia, and phalanges of the toes.

Division.—Exostosis may be divided into four varieties: the circumscribed, lamellated, spinous, and tuberculated. In the first variety, the disease appears in the form of a distinct, smooth, spherical tumour; in the second, in that of a rough, scabrous, lamellated surface; in the third, in the form of osseous spires or spinous processes; and in the fourth and last, in that of tuberculated knobs or irregular excrescences (*a*)

Causes.—The origin of the disease has generally been attributed to local violence, or to internal causes, such as a scrofulous or syphilitic diathesis. I am inclined, however, to believe that the complaint most commonly arises from a disordered or inflamed state of the vessels of the periosteum, more especially as it has been frequently detected in quad-

(*a*) Gibson on Bony Tumours, in Philadelphia Journal of the Med. et Phys. Sciences, vol. ii. p. 121.

rupeds, as the ox and the horse, and in which it can certainly not be owing to a venereal taint.

Symptoms.—When the disease arises from syphilis, as it no doubt sometimes does in the human subject, it is usually preceded by acute, deep-seated pain, which is most severe at night, and, if long-continued, it may gradually undermine the general health. If, on the contrary, it is caused by a scrofulous state of the system, or by external injury, the pain is either much duller, or it subsides soon after the occurrence of the disease, and does not return until the tumour has acquired considerable magnitude. Occasionally the disease is entirely unattended with pain, and its existence can not be ascertained till after death.

Some exostoses are extremely rapid in their progress, and soon acquire a very considerable size, while others again are quite small, and may continue so, without inconvenience, during life.

On examining the part, the tumour will generally be found to be firm and unyielding, and the soft parts, by which it is concealed, more or less tightened and attenuated.

Morbid alterations.—If an exostosis be carefully inspected, after it has been removed from its original situation, it will usually be found to consist of a bony cancellated substance, enclosed in a layer of cartilage, which separates it from the old bone, and adheres firmly to the internal surface of the periosteum. In other instances, however, there is not the least trace of the original separation, but the cancellated structure of the tumour communicates directly with that of the old bone, thus exhibiting a perfect resemblance to the natural deposition of osseous matter.

Prognosis.—So long as the tumour remains small and indolent, it may commonly be considered as of little importance; but when it increases rapidly, or is so situated as to interfere with the motions of a joint, or to encroach upon an important organ, it will generally be necessary to resort to

a surgical operation, especially as it is impossible, in most cases, to create an absorption of the tumour.

Treatment.—The treatment of exostosis must vary, in great measure, according to the causes by which it has been produced. When there is reason to infer that it is occasioned by a deranged state of the system, small doses of the oxymurias hydrargyri, either alone, or in union with sarsaparilla, will be particularly useful; when the complaint gives rise to much pain, opium, conjoined with diaphoretics, will be of signal benefit.

In most cases, however, topical treatment will be found the most important. In the early stage of the disease, the remedies most to be relied upon are leeches, blisters, and saturnine lotions, or fomentations of a decoction of poppy-heads. When the pain has abated, and the tumour presents the appearance of becoming indolent, saline, mercurial, or hydro-sulphureous frictions, or strong liniments, containing either a proportion of tincture cantharidum, or lin. ammoniæ, are often highly serviceable, as tending to correct the morbid action in the parts, as well as preventing further inflammation. Blisters will also be useful; they should be applied several times, or the discharge from the blistered surface should be kept open by equal parts of mercurial and savine ointment.

If the case has arisen from a scrofulous state of the system, the moderate and long-continued use of mercury, in conjunction with sea-bathing or general saline frictions, will be the most likely to afford relief. During the whole course of the treatment, the patient should be confined to a proper diet, and his bowels should be frequently opened by saline draughts, or a mixture composed of the following ingredients:

℞ Potassæ sup. tart.

F. Sulph. āā ℥ss.

P. Jalap. ℥ij.—M. and give a tea-spoonful or more every morning and evening.

If, notwithstanding the employment of these remedies, the disease still continues to progress, and is productive of much pain, presses upon some important organ, or is likely to impede the motions of a joint, the only chance of relief will be to remove the tumour, or, if this be impracticable, on account of the nature and extent of the exostosis, to amputate the limb.

Formerly, it was customary to remove exostoses with the actual or potential cautery; but from their being frequently found ineffectual or dangerous, they are now justly abandoned; except in those cases where the disease is located amongst important organs, or in a deep cavity where it is impossible to approach it with the knife.

Operation.—The operation is commenced by making a crucial or semi-elliptical incision through the integuments, and turning them back until the surface of the original bone is brought fairly into view. The exostosis may then be removed by means of the knife and a common metacarpal saw, by the trephine, gouge or chisel, or by the orbicular saw, invented by Professor Graefé of Berlin, or by the perpendicular wheel-like saw of Mr. Machell of London.

If the tumour has a very large base, and is insensibly confounded with the body of the bone, it should be divided into several portions, by perforating it at different points with a trephine or saw, and then detaching the pieces with a gouge and mallet. (*a*)

Treatment after the operation.—When the tumour is removed, the edges of the wound should be carefully approximated, and, if possible, healed by union of the first intention.

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SECTION XII.

OF OSTEO-SANGUINEOUS TUMOURS.

Synonyma: Bloody tumours in the substance of the osseous tissue; aneurism of the arteries of the bones, &c.

Definition.—Under the head of osteo-sanguineous tumours I mean to describe those morbid affections of the bones, which, in many of their phenomena, closely resemble aneurism from anastomosis of the soft parts. The term, perhaps, is not quite classically formed, as partaking of two distinct tongues; but as its import may be readily understood by the generality of practitioners, I have no hesitation in proposing it as the title of the disease under consideration.

History.—Aneurism of the arteries of the bones was

first pointed out in 1826, by M. Breschet, a celebrated French pathologist, in an interesting memoir inserted in the General Repertory of Anatomy and Clinical Surgery. The disease has since been noticed by other writers, particularly by Professor Lallemand of Montpelier, and Mr. Bell of Edinburgh; and there is good reason for believing that it is of more frequent occurrence than is at present generally supposed.

Differences according to age and sex.—The disease is most frequently seen in young and adult subjects; but no age, no sex, no rank, nor condition of life appears to be exempt from the possibility of being afflicted.

Seat.—Osteo-sanguineous tumours have heretofore been observed only in the long bones; and their most common situation, according to Breschet, to whom we are indebted for the most accurate and lucid account of this singular affection that has yet been published, is in the vicinity of the knee-joint, implicating the upper portions of the tibia and fibula, either separately or conjointly.

Causes.—The causes of this disease are still obscure: according to Scarpa it is sometimes the result of blows, falls, or other external violence; occasionally also it has been known as a sequela of gouty or rheumatic swellings of the knee-joint; but in most cases no rational cause can be assigned for it.

Symptoms.—The tumour is tense, swollen, and painful, the cutaneous veins are distended and varicose, and the whole limb being of a blue reddish colour, is exquisitely painful on pressure. In a short time a deep-seated pulsation, isochronous with that of the arteries, and somewhat similar to the motion which is observable in some of the erectile tumours of the face, may be felt in the affected part. This pulsation, which in the advanced stage of the disease is attended with a general "*mouvement d'expansion,*" can be easily interrupted by compressing the main artery of the limb, between the tumour and the heart.

The affected limb presents either an emaciated, or a puffy, œdematous appearance, and the motions of the joints are more or less painful, constrained, and difficult. On pressing upon some parts of the tumour, a feeling, similar to the crackling of parchment, or the breaking of an egg-shell, is communicated to the fingers; while pressure on other parts does not afford the slightest evidence of this singular phenomenon. The tumour varies in size in different cases, being sometimes small, sometimes large. In a case related by Mr. Bell, it measured more than nine inches in circumference, and more than six in length.

Morbid alterations.—The cellular texture of the diseased bone is either partially or wholly destroyed, and its medullary cavity is enlarged and filled with coagulated blood, disposed in concentric layers, as in old aneurismal tumours. These clots form one or more foci, each of which communicates with a branch from the second or third class of arteries. Sometimes the blood is partly fluid, and partly coagulated; but in the majority of cases it presents the appearance that has just been assigned to it.

The external table or lamina of the bone is considerably attenuated, in many parts destroyed, and in some so flexible and elastic that it may be bent like cartilage. Very often the bone is extremely brittle, and may be crushed like the shell of an egg. The periosteum and the external aponeurotic expansions are generally thickened, and of a firmer and denser structure than in the healthy state; sometimes they are converted into a fibro-cartilaginous tissue. The joints which are situated in the vicinity of the disease are always in a healthy condition, even when they are separated from it merely by a thin layer of cartilage.

When the limb in which the diseased bone is situated is injected with a preparation of glue and vermilion, the matter easily finds its way through the most minute of the distal arterial ramifications, thus showing in a clear and satisfactory manner, the communication existing between the

large vessels of the soft parts and the tumour of the bone. Most of the larger arteries and veins of the limb appear to be perfectly healthy; but this is not the case with the vessels which ramify through the substance of the bone; for these are usually increased in size, and open by numerous little orifices in the sac situated in the centre of the bone.

Prognosis.—If the disease be attended to in time, its progress may sometimes be arrested by the treatment which will presently be pointed out; if, on the contrary, it be permitted to proceed, nothing less than the amputation of the affected limb will be likely to succeed.

Treatment.—In the treatment of osteo-sanguineous tumours, it is an object of primary importance to strike at once at the root of the disease; and as this can only be done by tying the main artery of the limb, or, what I conceive to be better, the principal artery of the bone, the sooner the operation is performed the more favourable will be the chance of success. If the disease be allowed to progress, or the surgeon makes no attempt to arrest it till it has produced considerable disorganization, amputation offers the only hope of relief; for, as has been remarked by M. Breschet, no reliance whatever can be placed, even in the commencement of the disease, either upon compression, topical applications, or any other mode of treatment that has yet been suggested.

The credit of having first indicated the best method of treatment for this disease is due to Dupuytren, a man who is at once an honour to his country and an ornament to human nature.

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circumstance insolites. (*a*)—Benjamin Bell's Treatise on the Diseases of the Bones.—The American Journal of the Medical Sciences, vol. i. p. 199.

SECTION XIII.

OF INTERSTITIAL ABSORPTION OF THE CERVIX FEMORIS.

Interstitial absorption of the neck of the os femoris appears to be a disease of modern date, as no description of it is to be found in any of the older writers. It is impossible to suppose that an affection so strongly marked as this, could have escaped the attention of the ancients, had it then existed. We must presume, therefore, that it was not known in Europe until within a very few years. It was first noticed as a distinct disease by Mr. Benjamin Bell, in 1824, whose account of it is by far the most precise that has yet been published, and leaves me no other task than that of brief analysis.

Differences according to age.—The complaint usually occurs at an advanced period of life; but occasionally it makes its attack much earlier, a case being related by Dr. Knox, of Edinburgh, in which it occurred as early as the third year.

Causes.—Interstitial absorption of the neck of the os femoris may commonly be traced to the effects of cold, or to violence inflicted upon the trochanter major; but sometimes it appears to be an idiopathic affection, more especially when it occurs in old persons.

Symptoms.—The body is bent forwards, and the pelvis is more or less flexed upon the femur; the motions of abduction are constrained and difficult; a dull pain and sense of weariness are felt in the region of the hip-joint; the patient

(*a*) Both these memoirs may be found in the Répertoire Generale d'Anatomie et de Clinique Chirurgicale, T. 2. Paris, 1826.

is unable to stand erect or bear his weight upon the affected limb without experiencing considerable uneasiness; sharp rheumatic pains dart down the thigh, and spread across the lumbar regions; the muscles of the lower extremities become wasted; and the general health is not unfrequently impaired. Sometimes the trunk inclines to one side, and the limb becomes considerably shortened; but this is by no means a constant symptom. When the disease is the result of cold, it is often attended with much local uneasiness; while, in cases of an opposite character, little inconvenience is generally experienced.

There is good reason to believe that this disease has sometimes been confounded with fractures, dislocations, or scrofulous affections of the hip-joint; by an attentive examination, however, of the symptoms by which it is characterized, such mistakes will seldom occur.

Morbid alterations.—The synovial membrane is thickened and in a highly vascular, though not inflamed, state. Occasionally the thickening exists in distinct portions, of a round or nodulated form; but in the generality of examples it is diffused, affecting equally every part of the membrane. The vessels which are distributed to the neck of the os femoris, and which, in the healthy state, are colourless, are very turgid and of a bright red tint: they anastomose freely with each other, and give rise to a beautiful reticulated appearance. After some time, the periosteum also becomes thickened, and the bone is studded or perforated with numerous minute foramina. These generally exist in greater number at the lower or concave surface of the neck of the os femoris, and do not appear, at first, to extend deeper than the shell or outer table of the bone. By degress, however, they pervade the whole substance of the bone, producing at length so much disorganization as to occasion a considerable shortening of the limb. The absorption, indeed, sometimes proceeds so far that the head of the thigh-bone is brought

into contact with the trochanter minor, being lodged, as it were, in a hollow in that tuberosity.

In some rare cases, the shortening of the cervix femoris is combined with a flattening of the head of the bone, and the formation of a deep groove or rut around the lower edge of the corona. The absorption sometimes embraces more than two-thirds of the neck of the bone, and is not unfrequently attended with extensive osseous depositions, in which the bone seems, as it were, encased.

Prognosis.—Interstitial absorption of the thigh-bone may often be remedied during the early stages of the disease; when, however, it is allowed to go on, without any effort being made to counteract it, it generally proves injurious by interfering with, or completely destroying, the functions of the hip-joint.

Treatment.—In the early stage of the complaint, the patient should be kept quietly at rest, and recourse should be had to emollient cataplasms and evaporating lotions, conjoined with the use of tepid water, poured from the spout of a tea-kettle. If these means fail, local irritants may be employed, especially blisters, tartar emetic ointment, issues, setons, and the moxa. In using these remedies, the same rules should be observed with regard to their continuance, as in the treatment of the diseases of the other parts of the osseous system.

The state of the primæ viæ should be corrected by mild aperients, as those pointed out under the head of exostosis; and if there be much constitutional irritation, blood should be drawn from the arm, or from the part by means of leeches.

Remark.—Although I have treated of interstitial absorption of the osseous tissue only as it occurs in the neck of the os femoris, it is not hence to be inferred that it is peculiar to the femur; for future observation will no doubt demonstrate that it may take place in almost every part of the osseous system; and several cases, in fact, have already been published in which it attacked the bones of the spine, and the upper part of the humerus.

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PART II.

THE ANATOMY, PHYSIOLOGY,

AND

Diseases of the Joints.

THE

Anatomy, Physiology, and Diseases

OF THE

JOINTS.

CHAPTER I.

Of the General Anatomy of the Joints.

SECTION I.

OF THE DIARTHRODIAL CARTILAGES.

Definition.—The diarthrodial cartilages are those hard, white substances which cover the osseous surfaces of the moveable joints.

Conformation and arrangement.—The diarthrodial cartilages are arranged in the form of flattened lamellæ, and are firmly united to the extremities of the bones which enter into the formation of the moveable joints. On their free or external surface they are covered by a smooth synovial membrane, which separates them from the corresponding surfaces of the opposite articular cartilages. In the centre of the convex articular surfaces the cartilaginous lamellæ are thicker than at their circumference; but in the concave ones the opposite of this holds true.

Structure.—The diarthrodial cartilages are composed of a fibro-homogeneous substance, as may be satisfactorily shown by exposing them to long-continued maceration, or the action of boiling water. The fibres are small and delicate, and, according to Hunter and Delassone, they are dis-

posed in a perpendicular direction to the surface of the bones which they are to cover. The blood-vessels, nerves, and absorbents of the diarthrodical cartilages are so small as to be imperceptible to the naked eye. But there is every reason to suppose that they exist, both from analogy and the phenomena of disease.

Physical and chemical properties.—The diarthrodial cartilages are of a pearly white colour, smooth, and elastic. They may be readily cut with the knife, and when divided into thin layers they exhibit a semi-transparent, horny appearance. When boiled, they become brittle and indented, and are finally dissolved into a gelatinous mass. Exposed to the heat of the sun, or the dry heat of a fire, they assume a transparent yellowish colour; but upon macerating them for a few days, they gradually recover their former aspect. They resist for a long time, the putrefactive process, and months are required to macerate them. According to the analysis of Dr. Davy of Edinburgh, the diarthrodial cartilages consist of:

Albumen, ...	44.5
Water, ...	55.0
Phosphate of lime, ...	.5
	100.0 (*a*)

The results of this chemist are somewhat different from those obtained by Allen and Gendrin, who in addition to the substances already enumerated, detected a small proportion of carbonate of lime, and of animal mucus.

Vital properties.—In the sound state, the diarthrodial cartilages have but little sensibility, and their vital action is extremely obscure; but when inflamed or otherwise diseased, they often occasion very severe suffering.

Differences according to age.—During embryotic life, the diarthrodial cartilages exhibit the appearance and consistence of mucilage; but they gradually augment in densi-

(*a*) Monro's Elements of Anatomy, vol. i. p. 302.

ty until at length they acquire the hardness and solidity by which they are always characterized. In adult life they are highly flexible and elastic; but as we advance in age they become more hard, dry, opake, and sensibly thinner.

Functions.—The use of these cartilages is to facilitate the motion of the joints, and to prevent the extension of fractures, &c.

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SECTION II.

OF THE ARTICULAR SYNOVIAL MEMBRANES, AND THE SYNOVIAL FLUID.

ARTICLE 1.—*Of the Synovial Membranes.*

Form and arrangement.—The synovial membranes of the diarthrodial joints form fine shut sacs, which are of a spherical form, and are reflected over the diarthrodial carti-

lages, their ligaments, and the parts by which they are immediately surrounded. Their form and arrangement vary in many of the joints; in some, such as the ilio-femoral, they are reflected so as to cover the inter-articular ligament in the form of a vaginal sheath; and in the knee-joint their reflexions are still more various and complicated on account of the great number of ligaments which enter into its composition, and which are furnished with more or less complete synovial sheaths. Where these membranes are in contact with the ligaments and periosteum they are so intimately connected, that it is almost impossible to separate them. Their connexion with the central portions of the diarthrodial cartilages is so firm and obscure that several able anatomists, especially Gordon and Magendie, have denied their existence. This opinion, however, is by no means correct, as I am convinced from a number of experiments that I have recently performed with a view of satisfying myself with regard to this much disputed and interesting subject. By macerating the cartilages of the hip or knee-joint for several weeks, or by exposing them for a short time to the action of ebullition, I have almost invariably been able to detect the existence of these membranes, and to raise portions of them by means of a pair of dissecting forceps.

The existence of the synovial membranes of the joints has also been proved by the experiments of Nesbit, Bonn, Hunter, Bichat, Béclard, and other anatomists; and it is often rendered evident in the diseases of the diarthrodial joints.

Synovial fringes.—The synovial fringes consist of loose folds, analogous to those of the serous membrane in the cavity of the abdomen. They are formed by the duplicatures of the synovial membranes of the diarthrodial joints, and contain cellular tissue and blood-vessels, as well as small masses of fat, called glandulæ Haverii, in honour of Havers, an English anatomist, who improperly described them

as true secretory glands. These folds are very conspicuous in the hip and knee-joints, but in the smaller articulations they frequently consist of mere reddish points.

Remark.—Dr. Monro, the present professor of Anatomy in the University of Edinburgh, regards the synovial fimbriæ as being composed of "ducts like those of the urethra, which prepare a mucilaginous liquor without the assistance of any knotty or glandular organ."

Structure.—The synovial membranes of the joints are extremely delicate, and appear to be formed of a kind of condensed cellular tissue. Their outer or free surface is smooth and lubricated, and bears a striking resemblance to that of the pleura and peritoneum. No nerves can be traced into their substance; and their vessels, which do not carry red blood in the healthy state, can only be seen when they are in a state of inflammation.

Characters and physical properties.—All the articular synovial membranes are soft and thin, and exhibit a whitish semi-transparent appearance.

Vital properties.—The synovial membranes seem to be almost entirely destitute of sensibility during health; but when diseased, they present very evident symptoms of vitality.

Differences according to age.—In the fœtus and the infant the articular synovial membranes are thin and delicate; but as we advance in years they become gradually more dense, compact, and apparent. In old age and decrepitude, they become dry and rigid, and are one of the most powerful causes of the slowness of motion which marks the last stages of man's existence.

Functions.—The synovial membranes serve to cover the cartilaginous surfaces of the diarthrodial joints, and to facilitate the reciprocal motions of the parts between which they are situated.

Article 2.—*Of the Synovial Fluid.*

The synovia is derived from the numerous blood-vessels which are distributed between the duplicatures of the synovial membranes of the joints, and not, as was formerly supposed by Havers, from the elaboration of a glandular apparatus. Its quantity varies in the different joints; but in those of the hip and knee it is always more abundant than in the other articulations.

Remark.—Dr. Monro thinks that the synovia is furnished by the mouths of invisible exhalent arteries, by the ducts of the synovial fringes, and by oil exuding from the adipose vesicles, by passages that have not yet been discovered. He is of opinion, that these passages are extremely minute, "not only because they are not to be seen with the microscope, but because the oily matter is so well incorporated with the mucilaginous as not to be distinguishable, even with the microscope, in the form of globules."

Chemical properties.—The synovia is a yellowish transparent fluid, of a saline taste, and of a thick, viscid consistence. It is remarkably soft, smooth, and unctuous to the touch; and is, therefore, admirably well adapted for the office which it is designed to perform. It may be readily mixed with water; and when exposed to heat, it becomes turbid and partly coagulated. Its viscidity may be destroyed by mixing it with a small quantity of concentrated sulphuric, nitric, or muriatic acid. From the analysis of Dr. Davy it appears that one hundred parts of synovia consist of

Water, ...	98.3
Gelatine and mucilage, ...	.93
Muriate of soda, ...	.23
Albumen, ...	.53

Besides these ingredients, Dr. Davy also detected a small proportion of fixed alkali and traces of phosphate of lime.(*a*)

(*a*) Monro's Elements of Anatomy, vol. i. p. 316.

Functions.—The synovial fluid lubricates the surfaces of the diarthrodial joints, and facilitates their motions.

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SECTION III.

OF THE ARTICULAR LIGAMENTS.

Definition.—The articular ligaments are the spongy fibrous organs which are attached to the extremities of the diarthrodial joints.

Division.—They may be divided into lateral and capsular.

Conformation and arrangement.—The lateral articular ligaments are generally subdivided into external and internal, according to the situation which they occupy in relation to the joint. The external ligaments are usually situated along the sides of the bones, and are well adapted to moderate or prevent lateral motion. On the internal surface, they adhere intimately to the synovial membrane, and on the external, to the tendons and other parts which are immediately contiguous to the joints.

The internal articular ligaments consist of white fibrous

cords, which are situated within the hip and knee-joints. They are covered by the synovial membrane, and are firmly attached to the articular surfaces of the bones.

The capsular ligaments consist of large fibrous sacs, which surround some of the diarthrodial joints, and are attached to the circumference of the articular extremities of the bones. On their outer surface, they adhere more or less firmly to the adjacent parts, and on the internal, they are intimately connected with the external surface of the synovial membrane.

Structure.—The articular ligaments are composed of firm, white, inelastic fibres, which are arranged in parallel lines; and are connected together by small transverse or oblique fibrillæ.(*a*) They vary in thickness in different parts of the body, and are generally formed into two distinct layers, the outer one of which is more fibrous and considerably thicker than the inner.

The ligaments receive their supply of blood from the arteries which are in their immediate vicinity; and these are accompanied by corresponding veins and lymphatic vessels. Nerves may also be traced into their substance;(*b*) and in their recent state they contain a small quantity of fat, which is at first sight difficult to distinguish.

Characters, physical and chemical properties.—The ligaments are of a white, argentine colour, and of a firm, resisting nature. They possess but a very small share of elasticity; and when they are stretched, they retract with a degree of slowness proportioned to that of their distention. They are difficult of digestion, and when exposed to putrefaction they resist its action for a considerable time. By long-continued maceration, they may be changed into a soft, pultaceous mass, which, by the action of ebullition, may be almost entirely resolved into gelatine.

(*a*) A Treatise on the Ligaments, by Bransby B. Cooper, p. 7.

(*b*) See Monro on the Nervous System.

Vital properties.—According to the experiments of Haller, and other physiologists, the ligaments possess but a very small share of sensibility in the healthy state; but when they are affected with disease, they generally create severe suffering. They appear to be entirely destitute of contractility of texture; and when injured they are seldom, if ever, repaired.

Functions.—The articular ligaments connect the extremities of the diarthrodial joints, and moderate their motions.

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CHAPTER II.

OF INJURIES OF THE JOINTS.

SECTION I.

OF DISLOCATIONS IN GENERAL.

Definition.—A dislocation or luxation is the removal of the head of a bone from its corresponding articular surface; as the head of the humerus from the glenoïd cavity of the scapula.

Division.—Dislocations are divided into simple and complicated, complete and incomplete, primitive and consecutive, recent and old. Another species has lately been described by Professor Dupuytren, which, as it occurs at birth, he has called congenital.

A complete luxation is one in which the head of the bone is totally displaced from its corresponding articular cavity; in an incomplete luxation, on the contrary, the articular surfaces still remain partially in contact. In primitive dislocations, the head of the bone continues in the position into which it was originally forced; in consecutive, it abandons the first situation, and becomes fixed in another. The terms recent and old refer merely to the duration of the injury.

Seat.—All the joints, with few exceptions, are liable to luxation; but experience has proved that those which admit of various and extensive motions are most exposed to such injuries.

Direction.—In the ginglymoïd joints the bones may be displaced either backwards, forwards, or to either side; and

in the orbicular, upwards, downwards, forwards, or backwards.

Difference according to age.—Although the bones may be dislocated at any period of life, experience has shown that such accidents are much more frequent in adults and grown-up persons than in very young and elderly individuals. This circumstance may be very readily explained by the fact, that the bones of children more commonly give way at their epiphyses, and that those of old subjects are generally so brittle, that it requires much less force to break than to dislocate them.

Article 1.—*Of Simple Dislocations.*

Definition.—By a simple luxation is understood merely the removal of the head of the bone, accompanied by the rupture of one or more of the ligaments of the joint.

Causes.—Simple dislocations are mostly produced by external violence, such as blows or falls; but occasionally they arise from muscular action, preternatural laxity of the ligaments, caries of the bones, ulceration or distention of the articular cartilages, and a paralytic or weakened state of the muscles surrounding the joint.

The natural predisposing causes of dislocations, are the great latitude of motion which the joint admits of; the shallowness of the articular cavity; the small extent of surface by which the bones come in contact; and the laxity and small number of the ligaments of the joints.(*a*)

In some persons, the preternatural laxity of the ligaments is so great as to enable them to dislocate their joints at will. Sir Astley Cooper relates the case of a little girl who could thus displace her patella;(*b*) Dr. Lehman, that of a person who could thus dislocate his humerus;(*c*) and Mr. Dunn, of

(*a*) Boyer's Lectures on the Bones, translated by Farrell, p. 207.

(*b*) Lectures on Surgery, by Tyrrell, vol. iii. p. 200.

(*c*) American Journal of the Medical Sciences, vol. i. p. 243.

Scarborough, the case of a medical student who could spontaneously luxate the thumb of the left hand at the metacarpal joint.(*a*) I have known a young lady who could do the same thing with her index finger; she was a native of the West Indies, and was in other respects perfectly healthy.

Symptoms.—Dislocations may in general be readily distinguished from other accidents by a want of crepitation; by the elongation or shortening of the limb; by the lodgment of the head of the bone in an unnatural situation; by the alteration in the shape of the joint; by the diminution or loss of motion in the limb; by the unnatural prominence or depression in the vicinity of the affected part; by the possibility of feeling the head of the bone in its new situation; and by the change in the direction of the axis of the limb.

The pain which accompanies dislocations is usually caused by the pressure of the head of the bone on the surrounding parts, and is greatly increased on rotating or moving the limb. When the head of a dislocated bone rests upon a large nerve or other important organ, it often gives rise to extreme agony, and sometimes to obstinate and incurable paralysis. In some instances, indeed, the pressure which is thus created, may even endanger the life of the patient, as in the case cited by Sir Astley Cooper, in which the clavicle pressed upon the œsophagus, and produced so much inconvenience as to require the removal of its sternal extremity.(*b*)

Luxations are generally followed by considerable swelling, and this, together with the effusion of blood around the joint, renders it sometimes extremely difficult to ascertain the nature of the injury. If the bone be left in its unnatural situation until a day or two after the accident, the embarrassment of the surgeon may be still farther increased by a sensation of crepitus, resulting from the extravasation of fibrin into the joint or some of the neighbouring bursæ. As

(*a*) Cooper's First Lines, vol. ii. p. 77.

(*b*) On Dislocations, p. 401.

this circumstance has sometimes led the practitioner into error, it should be borne in mind that the crepitation thus produced "does not impart that grating feel which arises from the motion of the fractured ends of a bone upon each other."(*a*)

Dissection.—On dissecting parts that have been recently luxated, the head of the bone is found more or less removed from its socket; the ligaments are lacerated, elongated, or relaxed; blood is effused in the neighbourhood of the affected joint; and the tendons and muscular fibres are either ruptured or lengthened.

Prognosis.—Simple dislocations, if early attended to, may commonly be easily reduced, and can not generally be considered dangerous. If they are neglected, however, or improperly managed, more or less deformity and a partial or total loss of motion must be the necessary and inevitable consequence.

Luxations of the orbicular joints are generally less hazardous than those of the ginglymoïd; but they are always more difficult of reduction, on account of the muscles being more numerous and powerful, and thus offering greater resistance to the efforts of the surgeon.(*b*)

In children, old persons, and females, the reduction may generally be accomplished with much greater facility than in strong, robust individuals, in whom it requires much more force to overcome the resistance of muscles.

TREATMENT OF SIMPLE DISLOCATIONS.

Indications.—The principal indications in the treatment of simple dislocations, are to restore the displaced articular surfaces as speedily as possible to their natural situation, to support the joint with bandages or splints, until the lacerated

(*a*) Sir Astley Cooper's Lectures on Surgery, by Tyrrell, vol. iii. p. 197.

(*b*) S. Cooper's First Lines, vol. i. p. 364.

parts have had an opportunity of uniting, and to prevent or subdue inflammation and its consequences.

Reduction.—The reduction of a dislocation, like that of a fracture, is effected by extension, counter-extension, and coaptation; and is by far the most difficult and important part of the treatment of the injuries under consideration.

All the older surgeons recommended the extending force to be applied to the luxated bone; and their advice has been followed by many of the moderns, especially by J. L. Petit, Duverney, Callisen, Pott, Allan,(*a*) and most of the English practitioners. The practice, however, appears to be losing ground, and instead of making extension in the manner just stated, most surgeons, particularly Fabre, Dupouy, Desault, Boyer, Richerand, Levéillé, and Mr. Cooper, the accomplished writer on surgery, advise the extending power to be applied to the bone which is articulated with the dislocated one, and as far as possible from the seat of the injury.(*b*)

Sir Astley Cooper, who is probably the best writer upon dislocations of the present day, is of opinion that the old method of making extension is the best, except in a very few cases, which will be more particularly noticed hereafter.(*c*)

Extension and counter-extension may be made either by the hands of intelligent assistants, aided, if necessary, by napkins or sheets, or by means of pulleys. As a general rule the resisting power, or the counter-extending means should be fully equal to the extending, and both should be applied in such a manner as to create as little pain or inconvenience as possible.

In making extension and counter-extension great care should always be taken that the force be exerted in a slow and gradual manner, and that it be continued for a sufficient

(*a*) Operative Surgery, vol. ii. p. 186.

(*b*) Boyer on the Bones, p. 213.—Cooper's Surgical Dictionary, p. 373.

(*c*) Lectures on Surgery, by Tyrrell, vol. iii. p. 209.

length of time to fatigue the muscles which oppose the reduction.

With regard to extension it should always be first made in the direction of the luxated bone; but in proportion as the surgeon overcomes the resistance of the muscles, the bone is to be gradually brought back into its original position.

As the resistance of the muscles forms the chief barrier to the reduction of dislocations, it is often necessary, especially in very strong and robust individuals, to counteract their action by proper local and constitutional measures. The most efficient remedies of this description are blood-letting ad deliquium animi, nauseating doses of tartarized antimony, the warm bath, intoxication, and large quantities of opium. Of these blood-letting is by far the most powerful, and at the same time the most speedy method that can possibly be adopted, especially if the blood be drawn from a large orifice and the patient be kept in the erect position. In using the warm bath the temperature should be from one hundred to one hundred and ten degrees of Fahrenheit, and the patient should be kept in until fainting is induced. Temporary debility or muscular relaxation may also be produced by the exhibition of small doses of tartar emetic, by the administration of brandy or gin, or by smoking tobacco, as recommended by Dr. Physick.

Another method of overcoming muscular action, which has sometimes been known to succeed, is to divert the patient's attention, and to make attempts at reduction while the muscles are unprepared for resistance.

As soon as the patient feels faint, either from the abstraction of blood, or from the effects of the warm bath, or nauseating medicines, he should be put in a proper position, and recourse should immediately be had to such mechanical means as will be calculated to effect the reduction.

In reducing a dislocation, the limb should always be placed in the most favourable position for relaxing the muscles, as by this means our efforts will be greatly facilitated.

Although it is extremely desirable that every luxated joint should be reduced as speedily as possible, no attempt should be made to effect it when the parts are swollen and inflamed. Under these circumstances the surgeon should wait until he has subdued the inflammatory symptoms by local bleeding, cold or warm saturnine lotions, and anodyne fomentations.

The return of the head of the bone to its natural situation is indicated by the restoration of the shape and motion of the joint; by a snap or noise heard at the moment of the reduction, and by a great and sudden diminution of pain.

Treatment after the reduction.—When the reduction is completed, all that will be necessary to prevent a recurrence of the accident, is to keep the limb perfectly at rest by appropriate bandages or splints, and to enable the ruptured ligaments to unite. If the inflammation run high, recourse should be had to evaporating lotions, and to the application of leeches; and if there be much pain it should be combated by anodyne remedies.

When the inflammatory symptoms have abated, the limb should be gently moved to prevent anchylosis, and the muscles and ligaments about the joint should be strengthened by frictions with rough flannel, or a salt towel, and by occasionally pouring cold water over the parts.

Article 2.—*Of Complicated Dislocations.*

Definition.—A complicated luxation is the displacement of the head of a bone from its corresponding articular surface, accompanied by a wound communicating with the cavity of the injured joint, by the rupture of a blood-vessel or nerve, or by a fracture or solution of continuity of the osseous tissue.

Seat.—These dislocations are most frequently met with in the tibio-tarsal, humero-ulnar, and radio-carpal joints.

Causes.—The accident is always necessarily occasioned by external violence.

Symptoms.—The marks which characterize a complicated luxation, are distortion, severe pain, inability to move the injured limb, protrusion of the end of the bone, discharge of synovial fluid, a fixed state of the joint, shortening or lengthening of the limb, and more or less contusion or laceration of the soft parts.

Prognosis.—Complicated dislocations may always be regarded as very disagreeable accidents, since they are not unfrequently followed by violent and extensive inflammation, abscesses, caries, mortification, great constitutional disturbance, delirium, and even death. The danger depends in great measure upon the injury of the soft parts, the extent of the laceration and contusion, the length of time the joint has been exposed to the contact of the air, the age, health, and constitution of the patient, and a variety of other circumstances. (*a*)

TREATMENT OF COMPLICATED DISLOCATIONS.

Complicated dislocations should always be reduced as speedily as possible, and with as little violence and disturbance as the nature of the case will admit of. After the reduction is effected, the edges of the wound should be accurately brought together with strips of adhesive plaster, and the joint should be kept perfectly quiet in splints, in order to obtain a prompt union of the solution of continuity of the soft parts, and thus convert the injury into a simple case.

If the extremity of the bone protrudes, and is covered with dirt or other extraneous matter, it should be carefully washed with a sponge and warm water; and if there be any spiculæ of bone, the finger should be passed into the joint, and such of them as are loose or detached should be removed; but this should be done in the most careful and gentle

(*a*) Allan's Operative and Pathological Surgery, vol. ii. p. 191.

manner. If the bone is girt by the integuments, so as to prevent the reduction, the opening in them should be dilated with a knife, and the same practice should be adopted when there are loose pieces of bone, and the wound is so small as not to admit of the introduction of the finger.(*a*)

When the bone has been restored to its original situation the wound should be dressed with lint dipped in blood, and the joint should be covered with linen kept constantly wet with a solution of the acetate of lead, or spirits of wine and water. The limb is to be surrounded with the bandage of Scultetus, and the splints are to be fastened in such a manner as to create as little pain and inconvenience as possible. The patient should be kept on low diet, and the inflammatory symptoms should be subdued by general and local bleeding, saline draughts, and antimonial medicines. Should there be much nervous irritability, or watchfulness, anodyne remedies, and emollient applications will be necessary.

If the surgeon fail in producing union by the first intention, and there is much discharge, attended with approaching weakness, the patient should be allowed more nourishing food, and be directed to take bark, porter, wine, and such other remedies as his particular complaints may require.

When the reduction can not be accomplished by extension, even after the wound has been enlarged, as often happens in complicated dislocations of the thumb and ankle, it will sometimes be advisable to adopt the method of sawing off the head of the luxated bone, as recommended by Hippocrates, and practised by Hey, Evans, Cooper, and other surgeons.

The circumstances which may give rise to the necessity for primitive or consecutive amputation in complicated dislocations, are: 1. The advanced age and unhealthy or debilitated state of the patient. 2. Excessive contusion and laceration of the soft parts. 3. The rupture of a large blood-vessel or nerve, attended with a very extensive lacerated

(*a*) Sir Astley Cooper on Dislocations, p. 254.

wound. 4. The extremely shattered state of the bones. 5. Very great and permanent deformity of the limb. 6. Extensive suppuration. 7. Gangrene or mortification. 8. Incipient tetanus. (*a*)

Article 3.—*Of Old or Neglected Dislocations.*

Morbid alterations.—If a luxation remains a long while unreduced, the blood which was effused at the moment of the accident is gradually absorbed, and the functions of the parts are afterwards in a measure restored. The head of the dislocated bone accommodates itself to its unnatural situation, and the surrounding cellular tissue becomes condensed, and forms, as it were, new ligaments, which supply, in a certain degree, the office of the original joint, by allowing more or less motion.

Treatment.—It has long been a dispute among surgical writers, at what period after the occurrence of a dislocation, it should be considered impracticable to effect a reduction? Sir Astley Cooper, whose great skill and almost unrivalled reputation, entitle his opinions to the utmost confidence, thinks that three months for the shoulder, and eight weeks for the hip may be set down as the period from the accident, when any attempt at reduction, except in persons of very lax fibre or advanced age, would be highly imprudent. That this would be the case in the majority of instances, can not, I presume, be denied; but in surgery, as in grammar, there are always exceptions to the general rule; for numerous cases are on record, where dislocations of this description, have been reduced six months after the reception of the injury; and a case has been communicated to the

(*a*) For an account of the treatment of luxations complicated with fracture or the rupture of a large blood-vessel, see the article on Complicated Fractures.

public by the late Dr. Smith, the distinguished Professor of Surgery in Yale College, in which a reduction was effected nearly a year after the occurrence of the accident.(*a*) Instances of from four to seven months standing are related by Physick, M'Kenzie, Kirby, Dorsey, Gibson, Jameson, and a number of other surgeons. With regard to this subject, however, it is impossible to lay down any specific rule; for the management of the case must always depend upon existing circumstances, which must be left to the judgment of the surgeon.

It may be stated, as a general observation, that old luxations of the orbicular joints are more easy of reduction than those which occur in the ginglymoïd or hinge-joints; because in the latter the displacement is generally the result of a greater degree of violence; and because the bone, being seldom completely removed from its corresponding articular surface, the inflammation which ensues soon stiffens and partially ancholysis the joint.(*b*)

In reducing old luxations, it is necessary, before making extension, to move the bone freely and cautiously in different directions, for the purpose of first breaking its adhesions, lacerating the condensed cellular tissue which serves as an accidental capsule, and of producing, as it were, a second dislocation, in order to remove the first. Extension and counter-extension are then to be made in the ordinary way, but with an additional number of assistants.(*c*)

The extending force should always be applied in a slow and gradual manner, and should be steadily continued for a sufficient length of time to fatigue the resisting muscles, and enable the bone to slip into its former place. In no instance should the surgeon employ *violent* or *forcible* measures:

(*a*) See the Philadelphia Monthly Journal of Medicine and Surgery, edited by Dr. N. R. Smith, p. 214.—Oct. 1827.

(*b*) Allan's Operative Surgery, vol. ii. p. 184.

(*c*) Desault's Treatise on Fractures and Dislocations, by Caldwell, p. 144.

because such practice would not only irritate the resisting muscles, and thereby enhance the difficulties of the reduction, but give rise to dangerous and even fatal consequences.

Cases in which severe injury and even death have been the result of long-continued and violent attempts at reducing old luxations are recorded by Loder,(*a*) Sir Astley Cooper,(*b*) Pelletan,(*c*) Flaubert(*d*) Gibson,(*e*) Mr. Charles Bell,(*f*) and many other writers, whose names it were needless to enumerate on the present occasion.

Before I dismiss this subject, I shall merely remark, that whenever an attempt is made to effect the reduction of an old or neglected dislocation, our manual or mechanical efforts should always be aided by the local and constitutional means that were pointed out in a former section of this work.

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(*a*) Chirurgische Med. Beobachtungen, p. 173. Weimar, 1794.

(*b*) On Dislocations, p. 422.

(*c*) Clinique Chirurgicale, T. 2. p. 95.

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(*e*) American Journal of the Medical Sciences, vol. ii. p. 136.

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SECTION II.

OF PARTICULAR DISLOCATIONS.

ARTICLE I.—*Of Dislocations of the Head and Trunk.*

STRUCTURE OF THE TEMPORO-MAXILLARY ARTICULATION.

The condyles of the lower jaw articulate on each side with the glenoïd cavity of the temporal bones, and with the smooth surface on the anterior root of the zyogmatic process. In the recent state, these parts are covered with cartilage, and are retained in their situation by appropriate ligaments.

External lateral ligament.—The external lateral ligament consists of thin, short, parallel fibres, connected by dense cellular substance; it arises from the outer surface of the zygoma and the tubercle at the bifurcation of its root, and passing obliquely downwards and backwards, is inserted into the external surface and posterior border of the neck of the condyle of the lower jaw.

Internal lateral ligament.—The internal lateral liga-

ment, composed of long, narrow fibres, arises from the inner edge of the glenoïd cavity of the temporal bone, passes obliquely downwards and forwards, and is inserted into the antero-superior part of the posterior dental foramen.

Inter-articular cartilage.—The inter-articular cartilage is situated horizontally between the two articular surfaces; it is of an oval form, being elongated from before backwards, and thicker at its margins than at the centre, where it is often perforated, or so thin as to be perfectly translucent. Its inferior surface is regularly concave, to receive the condyle of the lower jaw; while the superior, which is concave from before backwards, and slightly convex from side to side, towards its two extremities, adapts itself to the glenoïd cavity and root of the zygomatic process of the temporal bone. Its use is to give extent and facility to the motions of the lower jaw, and to afford points of attachment to some of the fibres of the external pterygoïd muscle.

Synovial membrane.—After having lined the superior surface of the inter-articular cartilage, the synovial membrane is reflected upwards upon the lateral ligaments, and over the smooth cartilaginous surface of the glenoïd cavity. A similar membrane is interposed between the inferior surface of the cartilage and the condyloïd process of the lower jaw, so that both taken together form a double arthrodial joint.

Motions.—The lower jaw is capable of being moved upwards, downwards, forwards, and to either side. The muscles which are concerned in producing these motions, are the temporal, the masseter, the external and internal pterygoïd, the platysma myoïdes, the digastricus, the genio-hyoïdeus, the genio-hyo-glossus, and the mylo-hyoïdeus.

DISLOCATIONS OF THE TEMPORO-MAXILLARY ARTICULATION.

The dislocations of the lower jaw may be either complete or partial. When complete, the two condyles are thrown

into the space between the surface of the temporal bone and the zygomatic arch; but when partial, there is only a displacement of one of the condyloïd processes, while the other remains in its natural situation.

§ I. COMPLETE LUXATION.

Causes.—Complete luxation of the temporo-maxillary articulation is generally produced by the action of the muscles, as in yawning, laughing, and vomiting. The same effect may also be occasioned in attempts to extract the teeth, and in consequence of blows or falls upon the chin, when the mouth is widely opened.

Symptoms.—The mouth is always more or less open, and every attempt to close it is attended with pain; the patient speaks indistinctly, and swallows with great difficulty; the cheeks and temples are flattened; the saliva is increased in quantity, and comes away involuntarily; the projection of the coronoïd process is very distinguishable through the cheek, particularly within the mouth; and instead of the prominence formed by the external side of the condyle, immediately behind the root of the zygoma, there is an empty, hollow space, caused by the outer portion of the glenoïd cavity of the temporal bone.

In recent luxations of the lower jaw, the symptoms which have been just enumerated are always sufficient for establishing a correct diagnosis; but when the accident has continued several days or weeks, they are by no means so strongly marked, though they still exist to a greater or less degree.

Prognosis.—Hippocrates, who was born in the island of Cos, four hundred and sixty years before Christ, was of opinion that every luxation of the jaw, if not reduced before the tenth day, would necessarily be attended with fatal consequences. The experience of succeeding ages, however, has fully proved that this is not the case. The most disagreeable consequence, in fact, which is to be apprehended

in cases of this description, is a return of the accident, to which, as we shall see hereafter, some people are extremely subject.

Reduction.—In reducing this dislocation, the patient is to be placed upon a low chair, and his head is to be supported against the breast of an assistant. The surgeon standing in front of the patient and defending his thumbs with a piece of leather or linen, introduces them into the mouth, and places them as far back upon the molar teeth as possible, at the same time that he applies the four fingers of each hand under the chin and base of the jaw. When the head is steadily fixed, the surgeon presses upon the large grinders, and bringing the jaw downwards and backwards, he disengages its two condyles from their situation in the zygomatic fossa. As soon as the condyles begin to descend, the chin is to be elevated and pushed back by the fingers, so as to convert the bone into a lever of the first kind. At the moment the reduction is effected, the operator must be careful to remove his thumbs quickly from between the teeth; for if this be neglected, they will be in danger of being injured, in consequence of the sudden spasmodic closure of the jaws.

Should the first attempts at reduction be unattended with success, on account of the swelling of the soft parts, or the violent contraction of the muscles, it will be necessary to draw blood from a large orifice, and to resort to such other measures as are calculated to produce temporary faintness.

The older surgeons were sometimes in the habit of reducing dislocations of the lower jaw, by placing two pieces of cork or wood between the molar teeth, on each side, and while they employed these as levers to depress the back part of the bone, they elevated the chin by means of a bandage. Another mode of reducing dislocations of this kind, was to place a stick between the back teeth, so as to keep the jaws apart, until the muscles, which were spasmodically contracted, became relaxed, and thus allow the condyles to resume their natural situation. These methods have been

particularly described by De Vigo, Le Cat, and Guido de Cauliaco.

It has also been proposed to replace this luxation by forcing the chin upwards and backwards by a sudden blow of the fist; but this method is always so dangerous, that it should never be employed.

Treatment after the reduction.—When the reduction is effected, a return of the accident is to be prevented by applying the four-tailed bandage, as recommended in cases of fractures of the lower-jaw. The patient should be nourished for some time upon broths, and be careful to avoid such food as may require much mastication.

Remark.—The lower jaw is seldom, if ever, luxated in infants and young children, on account of the peculiar conformation of the body and branches of the bone; but in delicate old persons it is an accident which is by no means of unfrequent occurrence, and in whom, when it has once taken place, it is extremely apt to return.

§ II. PARTIAL LUXATION.

Causes.—Blows or falls upon the side of the face.

Symptoms.—In a partial luxation of the lower jaw, the chin is thrown to the opposite side; the lower teeth lose their relation with those of the upper jaw; the mouth is slightly opened; the articulation of words is difficult, but not perfectly impeded; and the depression in front of the ear is perceptible only on the injured side.

Prognosis.—More favourable than in the preceding case, as the reduction is effected with more ease, and a return of the injury less liable to occur.

Reduction.—The reduction is effected in the same manner as in those cases in which the dislocation is complete, except that instead of two only one hand is necessary. Sir Astley Cooper recommends the use of the wooden lever, or the introduction of the cork on one side, and the elevation of the chin on the other.

Remark.—In addition to the two species of dislocation above-mentioned, there is another which has been described by Sir Astley Cooper, under the name of sub-luxation, and which is owing to a great degree of relaxation of the ligaments of the lower jaw. It most frequently occurs in delicate females; and is characterized by an inability to close the mouth, and by pain on the injured side.

In reducing this dislocation, "the force must be applied directly downwards, so as to separate the jaw from the temporal bone, and to give the cartilage an opportunity to replace itself upon the rounded extremity of the condyloïd process."

When the relaxation is very great, much benefit may be derived from the internal exhibition of ammonia and steel, the use of the shower bath, and the application of blisters to the temple.

STRUCTURE OF THE STERNO-CLAVICULAR ARTICULATION.

The sterno-clavicular articulation is formed by the round button-like head of the clavicle and the flat articulating surface of the upper bone of the sternum. In the recent state, these parts are encrusted with cartilage and strengthened by the following ligaments.

Anterior sterno-clavicular ligament.—The anterior sterno-clavicular ligament consists of strong parallel fibres, which arise from the inner extremity of the clavicle, and passing downwards and inwards, are inserted into the anterior surface of the sternum.

Posterior sterno-clavicular ligament.—The posterior-sterno-clavicular ligament passes from the back part of the internal surface of the clavicle to the supero-posterior surface of the sternum; it is less broad and strongly marked than the preceding, but is nearly of the same shape.

Inter-clavicular ligament.—The inter-clavicular ligament is composed of strong fibrous fasciculi, and passes transversely from the extremity of one clavicle to that of

the other. The use of this ligament is to connect the clavicles with each other, to strengthen their articulations with the sternum, and to protect the trachea in its passage through the superior opening of the cavity of the thorax.

Costo-clavicular ligament.—This ligament, which consists of a broad fasciculus of fibres, is attached to the inferior surface of the clavicle, and passes obliquely downwards and forwards to be fixed to the cartilage of the first rib, near the sternum. Though not properly belonging to the sterno-clavicular joint, it contributes materially to retain the clavicle in its situation.

Inter-articular cartilage.—The inter-articular cartilage is situated between the articulating surfaces of the sternum and the clavicle, and is of a circular wedge-like form, being thick and rough at its circumference, and comparatively thin, and sometimes perforated, in its centre. Towards its supero-posterior part it is attached to the margin of the clavicle, and at the opposite point to the cartilage of the first rib. According to Boismont it is often extremely thin, or almost entirely wanting.(*a*)

Synovial membrane.—In the sterno-clavicular articulation, as in that of the lower jaw, there are two synovial membranes; one of which is reflected over the articulating surface of the sternum and the adjacent surface of the inter-articular cartilage, while the other is disposed similarly between the cartilage, and the sternal extremity of the clavicle.

Motions.—The motions of the sterno-clavicular articulation are always dependant upon those of the scapula, which can be moved upwards, forwards, downwards, and backwards.

(*a*) Traité Elémentaire d'Anatomie, p. 195. Paris, 1827.

DISLOCATIONS OF THE STERNO-CLAVICULAR ARTICULATION.

The sternal extremity of the clavicle may be dislocated forwards, backwards, and upwards. Luxation downwards is rendered impossible on account of the resistance afforded by the cartilage of the first rib.

§ I. LUXATION FORWARD.

Causes.—Luxation forward is generally produced by violence inflicted upon the top of the shoulder, or by falls upon the elbow, at the time the arm is separated from the trunk. Under these circumstances, the clavicle is pushed violently forwards and inwards, and produces a laceration of the ligaments, and perhaps even a part of the tendon of the sterno-cleido-mastoïd muscle. (*a*)

Symptoms.—The symptoms which denote this accident are, a hard circumscribed tumour on the anterior and upper part of the sternum, which recedes in proportion as the shoulder is carried outwards and forwards; and an empty space in the natural situation of the sternal extremity of the clavicle. In thin emaciated persons the nature of the case may generally be at once determined; but in those of an opposite character it is always difficult to detect.

Prognosis.—In this, as well as in the two other varieties of dislocation of the sternal end of the clavicle, it generally happens, in spite of the best directed efforts of the surgeon, that the luxated extremity will remain more prominent than in the natural state. This deformity may, therefore, almost always be expected, and should be carefully borne in mind by the young and enthusiastic practitioner, who is frequently too apt to promise what neither he nor riper experience can accomplish.

Reduction.—To reduce this luxation the surgeon is to

(*a*) Delpech's Traité des Maladies Chirurgicales, T. 3. p. 65.

apply one hand under the axilla, and the other to the external and lower part of the arm. The latter part is then to be carried towards the trunk, so as to push the upper part of the humerus outwards, and make this bone answer the purpose of a lever, the action of which operates immediately upon the clavicle. The elbow is now to be carried forwards, and the shoulder upwards and backwards, in order that the extension may be made outwards, upwards, and backwards, or in the oblique direction of the clavicle. By this manœuvre, the bone will generally glide into its place; but should this not be effected, the reduction is to be promoted by pressing upon the displaced part from before backwards.

While the parts are kept in this situation, the wedge-like cushion, used in fractures of this bone, is to be placed under the axilla, and the arm is to be confined upon it by a roller carried round the limb and trunk, and the elbow and forearm are to be well supported in a sling. The action of the bandage should be promoted by applying thick compresses over the injured part, and by filling up the interspaces on the anterior and posterior parts of the arm.

In order to facilitate the reunion of the lacerated ligaments, an accident which always attends this dislocation, the apparatus to which I have just referred should be kept on a considerable time longer than in fractures of the clavicle.

Remark.—Luxations of the sternal extremity of the clavicle forwards, are much more frequent than the other two varieties, and in fact they are almost the only ones that are met with in practice.

§ II. LUXATION BACKWARDS AND UPWARDS.

Causes.—A dislocation of the sternal extremity of the clavicle upwards and backwards, may be caused by excessive deformity of the spine, as in the case mentioned by Sir Astley Cooper, or by severe violence applied to the forepart of the bone.(*a*)

(*a*) On Dislocations, p. 289.

Symptoms.—In the luxation backwards and upwards, the extremity of the clavicle is pushed behind the sternum, and forms a projection at the antero-inferior part of the neck, which, according to J. L. Petit, compresses the trachea, the œsophagus, and the cervical vessels and nerves. All the ligaments are more or less lacerated; and the neck is inclined towards the side on which the injury itself is situated.

Reduction.—The reduction is to be effected upon the same principles as in the preceding case, care being taken to elevate the shoulder and push it a little farther back than in the luxation forwards. The elbow is to be well kept up in a sling, at the same time that it is inclined backwards, and the shoulder is to be confined upwards and backwards by means of a proper bandage.

Remark.—It sometimes happens in cases of dislocations backwards and upwards, that the end of the clavicle gradually glides behind the sternum, and creates such a degree of pressure upon the œsophagus as to give rise to the most alarming symptoms, and lead to the necessity of removing its sternal extremity. An operation of this kind was performed some years since by Mr. Davie, an English surgeon. Having made an incision from two to three inches in length upon the sternal extremity of the clavicle, in a line with the axis of that bone, and detached its ligamentous connexions, he divided the bone about one inch from its articular extremity by means of Hey's saw, care being taken to protect the soft parts from the action of the instrument by the introduction of a piece of firm sole leather. The patient speedily recovered, and lived about six years after the operation.

STRUCTURE OF THE SCAPULO-CLAVICULAR ARTICULATION.

The scapulo-clavicular articulation is effected between the acromion process of the scapula and the external end of the clavicle; the former of which is concave, the latter convex, and both are tipped with cartilage. It is strengthened by two ligaments, a superior and an inferior.

Superior acromio-clavicular ligament.—The superior acromio-clavicular ligament consists of a strong, broad band of fibres, and extends from the acromion process of the scapula to the adjacent extremity of the clavicle.

Inferior acromio-clavicular ligament.—The inferior acromio-clavicular ligament bears a striking resemblance to the preceding, and is attached to the posterior surface of the same bones.

Besides these ligaments, there are two others, which, though not immediately connected with the scapulo-clavicular articulation, are of great importance in preventing dislocations. These are called the internal and external coraco-clavicular ligaments, or the conoïd and trapezoïd. The first passes from the root of the coracoïd process, and is inserted into the inferior surface of the clavicle, about two inches from its extremity; the second proceeds from the coracoïd process, and is attached to the external extremity of the clavicle.

Synovial membrane.—The synovial membrane lines the articular surfaces of both bones, but secretes very little synovial fluid. It is sometimes divided into two cavities by the interposition of an inter-articular cartilage, but this arrangement is of rare occurrence.

Motions.—The motions of this joint are so extremely obscure that it would be altogether superfluous to describe them.

DISLOCATIONS OF THE SCAPULO-CLAVICULAR ARTICULATION.

The scapular extremity of the clavicle is seldom dislocated in any other direction than upwards; though experience has shown that the accident may sometimes take place downwards, and that the extremity of the bone may glide under the acromion process of the scapula.(*a*) The dislocation upwards, however, is the only one which merits particular consideration.

(*a*) Boyer on the Bones, p. 237.

LUXATION UPWARDS.

Causes.—The chief causes of this dislocation are blows or falls upon the shoulder or scapula.

Symptoms.—The existence of a dislocation of the scapular extremity of the clavicle upwards, is evinced by pain at the top of the shoulder, by great difficulty in raising the arm, by the end of the clavicle projecting under the integuments of the acromion, and by the inclination of the head to the affected side. "But the easiest mode of detecting this accident is to place the finger upon the spine of the scapula, and to trace this portion of bone forwards to the acromion in which it ends; the finger is arrested by the projection of the clavicle over it, and so soon as the shoulders are drawn back, the point of the clavicle sinks into its place, but re-appears when the shoulders are let go."(*a*) The displacement which results from this luxation is always accompanied by a laceration of the ligaments of the joint, and even of some of the ligamentous bands which connect the clavicle to the coracoïd process.

Prognosis.—The dislocations of the scapular extremity of the clavicle are always cured with difficulty; and it very rarely happens that they get well without some degree of distortion. Professor Boyer, one of the most able and copious writers upon surgery of the present day, relates a case in which the patient, after five months regular treatment, could not move his arm without causing a relapse of the complaint. Cases of this description, however, are by no means of frequent occurrence; for we are generally able to effect a more or less perfect cure in the space of five or six weeks.

Reduction.—Having enabled the clavicle to resume its natural situation by putting the knee between the shoulders, and drawing them backwards and upwards, a thick firm

(*a*) Cooper on Dislocations, p. 293.

cushion is to be placed in each arm-pit, in order to elevate the scapula, to keep it from the side, and to defend the margins of the axilla from the pressure of the bandages. The shoulder is then to be confined inwards and backwards by means of Desault's apparatus for fractures of the clavicle, and the elbow being inclined backwards, is to be well supported in a sling.

Remark.—The above plan, which is recommended by M. Boyer and Sir Astley Cooper, is decidedly preferable to the common practice, which consists in applying a compress and the figure-of-eight bandage, and keeping the arm in a sling.

STRUCTURE OF THE OCCIPITO-ATLOIDEAN ARTICULATION.

The occipito-atloïdean articulation, is formed between the condyle of the os occipitis and the superior processes of the atlas. The articular surfaces of these bones are covered with cartilages, lined by a synovial membrane, and retained in contact by two ligaments.

Anterior ligament.—The anterior occipito-atloïdean ligament is a thin, broad, membranous expansion, which arises from the anterior margin of the foramen magnum, between the condyles of the occipital bone, and passes downwards to be inserted into the fore-part of the arch of the atlas, between its superior articular processes.

Posterior ligament.—It arises from the posterior margin of the foramen magnum, and is inserted into the upper part of the posterior arch of the atlas.

Synovial membrane.—The synovial membrane invests the condyles of the os occipitis, the upper articular surfaces of the atlas, and the internal surfaces of the anterior and posterior atloïdean ligaments, and thus forms capsular prolongations for the more perfect security of the articulation under consideration.

Motions.—The motions which this joint is capable of

performing are flexion, extension, and a slight degree of lateral inclination.

DISLOCATIONS OF THE OCCIPITO-ATLOIDEAN ARTICULATION.

The motions of this articulation are so limited, and its connexions so firm, that it has generally been considered impossible to luxate it by external violence. Of the few examples of this terrible accident, which are to be found in the records of our science, there is not a solitary instance that was not produced by a scrofulous or carious state of the articular surfaces of the bones, or of the neighbouring parts. For the truth of this assertion I may refer the student to the works of Sandifort, Boyer, Rust, and Schupke, the latter of whom has given us an accurate account of the symptoms of this disease, as collected from the writings of Frank, Reil, and other German physicians.

The severe sufferings which result from this disease are to be allayed by blisters, leeches, setons, issues, and anodyne remedies; but all the means that can possibly be resorted to are only capable of retarding the progress of the complaint, and of producing an abatement of the symptoms. The occasional cause will still continue to act, and in spite of all our best directed efforts, the patient will gradually waste away, and at length fall a prey to the ravages of the disease.

STRUCTURE OF THE ATLO-AXOID ARTICULATION.

This articulation is effected between the bodies of the atlas and axis, and the odontoïd process of the latter, which is connected with the arch of the former, so as to constitute the pivot on which the head turns in its rotatory motions. These parts are maintained in contact by three ligaments, and four synovial membranes.

Transverse ligament.—The transverse ligament is a strong thick fasciculus of fibres; it is arched in its direction;

and is attached on each side to the inner margin of the superior articular process of the atlas.

Anterior atlo-axoïd ligament.—This ligament is thin and membranous, and extends from the lesser arch of the atlas and its tubercle to the body of the axis and the root of its odontoïd process.

Posterior atlo-axoïd ligament.—The posterior atlo-axoïd ligament connects the posterior arch of the atlas with the plates of the axis.

Synovial membranes.—Two synovial membranes are situated between the articular processes of the atlas and the axis; one between the arch of the atlas and the transverse ligament; and another between it and the odontoïd process.

DISLOCATIONS OF THE ATLO-AXOID ARTICULATION.

Causes.—The atlo-axoïd articulation may be luxated by a violent blow on the head; a forcible twist of the neck; lifting up a child by the head; tumbling; standing upon the head; and various other causes.

Symptoms.—The symptoms which accompany this accident must necessarily vary with the circumstances of the case, and may be either of a local or constitutional nature. According to Boyer, "when in consequence of a sudden and violent effort, the head is turned to one side, either right or left, with inability to bring it back, the ear a little inclined to one side, and the sterno-cleido-mastoïdeus in a state of relaxation, there can be no doubt but that a luxation of one of the cervical vertebræ has taken place." In some instances the patient is immediately deprived of sensibility, and lies as if dead; and soon expires, unless he is immediately relieved.

Prognosis.—Whenever this articulation is luxated, the odontoïd process exerts such a degree of pressure upon the spinal marrow as to lead inevitably to a fatal termination. There is, in fact, no well authenticated case on record, where a dislocation of this description has ever been successfully

treated. The alleged instances of the successful reduction of a luxation of the neck by Desault(*a*) and Settin,(*b*) appear to be without the least foundation, since the accident was evidently in both cases, merely a dislocation of one of the oblique processes of one of the middle cervical vertebræ.

Reduction.—If the surgeon be called in immediately after the reception of the injury; if there be symptoms indicating compression of the spinal marrow; and if the patient absolutely insist upon his interfering, he is to commence the reduction "by inclining the head to the side towards which it is directed, in order to disengage the articulating process of the upper vertebræ. This part of the operation is extremely dangerous, as it may kill the patient by causing a compression of the spinal marrow. When the process is disengaged, the head and neck are to be brought to their natural position by rotating them in a direction contrary to that in which the luxation took place.(*c*)

A recurrence of the accident is to be prevented, by keeping the head perfectly at rest by means of a bandage.

Remark.—With respect to the dislocations of the other cervical vertebræ, experience has proved, that if the injury be seated below the origin of the phrenic and intercostal nerves, the symptoms will be less violent, and dissolution may be protracted; though if the patient be not relieved, death must be the inevitable consequence, and that at no very remote period.

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(*a*) Levéillé's Nouvel. Doct. Chirurgicale, T. 2. p. 62.

(*b*) Scmucker's Vermischte Chirurgische Schriften. B. 1. p. 515.

(*c*) Boyer's Lectures on the Diseases of the Bones, p. 229.

tions, vol. 2. p. 148.—Schmucker's Vermischte Chirurgische Schriften, B. 1.—Sir Astley Cooper on Dislocations.—Boyer's Treatise on Surgical Diseases, vol. ii.—Boyer on the Bones.—Mauchart's Diss. de Luxatione Nuchæ, Tubing. 1747.—Murrayet Grillson's Diss. de Spinæ dorsi Luxatione, Upsal. 1780.

STRUCTURE OF THE COSTO-STERNAL AND COSTO-VERTEBRAL ARTICULATIONS.

These articulations are formed in front, between the anterior extremities of the cartilages of the ribs and the fossæ in the margins of the sternum, and behind between the heads of the ribs and the sides of the bodies of the dorsal vertebræ. The articular surfaces of these bones are tipped with cartilage, lined by synovial membranes, and retained in their situation by strong, powerful ligaments.

DISLOCATIONS OF THE COSTO-STERNAL AND COSTO-VERTEBRAL ARTICULATIONS.

The ligaments which connect the ribs to the vertebræ are so strong and numerous, that external violence is perhaps never capable of producing a displacement of their articular surfaces. The possibility of this occurrence, however, was maintained by many of the older surgeons, especially by the celebrated Paré, Barbette, Platner, and Heister; and in their works may be found a description even of what they regarded as varieties of this accident. But, notwithstanding the authority of these great masters in surgery, modern experience is decidedly opposed to their opinion, and if we carefully examine the annals of the healing art, we shall probably not find a single case that can be said, properly, to have been a luxation of the costo-vertebral or costo-sternal articulations. I am fully aware that cases have been related where this accident is stated to have taken place, but by an attentive examination of the symptoms described, it will be

seen that the injury sustained was either a fracture or an accident quite different from a dislocation of the ribs.

Although I must agree with the best modern surgical writers in denying the possibility of a dislocation of the costo-vertebral articulations, I would by no means wish to be understood to dispute the well-authenticated cases in which the ribs are said to have been displaced from their cartilages. When this accident takes place, the rib may be confined in its situation by placing a large, thick compress over the seat of the injury, and applying a roller round the chest; care being taken that the patient be kept perfectly at rest until the parts have become reunited.

Remark.—A remarkable case, in which all the ribs were dislocated from their cartilages by the chest being violently compressed between a wall and the beam of a mill, is related by Mr. Charles Bell, in his Surgical Observations.

STRUCTURE OF THE SACRO-ILIAC ARTICULATION.

The sacro-iliac articulation is formed between the lateral surfaces of the sacrum and os ilium; and is strengthened by very strong ligaments.

Dislocation.—Notwithstanding the great extent of the lateral articular surfaces of the pelvis, and the vast strength of the ligaments by which they are connected, observation has demonstrated that they may sometimes be displaced by external violence. The enormous force which is necessary to produce such an accident commonly gives rise to a concussion or total disorganization of the spinal marrow, extravasation of blood in the cellular substance of the pelvis, injury of the sacral nerves, and fracture of one or more bones of the pelvis. (*a*) When the accident is occasioned by violence, therefore, as a fall from a great height, or by the pelvis being pressed between a wall or post and the wheel of a carriage, the case will generally have a fatal termination,

(*a*) Delpech's Precis des Mal. Chirurg. T. 3. p. 52.

not so much on account of the displacement of the bone, as on account of the injury of the pelvic or abdominal viscera. Even where the patient survives the immediate effects of the great violence committed on the soft parts, he not unfrequently falls a victim in consequence of the suppurative inflammation of the articular surfaces of the bones, and the abscesses which are developed in the cellular substance of the pelvis.(*a*)

In the treatment of this affection, the most important object is to prevent inflammation and its consequences. To accomplish this, the patient is to be kept perfectly at rest, and recourse is to be had to general and local bleeding, and to a strictly antiphlogistic regimen. A roller should be passed circularly round the pelvis, and every thing that may have a tendency to disturb the parts should be carefully obviated. The patient should be kept perfectly clean; and if there be any inability to discharge the urine by the natural efforts, it must be drawn off by means of the catheter. When the violence of the symptoms has abated, the bone may generally be restored to its proper position by a slight degree of pressure, but in most cases, unless it is very much displaced, it will gradually return without any manual effort. The recovery of the patient should be facilitated by proper constitutional remedies and counter-irritants, such as blisters, stimulating liniments, and friction with the salt towel.

STRUCTURE OF THE SACRO-COCCYGEAL ARTICULATION.

The sacro-coccygeal articulation is effected between the apex of the sacrum and the base of the os coccygis, and is protected by an anterior and a posterior ligament.

Dislocation.—The sacro-coccygeal articulation may be dislocated either by external violence, such as a fall, or the kick of a horse, or by the pressure of the child's head in dif-

(*a*) Boyer's Traité des Mal. Chir. T. 4. p. 147.

ficult parturition. The symptoms which characterize this accident, are pain, retention of urine, difficulty in voiding the feces, tenesmus, and inflammation.

In rectifying this dislocation, the patient is to be placed upon his abdomen, and the index finger of one hand is to be introduced into the rectum, while by the assistance of the fingers of the other hand the displaced bone is to be brought to its natural situation.(*a*) When the reduction is completed, the symptoms above-mentioned will generally soon subside, and the patient be able to follow his usual occupation.

Article 2.—*Of Dislocations of the Superior Extremities.*

Structure of the Scapulo-humeral Articulation.

The osseous parts which enter into the composition of this joint, are the semi-spherical head of the humerus and the glenoïd cavity of the scapula. In the recent state, they are both covered with cartilage, but the latter is rendered somewhat deeper by the glenoïd ligament, which is of a fibro-cartilaginous nature, surrounds the margin of the glenoïd cavity, and appears to be a continuation of the tendon of the biceps muscle.

Capsular ligament.—The capsular ligament of the scapulo-humeral articulation is of an oblong form, being thick and firm at its superior part, and comparatively thin and weak at its inferior. It arises from the neck of the scapula, and as it passes downwards it gradually expands to surround the herd of the humerus, and again contracts where it is inserted into the neck of this bone. At the bicipital groove it is perforated by the long head of the biceps, which is confined by a ligamentous sheath, and gives additional strength to the upper part of the joint.

(*a*) C. Bell's Operative Surgery, vol. ii. p. 306.

At its supero-internal part, the capsular ligament is strengthened by a bundle of fibres, which pass outwards and forwards from the coracoïd process to the great tubercle of the humerus, and constitute what is called the coraco-humeral ligament. In addition to this, it also receives considerable strength from the tendons of the sub-scapularis, the teres minor, and the supra and infra spinati muscles, which are intimately connected with it as they proceed to be inserted into the tubercles of the os humeri.

Synovial membrane.—After having lined the glenoïd cavity the synovial membrane covers the internal surface of the capsular ligament, the tendon of the sub-scapularis, the neck and head of the humerus, and passing down into the bicipital groove, it is reflected upon the tendon of the biceps, which it invests in the form of a tube or sheath, and accompanies it into the glenoïd cavity. (*a*)

Motions.—The motions of the scapulo-humeral articulation are more extensive than in any other joint of the body, it being capable of elevation, depression, adduction, abduction, circumduction, and rotation.

Remark.—The rotatory motion of this joint is extremely limited, on account of the shortness of the neck of the humerus, and also on account of the capsular ligament, which is twisted either from within outwards or from without inwards.

DISLOCATIONS OF THE SCAPULO-HUMERAL ARTICULATION.

The head of the os humeri may be thrown from the glenoïd cavity in four different directions—downwards, forwards, backwards, and upwards against the outer side of the coracoïd process of the scapula. The first three of these luxations are called complete, but the latter is only partial, and is always accompanied by a laceration of the anterior portion of the capsular ligament.

Remark.—This division, which is as natural as it is simple, is somewhat similar to that which was adopted by the Greek and Arabian writers, prior to the time of Hippocrates.

(*a*) Boismont's Traité Elementaire d'Anatomie, p. 199.

§ I. LUXATION DOWNWARDS.

Causes.—Luxation downwards or into the axilla is by far the most common, and is usually occasioned by force applied to the elbow while the arm is elevated and removed from the side of the body. It may also be produced by a fall upon the top of the shoulder, and sometimes, perhaps, by the action of the deltoïd muscle.

Symptoms.—In a dislocation downwards the arm is always a little longer than in the natural state; there is a hollow or depression below the acromion, and the natural roundness of the shoulder is destroyed; the head of the humerus can be felt in the axilla when the elbow is carried from the side of the trunk, the patient is unable to raise his arm by muscular effort, and there is an inability to perform the motions of circumduction; the elbow is removed more or less from the axis of the body by the action of the deltoïd muscle, and the pain which results from this position, compels the patient to lean towards the injured side, and so to support his limb as to relax the muscles and prevent all painful motion.

Additionally to these symptoms there is also frequently a considerable numbness in the fingers, arising, no doubt, from the pressure of the head of the os humeri upon the nerves of the axillary plexus. This circumstance was already known to Avicenna, an eminent physician, who was born in Chorasan, in the year nine hundred and eighty, and who afterwards practised medicine with great eclat at Bagdat; and it was several times observed by the celebrated Desault in the clinical wards of the Hôtel Dieu.

In recent or primitive luxations of the os humeri downwards, the capsular ligament of the scapulo-humeral articulation is generally extensively lacerated, and the opening in the capsule is so large as to allow of the easy return of the head of the bone into its natural situation. It often hap-

pens, also, that the tendons of the sub-scapularis, the teres minor, and the supra and infra spinati muscles are torn from the bone, but that of the biceps is seldom injured, at least this would appear to be the general opinion of the writers of the present day.

Prognosis.—This luxation, as I have just stated, may generally be easily reduced; and, when not complicated with fracture of the head of the bone, it usually gets well without any untoward occurrence.

Reduction.—To reduce this dislocation, the patient should be placed in the recumbent posture upon a mattress or table, and a strong handkerchief should be tied round the arm immediately above the elbow. The surgeon, resting one foot upon the floor, is then to separate the elbow from the side of the body, and place the heel of the other foot in the hollow of the axilla, taking care that the head of the bone be received upon it, whilst he himself remains in the half sitting posture. The fore arm is then to be bent to a right angle with the os humeri, and the arm is to be steadily drawn for three or four minutes, by means of the handkerchief, when the head of the bone will generally resume its original situation. Should this process, however, be found insufficient, on account of the resistance of the muscles, the extending power may be increased by applying a folded towel, and intrusting it to the care of several assistants, at the same time that the heel is kept in the axilla. This method is usually attended with complete success, and should therefore always be tried before recourse be had to more powerful means. (*a*)

Reduction by means of the knee.—This method, like the one just described, is particularly applicable to dislocations occurring in delicate females, and in old emaciated individuals. Having placed the patient upon a low chair, the surgeon is to stand on the side of the affected limb, and

(*a*) Sir Astley Cooper on Dislocations, p. 306.

separate the arm from the trunk to a sufficient extent to enable him to place his knee in the axilla. The foot being now suppported upon the side of the chair, and one hand applied to the lower part of the arm immediately above the elbow, and the other to the acromion process of the scapula, the arm is to be drawn down over the knee, by means of which, the head of the humerus will readily glide back into its place.(*a*)

Kirby's Method.—Mr. Kirby of Dublin, has lately devised a very ingenious method for reducing dislocations of the shoulder-joint, an account of which, should by no means be omitted on the present occasion. The patient is to be seated upon the floor on a mattress, and a bandage is to be fixed round the lower part of the arm. Extension and counter-extension are then to be made by two assistants, one of whom is to steady the scapula by placing one arm before, and the other behind the chest, while the other takes hold of the extending bandage. Care should always be taken that the assistants be placed oppositely to each other, and that their legs be disposed in such a way that the soles of their feet shall be brought into contact both before and behind the patient. The arm is now to be raised nearly to a right angle with the body, and while the assistant makes the extension in a slow and gradual manner, the surgeon presses gently upon the head of the humerus, and directs it towards the glenoïd cavity, by elevating the elbow and bringing it to the side of the body.

The methods which have been detailed will generally be attended with success in weak and delicate individuals, during the early stage of the injury; but when the limb has become firmly fixed in its new situation, or has remained unreduced for a considerable length of time, and the muscles have become powerfully and permanently contracted, it will be necessary to have recourse to other means.

(*a*) Sir Astley Cooper, op. cit. p. 310.

One of the best methods that can be employed for this purpose is to place the patient upon a chair, and to apply a compress under the axilla, on the side affected, and upon this compress the middle of a folded sheet, the ends of which are to be carried over the opposite shoulder, and secured to a staple or post. Another strong sheet or towel is then to be fixed to the wrist or immediately above the elbow, and its ends are to be given to two or three assistants. All that now remains to be done is to fix the scapula, without which every other precaution would be of little service. This object is effected by a third sheet, the centre of which is to be applied upon the acromion process, and there secured by an assistant, while the extremities are carried obliquely before and behind the chest, and firmly fixed at the opposite side. The fore-arm should then be raised to a right angle with the body, or a little above the horizontal line, to relax the deltoïd and supra-spinatus muscles; and while the assistants make the necessary extension and counter-extension, the surgeon places his knee in the axilla, and at the same time that he raises it upwards, he pushes the acromion process downwards and inwards, and by this means enables the head of the os humeri to slip into its natural situation.

Should this plan, however, not be attended with success, it will be necessary to remove the apparatus, and attempt to reduce the bone by means of pulleys. For this purpose, the patient should be placed upon a low seat, and the middle of a broad sheet should be passed round the chest, and the ends secured on the side opposite to the injured shoulder. The lower part of the arm is then to be enveloped with soft buckskin, and over this is to be applied the middle of a strong napkin, the ends of which are to be tied together, and hooked upon a pulley fastened in the floor. The next thing to be done is to secure the scapula, which may be readily effected by passing the middle of a sheet or towel, hollowed out for the purpose, over the acromion process, and giving the ends of it to one or two assistants, seated upon the floor

on the sound side of the patient. Every thing being thus arranged, the surgeon bends the patient's fore-arm across the chest, and using it as a lever, communicates a gentle rotatory motion to the arm, at the same time that an assistant keeps up a slow and gradual extension by tightening the cord of the pulley.(*a*)

§ II. LUXATION FORWARDS.

Causes.—This dislocation is usually produced by a blow upon the head of the os humeri, or by violence applied to the elbow while the arm is elevated and thrown behind the central line of the body.

Symptoms.—The head of the humerus may be distinctly felt on the sternal side of the coracoïd process, immediately below the middle of the clavicle; the arm is somewhat shortened; the elbow is carried out from the body and directed backwards; the depression beneath the acromion is more conspicuous than in the dislocation downwards; and if the arm be rotated, the head of the bone will roll beneath the finger in such a manner as to render it almost impossible to mistake the nature of the accident. The pain is also slighter than when the bone is luxated into the axilla, from its not compressing the axillary nerves, but the motions of the joint are more materially affected. Whatever may be the cause by which the accident is produced, the anterior portion of the capsular ligament of the articulation is always torn, and the patient is unable to perform the motion of circumduction.

Prognosis.—In the dislocation forwards, the prognosis is always more unfavourable than in that downwards, on account of the straining and laceration of the parts being more considerable, and the reduction more difficult.(*b*)

(*a*) Gibson's Institutes of Surgery, vol. ii. p. 19–20.

(*b*) Boyer's Lectures on the Diseases of the Bones, p. 248.

Reduction.—The reduction may usually be accomplished by placing the foot in the axilla, so as to press upon the head of the bone, at the same time that the arm is drawn obliquely downwards and a little backwards; but if some time has elapsed before the reduction is attempted, it will be requisite to employ continued extension by means of the pulleys.

In using the pulleys, it is necessary to employ the same extending and counter-extending bands as in the dislocation downwards. The fore-arm should be bent, to relax the biceps muscle, and the arm should be drawn obliquely downwards and forwards. When the bone begins to move from its accidental situation, the surgeon is to apply his heel against the head of the os humeri at the anterior part of the shoulder, and as soon as it arrives below the level of the coracoïd process, it is to be pushed backwards towards the glenoïd cavity, care being taken at the same time that the elbow be drawn forwards. (*a*)

Remark.—Although pulleys may generally be used with perfect safety in the hands of a prudent and scientific surgeon, they should always be employed with the greatest caution, for fear of doing severe and extensive mischief to the soft parts.

In the luxation forwards, Boyer recommends that the limb be inclined forwards and downwards, and that the extension be made horizontally outwards and a little backwards. As soon as the bone begins to move, the surgeon is to press with one hand upon the back of the elbow, and with the upper upon the antero-superior part of the humerus, in order to push the head of the bone from within outwards, and direct it towards the glenoïd cavity of the scapula. These last manœuvres may be considerably facilitated by carrying the arm obliquely over the anterior part of the chest. (*b*)

(*a*) Sir A. Cooper on Dislocations, p. 314-15.

(*b*) Boyer's Traité des Maladies Chirurgicales, T. 4. p. 203-5.

Remark.—In the reduction of this luxation, it is necessary that the extension should be kept up longer than in the dislocation downwards, on account of the greater resistance of the parts.

§ III. LUXATION BACKWARDS.

Causes.—Dislocation backwards may be occasioned by any of the causes to which I have alluded in the preceding paragraphs.

Remark.—Although many surgeons are of opinion, that the head of the humerus can not be displaced backwards, yet there are numerous cases on record which clearly establish its existence. "No force," says the learned Mr. Charles Bell, "can be applied in a direction to dislocate the humerus, and push its head behind the scapula, for this very evident reason, that the chest prevents the necessary position of the humerus."(*a*) After what has just been said, it is scarcely necessary to add, that the assertion of this gentleman is altogether gratuitous, for its inaccuracy has been satisfactorily shown by many distinguished surgeons, especially by Fizeau,(*b*) Delpech,(*c*) Physick,(*d*) Toulmin, Coley, and Sir Astley Cooper.(*e*)

Symptoms.—The head of the humerus is forced upon the dorsum of the scapula, and forms a protuberance of considerable magnitude at the postero-external part of its inferior costa; the arm is closely approximated to the side; the natural rotundity of the shoulder is destroyed; the fore-arm is turned inwards, and passed obliquely across the chest; the luxated head may be distinctly felt with the fingers, and on rotating the elbow, it will be found to obey its motions.

Reduction.—In reducing this luxation, the bandages should be applied in the same manner as in the dislocation into the axilla, and the extension should be made in the same

(*a*) Operative Surgery, vol. ii. p. 339.

(*b*) Journal de Médicine, Chirurgie, &c. par M. M. Corvisart, Le Roux, et Boyer, T. X. p. 386.

(*c*) Precis Elementaire des Mal. Chir. T. 3. p. 72.

(*d*) Dorsey's Elements of Surgery, vol. i. p. 243.

(*e*) On Dislocations, p. 315. et seq.

direction as in cases of that description. The fore-arm is to be elevated and rotated outwards, and as soon as the head of the bone can be perceived in the axilla, the limb is to be brought gently downwards and backwards into the horizontal line, care being taken to keep the humerus all the while in the same situation. An assistant being now requested to make the requisite extension, the surgeon places his hand firmly upon the acromion process of the scapula, and thus pushes the head of the bone into its former position. (*a*)

Remark.—In a case of dislocation backwards, which came under the care of Dr. Physick, in 1811, this gentleman succeeded in effecting a reduction by making extension and counter-extension in the usual way, applying pressure upon the head of the bone, and pushing it towards the glenoïd cavity, whilst the extension was kept up by the assistants. (*b*)

§ IV. LUXATION AGAINST THE CORACOID PROCESS.

Causes.—The most frequent cause of this dislocation, is a violent blow or fall upon the elbow at the moment the arm is carried backwards, beyond the line of the body, as in the luxation downwards.

Symptoms.—The head of the luxated bone is generally forced towards the anterior part of the glenoïd cavity, and can be distinctly felt resting against the coracoïd process; the natural roundness of the shoulder is destroyed, and there is an evident depression under the acromion; the arm is thrown inwards and forwards, and though the lower portion of the limb is still capable of being moved, it is impossible to elevate it, on account of the head of the humerus striking against the coracoïd process. In this luxation, the anterior portion of the capsular ligament must, of course, always be torn; but it seldom happens that there is a rupture of the tendons of the muscles which are connected with the joint.

Prognosis.—In this luxation, it is usually more easy to

(*a*) Sir Astley Cooper, op. cit. p. 318.

(*b*) Dorsey, op. cit. vol. i. p. 248.

effect a cure than in some of the preceding, provided proper care be taken to prevent a relapse, which is always apt to occur if the limb be not well supported until the parts have become firmly united.

Reduction.—The reduction may be effected according to the directions already given for the management of the dislocation forwards, only that it will be necessary to draw the shoulder backwards, in order to push the head of the bone into the socket of the joint.

Treatment after the reduction.—Whatever may be the kind of dislocation, a recurrence of the accident should always be prevented by keeping the elbow for some days at rest, and close to the side in a sling. This precaution should be particularly observed when the head of the humerus is thrown against the coracoïd process, as in this case a relapse is extremely liable to take place. Under ordinary circumstances this may be effectually obviated by applying a roller round the trunk, so as to include the elbow; but in some instances it will be absolutely necessary to resort to Desault's bandage for fractures of the clavicle, as is usually done in all cases of dislocations by the French surgeons.

The symptoms which accompany or follow a luxation of the scapulo-humeral articulation, such as pain, paralysis of the deltoïd muscle, or œdema of the arm, are to be treated according to the circumstances of each individual case.

If there be much pain and severe contusion of the soft parts, it will be necessary, especially if the patient be young and robust, to take away blood by general and local bleeding, to apply emollient poultices, and administer cooling laxatives and anodyne remedies. As soon as the pain has abated, the parts are to be bathed with discutient applications, such as the linimentum ammoniæ, salt-water, or opodeldoc; and the limb is to be gradually and gently moved to enable it to recover its natural motions.

Paralysis of the arm or deltoïd muscle may proceed from injury done to the axillary plexus or circumflex nerve, by

the head of the humerus.(*a*) When the injury is slight, the paralytic affection may get well spontaneously, or yield to the application of blisters, the moxa, or irritating frictions; but when it results from severe contusion and disorganization of the nerves, it frequently resists the most powerful applications, and may even forever remain incurable.(*b*)

Œdema of the arm is a consequence of rare occurrence, it may arise from the pressure of the head of the os humeri upon the axillary veins and lymphatic vessels which return the fluids of the superior extremity; and generally gets well spontaneously as soon as the exciting cause is removed. Another consequence of dislocations of the shoulder-joint, which seldom occurs in practice, but which was several times observed by Desault, is a sudden extravasation of air arising at the moment of the reduction. It makes its appearance suddenly under the pectoralis major muscle, and as it increases, it spreads rapidly towards the axilla, the whole extent of which it occupies. It may be readily distinguished from a rupture of the axillary artery by its elasticity; by the continuance of the pulse at the wrist; and by the natural colour of the skin; and may be dispersed without difficulty by gentle compression and the lotio plumbi acetatis.

STRUCTURE OF THE HUMERO-ULNAR ARTICULATION.

The humero-ulnar articulation, or elbow-joint, is formed by the inferior extremity of the humerus and the superior extremity of the ulna and radius. The sigmoïd cavity of the ulna articulates with the trochlea of the humerus so as to form a complete hinge-joint; while the cup-shaped depression on the head of the radius turns freely on the rounded tuberosity, to which it is applied, and enables the hand to execute the motions of pronation and supination.

(*a*) Boyer's Lectures on the Bones, p. 242.—Delpech's Precis. des Mal. Chir. T. 2. p. 73.

(*b*) Cooper's First Lines, vol. ii. p. 463.

Humero-ulnar ligament.—The humero-ulnar ligament is of a triangular form; it arises from the internal condyle of the humerus and passes downwards and backwards to be inserted into the corresponding part of the coronoïd process, and the inner margin of the olecranon.

Humero-radial ligament.—This ligament, like the one just described, is of a triangular form, its apex being situated above, its base below; it arises from the external condyle of the humerus, and, becoming broader as it descends, is inserted into the anterior and posterior edge of the superior sigmoïd cavity of the ulna, in common with the annular ligament of the radius.

Remark.—The above ligaments have commonly been described by anatomists, under the names of external and internal lateral ligaments; sometimes also under those of brachio-cubital and brachio-radial; but the terms by which they are designated above, would certainly appear to be the most appropriate.

Anterior ligament.—The anterior ligament is a thin flattened membrane, situated in front of the joint, extending from the superior part of the coronoïd cavity of the humerus to the anterior margin of the coronoïd process of the ulna and to the annular ligament of the radius. Its fibres pass in different directions, some obliquely downwards and outwards, others vertically downwards.

Posterior ligament.—This ligament arises from the superior part of the olecranoïd cavity of the humerus, and is inserted into the extremity of the olecranon and postero-inferior part of the os humeri, between its two condyles.

Synovial membrane.—After having lined the internal surface of the anterior ligament, the synovial membrane is prolonged into the coronoïd cavity of the humerus, as far as the inferior surface of that bone, from whence it is reflected into the olecranoïd cavity. After lining which, it passes upon the posterior ligament, and enters the superior radio-ulnar articulation.

Motions.—The motions of this joint are flexion, extension, and a slight degree of lateral inclination.

DISLOCATIONS OF THE HUMERO-ULNAR ARTICULATION.

The bones of the fore-arm may be dislocated from the humerus backwards, or to either side. Lateral luxations are by far the least frequent, and are always incomplete, on account of the great extent of the articular surfaces in this direction, and the strength of the muscles and ligaments which surround the joint.

Remark.—The bones of the fore-arm can seldom be thrown forwards without the olecranon being broken; and Professor Delpech asserts that there is but a single instance of this luxation upon record, that was not accompanied with fracture of the olecranon. (*a*)

§ I. LUXATION BACKWARDS.

Causes.—The dislocation backwards usually takes place from a fall in which the patient extends his arm, as it were, by mechanical instinct to protect the body, and receives the whole shock upon the palm of the hand.

Symptoms.—The existence of this dislocation is evinced by a large protuberance on the posterior part of the elbow, caused by the unnatural projection of the olecranon; the lower end of the humerus is situated upon the anterior surface of the radius and ulna, between the coronoïd process and the insertion of the tendon of the biceps muscle; the fore-arm is in a state of semi-flexion, very painful when extended, and can not be carried to the mouth or forehead by muscular exertion; the humero-ulnar and humero-radial ligaments are torn; the biceps, pronator radii teres, supinator brevis, and triceps extensor cubiti, are all in a state of ten-

(*a*) Precis Elémentaire des Maladies, Chirurgicales, T. 3. p. 81.

sion; and the hand and fore-arm are supine and can not be rendered entirely prone. (*a*)

Remark.—According to Professor Boyer, this accident may sometimes be mistaken for a fracture of the head of the radius, the olecranon, or even the lower extremity of the humerus. Hence, great care should always be taken to establish a correct diagnosis; for if the reduction be not effected, and the case be treated as a fracture, considerable mischief must necessarily be the consequence.

Prognosis.—If this dislocation be not reduced in a short time after the reception of the injury, all our efforts at reduction will prove unavailing; the heads of the radius and ulna will unite to the posterior part of the humerus, and the patient will be deprived, in great measure, of the use of his arm. Nature is always impeded in her attempts at re-establishing motion, nor does she ever succeed in effecting her purpose but in an imperfect manner.

Reduction.—Sir Astley Cooper's method.—To reduce this dislocation, the patient is to be seated upon a chair, and the surgeon is to place his knee in the bend of the joint. The arm is then to be flexed, by taking hold of the patient's wrist, and the radius and ulna are to be separated from the inferior part of the humerus, by the pressure of the knee. During this manœuvre, the fore-arm is to be slowly and forcibly bent, and the reduction will soon follow.

Sir Astley Cooper has also sometimes succeeded in effecting a reduction by forcibly bending the arm whilst it was placed round the post of a bed, or through the opening in the back of an elbow chair.

Boyer's method.—The patient being seated firmly in a chair, extension and counter-extension are to be made by two assistants, one of whom is to take hold of the wrist, the other of the middle of the arm. The surgeon being seated on the outside of the affected limb, now places the four fin-

(*a*) Sir Astley Cooper on Dislocations, p. 333.—Boyer on the Bones, p. 252.—Delpech, op. cit. T. 3. p. 82.

gers of each hand on the fore part of the humerus, and his thumbs on the olecranon, and while he pushes this process downwards and forwards, he draws up the lower end of the os humeri. By this management, the surgeon will generally be able to effect a reduction; but if more force be required, it will be necessary to apply a fillet round the wrist, and to make the extension and counter-extension as in dislocations of the shoulder-joint.

Remark.—When the ulna is alone dislocated backwards, as frequently happens in practice, the fore-arm and hand are turned inwards; the olecranon forms a projection behind the humerus; and the patient is unable to extend his arm. The accident usually arises from severe violence applied to the lower extremity of the ulna, by which it is suddenly and forcibly pushed upwards and backwards. The bone may be easily reduced by bending the arm over the knee, and pulling down the fore-arm. (*a*)

Treatment after the reduction.—When the reduction of the dislocation is accomplished, which may always be known by some degree of noise, and by the relative position of the parts, a bandage is to be applied round the elbow in the form of a figure-of-eight, and the arm is to be supported upon a splint and kept in a sling. The laceration which invariably takes place in this luxation, is always followed by more or less inflammation and swelling, which is to be combated by the usual antiphlogistic measures. When the inflammatory symptoms have nearly subsided, which generally takes place in about a week or ten days, the arm is to be gently moved, and the motion is to be daily increased, in order to prevent rigidity and anchylosis, to which the humero-ulnar articulation is peculiarly subject. (*b*)

Remark.—It has sometimes happened in this dislocation, that the inferior extremity of the humerus has been thrown so far upon the anterior surface of the radius and ulna as to project through the integuments,

(*a*) Sir Astley Cooper on Dislocations, p. 336-7.

(*b*) Boyer's Lectures on the Bones, p. 253-4.

and occasion a rupture of the humeral artery, or to be so far protruded as to be irreducible, and require to be removed with the saw.(*a*)

§ II. LATERAL LUXATIONS.

Causes.—The lateral dislocations of the elbow-joint are usually caused by a blow or fall upon the wrist, which drives the upper part of the fore-arm violently outwards or inwards: they may also be occasioned by a wagon or coach passing over the arm whilst it is placed upon an uneven surface, or by getting the limb entangled in the spokes of a wheel, as in the case mentioned by J. L. Petit.

Symptoms.—When the heads of the radius and ulna are dislocated inwards, the olecranon and coronoïd process are situated more internally than in the natural state; the arm is constantly bent; the upper extremity of the radius is forced upon the trochlea of the humerus, and the sigmoïd cavity of the ulna is thrown more or less from the latter bone, and forms a projection at the inside of the elbow. The brachialis, biceps and triceps muscles are displaced inwards, and very prominent; while the short supinator, being in a state of tension, rotates the radius outwards.

In the lateral dislocation outwards, the point of the olecranon is always in contact with the posterior part of the humerus; the fore-arm is slightly flexed; and the biceps, triceps, and brachialis internus are put upon the stretch; the hand is in a state of fixed pronation; the fingers are bent;(*b*) the motions of flexion and extension are greatly impeded; the internal portion of the trochlea of the humerus has lost its natural relation with the ulna, and forms a projection at the inside of the elbow.(*c*)

As these luxations are generally produced by severe violence, and are followed by so much swelling as to obscure

(*a*) Delpech, op. cit. T. 3. p. 82.—Evans's Practical Observations on Compound Dislocations, p. 101.

(*b*) Delpech's Precis Elém. des Mal. Chir. T. 3 p. 83.

(*c*) S. Cooper's First Lines, vol. ii. p. 474.

the form of the joint, it is often a matter of considerable difficulty to establish a clear diagnosis. One of the most common causes of mistake is the feel of a very evident crepitus on moving the fore-arm; but it should be borne in mind that this symptom accompanies almost every dislocation of the humero-ulnar articulation, and that it is by no means sufficient to afford a correct idea of the nature of the injury. Mr. S. Cooper relates several deplorable cases of this kind, where the reduction was deferred by the attending surgeons from mistaking the nature of the case, and the patients remained permanently crippled.

Reduction.—The lateral dislocations of the elbow may be readily reduced, either by bending the arm over the knee, as in the dislocation backwards; or by making extension and counter-extension at the same time that the extremities of the humerus and of the bones of the fore-arm are pushed in opposite directions.

Treatment after the reduction.—Having effected the reduction, the fore-arm is to be kept moderately bent in a sling; and if there be much pain and swelling, recourse must be had to general and local bleeding, cold applications, low diet, and mild laxatives. The arm should be kept perfectly at rest; and for this purpose it may sometimes become necessary to make use of a bandage, a compress, and splint.

STRUCTURE OF THE SUPERIOR RADIO-ULNAR ARTICULATION.

The superior radio-ulnar articulation is formed by a part of the circumference of the head of the radius and the small sigmoïd cavity of the ulna. The articular surfaces are tipped with cartilage, and invested by a portion of the synovial membrane of the elbow-joint: the radius is connected to the ulna by an annular ligament.

Annular ligament.—The annular, orbicular, or coronary ligament is a strong band of circular fibres; it is attached to the anterior and posterior margins of the lesser sigmoïd

cavity, in the form of a ring, which encircles the head of the radius, and binds it firmly in its place.

Motions.—The superior radio-ulnar articulation forms a lateral hinge, which enables the hand to perform the motions of pronation and supination, but is not affected by the motions of flexion and extension of the fore-arm.

DISLOCATIONS OF THE SUPERIOR RADIO-ULNAR ARTICULATION.

The head of the radius may be dislocated from the upper extremity of the ulna in two different directions—viz. backwards and forwards.

Remark.—Desault, who was one of the most able surgeons of his age, and who has transmitted the result of his experience in a work that will remain immortal, was of opinion that it was impossible for the upper head of the radius to be thrown from the sigmoïd cavity of the ulna by any sudden external violence, and as a single and uncomplicated injury. But the observations of Duverney, Boyer, Richerand, Sir Astley Cooper, Mr. Dunn of Scarborough, and of Mr. Lawrence and Mr. Earle, of London, as well as of other distinguished surgeons, put the fact beyond the possibility of a doubt.

§ I. LUXATION BACKWARDS.

Causes.—The most common cause of this luxation, is violence applied to the hand, when the fore-arm is in a state of pronation, and carried beyond the natural line of the body. In children it is said to be often occasioned by pulling at the arm in an over-stretched state of pronation, when they are in danger of falling.

Remark.—Professor Boyer, to whose works I have had occasion so frequently to refer in the preceding parts of this treatise, is of opinion, that luxation backwards occurs more readily and frequently in children, than in adults and old persons, a circumstance which appears to be owing, chiefly to the smallness of the lesser sigmoïd cavity of the ulna, and to the weakness of the annular, humero-ulnar, and humero-radial

ligaments, which, in more advanced age, contribute materially to the protection of the superior radio-ulnar articulation.

Symptoms.—There is an evident depression at the upper and external part of the fore-arm; the head of the radius forms a considerable prominence at the outside of the external condyle or behind the lesser head of the humerus; the fore-arm is bent, and the hand fixed in a state of pronation; the fingers are moderately flexed; and every attempt to perform the motion of supination is unattended with success and gives rise to a considerable increase of pain.

Prognosis.—Although this dislocation may be easily enough reduced, yet as the annular ligament is always more or less lacerated, it usually requires considerable time and attention to effect a permanent cure.

Reduction.—The luxation may be rectified by extending the fore-arm; and pushing the head of the radius from behind forwards, towards the lesser tubercle of the humerus, at the same time that the hand of the patient is to be brought in the supine position. The return of the bone is always indicated by an audible noise, and by an ability to bend and extend the elbow and supinate the hand.

Treatment after the reduction.—As soon as the reduction is accomplished, proper measures must be taken to prevent a return of the accident, and give nature an opportunity of repairing the lacerated ligaments. A splint should be applied along the inside of the fore-arm, and the hand should be carried supinely in a sling for three or four weeks. The arm should be frequently moved, but always gently, and not until ten days or two weeks after the accident.

§ I. LUXATION FORWARDS.

Causes.—The chief causes of this dislocation, are falls upon the hand, in which the radius receives the whole weight of the body, and is thrown upon the coronoïd process of the ulna.

Symptoms.—In the dislocation of the superior radio-ulnar articulation forwards, the head of the radius may be distinctly felt at the upper and anterior part of the elbow, and if the hand be rotated the bone will be perceived to follow its motions, the fore-arm is slightly bent, and every attempt to extend it or bring it to a right angle with the arm proves unsuccessful, and has only a tendency to augment the sufferings of the patient; the hand is in a state of pronation, and when the fore-arm is suddenly flexed, the head of the radius will be found to strike against the antero-inferior part of the humerus, and put a sudden check to its motions.

Reduction.—The reduction is to be effected by fixing the os humeri, and bending the hand towards the ulnar side of the fore-arm, at the same time that the surgeon endeavours to push the head of the radius from above downwards into its natural situation.

Treatment after the reduction.—This is precisely the same as in the preceding case, only that the splint is to be placed along the back, instead of the anterior part of the arm. It will be proper also during the first eight or ten days to lay the arm upon a pillow, as putting it in a sling would be apt to cause a return of the dislocation.

STRUCTURE OF THE INFERIOR RADIO-ULNAR ARTICULATION.

The inferior radio-ulnar joint is effected between the concave articular surface of the radius, and the convex articular surface of the ulna. The two bones are retained by anterior and posterior ligamentous fibres, which pass transversely from one bone to the other, and are so thin and scattered as scarcely to admit or require description; internally they are connected by an inter-articular fibro-cartilage, and a synovial membrane.

Inter-articular cartilage.—The inter-articular cartilage is situated transversely between the two bones, being at-

tached by its apex to the depression which separates the styloïd process from the articular surface of the ulna, and by its base to the border which separates the two articular cavities of the radius. Its superior surface looks towards the lower extremity of the ulna, its inferior to the cuneiform bone of the first range of the carpus: both are smooth, lubricated, and lined by synovial membrane; the superior one by the small membrane peculiar to the radio-ulnar articulation, the inferior by the large one of the radio-carpal or wrist-joint.

Synovial membrane.—This membrane, which is frequently dignified by the title of membrana capsularis sacciformis, may be regarded as presenting two parts, both of which are continuous with each other. One invests the head of the ulna, with the corresponding surface of the fibro-cartilage; the other is reflected perpendicularly upwards into the radio-ulnar articulation, and lines the contiguous surfaces of both bones.

Motions.—The inferior radio-ulnar articulation allows the radius to roll upon the ulna, and perform the motions of pronation and supination of the hand.

DISLOCATIONS OF THE INFERIOR RADIO-ULNAR ARTICULATION.

The inferior extremity of the ulna may be luxated from that of the radius, either forwards or backwards.

§ I. LUXATION FORWARDS.

Causes.—The ulna may be displaced forwards by a fall upon the wrist, by a violent twist of the hand while in a state of supination, or by violence applied directly to the fore-arm; it is an accident of rare occurrence.

Symptoms.—The fore-arm is slightly bent and fixed in the supine state; the head of the ulna forms a remarkable

projection above the ulnar extremity of the carpus, and instead of being parallel with the radius it crosses obliquely at its lower extremity; the fingers are slightly flexed; and the hand can not be pronated.(*a*)

Prognosis.—Experience has shown that this luxation is never susceptible of spontaneous reduction; and that if it be neglected the motions of the hand and fore-arm will be either lost or at least greatly impeded.

Reduction.—The dislocation may be rectified by pulling at the fore-arm, and pushing back the ulna, at the same time that the extremity of the radius is carried forwards, and the hand brought to the state of pronation. Success is indicated by the noise of the bone in resuming its natural situation, by the disappearance of the deformity, and the recovery of the motions of the hand.

Treatment after the reduction.—The bone is to be kept in its proper situation, by means of a padded splint, extending from the anterior part of the bend of the elbow to the extremity of the fingers. A firm compress is to be placed upon the head of the ulna; and the apparatus is to be secured with a roller, applied with sufficient tightness. The arm is to be kept quietly in a sling; and if there arise any unpleasant symptoms, they are to be combated by the usual means.

§ II. LUXATION BACKWARDS.

Causes.—The luxation backwards is usually the result of violence applied to the hand or fore-arm, when in a state of strong pronation. The accident is particularly liable to take place in laundresses and in persons whose occupations make it necessary that their hands should be suddenly and powerfully pronated.

Symptoms.—The hand is fixed in a state of pronation,

(*a*) Boyer, op. cit. p. 217.—Delpech, op. cit. p. 100.

and is a little inclined towards the ulnar side; the head of the ulna passes obliquely across the radius, and forms a prominence above the level of the os cuneiforme; the sacciform ligament is lacerated; and the styloïd process has lost its parallelism with the metacarpal bone of the little finger.

Prognosis.—Nearly the same as in the preceding case, excepting that, if the reduction be neglected, the hand and arm can be used with more facility.

Reduction.—The reduction is effected by gradually but forcibly extending the hand, and moving it laterally until it is restored to its supine position.

Treatment after the reduction.—The after treatment is the same as in the dislocation forwards, except that the splint is to be placed along the posterior part of the fore-arm.

STRUCTURE OF THE RADIO-CARPAL ARTICULATION.

This articulation is formed by the inferior extremity of the radius and the upper surfaces of the scaphoïd, semi-lunar, and cuneiform bones of the carpus: it is retained in situ by four ligaments and a synovial membrane.

Radio-carpal ligament.—The radio-carpal or external lateral ligament is of a triangular form, being narrow above and broad below. It arises from the lower extremity of the styloïd process of the radius, and passing downwards, is inserted into the external side of the os scaphoïdes, some of its fibres being continued as far down as the trapezium and annular ligament of the wrist.

Ulna-carpal ligament.—The ulna-carpal or internal lateral ligament arises from the inner surface of the styloïd process of the ulna, and is inserted into the cuneiform bone of the carpus: it also sends some fibres to the annular ligament and os pisiforme.

Anterior radio-carpal ligament.—The anterior radio-carpal ligament presents a broad membranous appearance; it arises from the anterior margin of the lower extremity of

the radius, and is inserted into the anterior surface of the scaphoïd, semi-lunar, and cuneiform bones of the wrist.

Posterior radio-carpal ligament.—The posterior radio-carpal ligament extends obliquely downwards and inwards from the infero-posterior part of the radius, to the upper surface of the semi-lunar and cuneiform bones of the carpus.

Synovial membrane.—The synovial membrane, after having lined the articular surface of the radius and the inter-articular cartilage, is reflected upon the anterior and poste rior radio-carpal ligaments, and the convex surface of the carpal bones.

Motions.—The motions of this joint are flexion, extension, lateral inclination, and circumduction.

DISLOCATIONS OF THE RADIO-CARPAL ARTICULATION.

The carpus, in its articulation with the fore-arm, may be luxated in four directions; forwards, backwards, and to either side. The dislocation outwards or inwards is always partial or incomplete.

§ I. LUXATION FORWARDS.

Causes.—Luxation forwards is commonly produced by a blow or fall upon the palm of the hand, the fingers being extended, and more force being applied to the lower than to the upper part of the palm.

Symptoms.—The characteristic marks of this accident, are a projection at the back part of the wrist, caused by the displacement of the upper range of the bones of the carpus;(*a*) a painful extension of the hand, and great difficulty in restoring it to its natural direction.

Prognosis.—This luxation is always accompanied by so much laceration of the ligaments, and such a degree of in

(*a*) Delpech's Precis Elémentaire des Mal. Chir. T. 3. p. 103.

flammatory swelling, that it generally requires a considerable time before the patient recovers the full use of his wrist.

Reduction.—In reducing this dislocation, an assistant should be requested to take hold of the lower part of the humerus, immediately above the elbow, while the surgeon grasps the patient's hand with his right hand, and supports the fore-arm with his left. They are then to pull in opposite directions, at the same time that pressure is applied to the protruded bones, until the reduction is accomplished.

§ II. LUXATION BACKWARDS.

Causes.—The chief causes of this luxation, are falls or blows upon the back of the hand, while it is immoderately flexed.

Symptoms.—The accident is evinced by a depression at the anterior part of the wrist; by a remarkable prominence at the lower part of the dorsal surface of the fore-arm; by an extraordinary flexion of the hand; and by a permanent extension of the fingers.

Prognosis.—The prognosis is the same as in the luxation forwards.

Reduction.—The bones are to be replaced in the same manner as in the preceding case.(*a*)

§ III. LATERAL LUXATIONS.

Causes.—Luxations inwards or outwards are commonly produced by falls, or by severe violence applied to the hand while in a state of adduction or abduction.(*b*)

Symptoms.—The lateral luxations of the radio-carpal articulation are characterized by a permanent state of adduction or abduction of the hand; by a considerable tumour at

(*a*) Sir Astley Cooper on Dislocations, p. 355.

(*b*) Delpech's Precis Elémentaire des Mal. Chir. T. 3. p. 103.

the ulnar or radial side of the joint; and by a laceration of the ligaments.

Prognosis.—As there is always more or less straining and laceration of the ligaments of the wrist and of the adjacent soft parts, this accident is usually followed by considerable tumefaction; sometimes by anchylosis; and sometimes even by caries.(*a*)

Reduction.—The reduction is effected by making extension and counter-extension at the hand and fore-arm, at the same time that the two surfaces of the radio-carpal articulation are made to slide upon each other in a direction contrary to that which they took at the time of the dislocation.

Treatment after the reduction.—Whatever may be the kind of dislocation, whether backwards, forwards, or to either side, it is always necessary, as soon as the reduction is effected, to apply a roller, dipped in some cooling lotion, tightly round the wrist, and to support the whole by means of two splints placed along the anterior and posterior parts of the fore-arm, as far as the extremities of the metacarpal bones. The rest of the treatment is to be conducted upon the same principles as in dislocations of other joints.

STRUCTURE OF THE CARPAL ARTICULATIONS.

The bones of the carpus are connected together by short dorsal and palmar ligaments, which pass from one bone to the other, and greatly restrict their respective motions. Besides this mode of articulation, however, there is a complete ball and socket joint, which is formed between the rounded extremities of the os magnum and os unciforme, and the cup-shaped surfaces of the scaphoïd, semi-lunar, and cuneiform bones. The articular surfaces are tipped with thin cartilage, and are lined by a synovial membrane, so as to facilitate their motions.

Motions.—The pisciform bone is susceptible of a slight

(*a*) Boyer's Lectures on the Bones, p. 261.

degree of elevation and depression, but all the other bones, considered separately, can scarcely be perceived to execute the least gliding motion. The motions of the first with the second range of carpal bones, however, are more remarkable; and are somewhat similar to those of the radio-carpal articulation.(*a*)

DISLOCATIONS OF THE CARPAL ARTICULATIONS.

From the firm connexions and limited motions which characterize the articulations of the bones of the carpus, it is evident that displacement must be an accident of rare occurrence. It has even been asserted by some, that such an accident is impossible; but such general expressions are altogether unwarrantable, and are only calculated to inculcate precepts based upon presumptuous ignorance. Let it not be supposed, however, by the young practitioner, that all the carpal bones are equally liable to luxation; this is by no means the case; for observation has demonstrated that the os magnum and os cuneiforme are the only ones that are in the least susceptible of displacement.

Cases of this dislocation are related by Baudelocque, Chopart, Desault, Boyer, Richerand, Sir Astley Cooper, and other writers. It usually arises from violence or extreme relaxation of the ligaments of the os magnum and os unciforme, and is characterized by a protuberance on the dorsal surface of the hand, which increases when the wrist is bent, and diminishes when it is extended.

Boyer thinks that this accident is more common in women than in men; a circumstance which he attributes to the greater mobility of their carpal bones, and to the weakness of the ligaments by which they are connected.

Reduction.—The bones may be easily replaced by extending the hand, and making gentle pressure upon the protuberance at the back of the wrist. They are to be kept in

(*a*) Boismont's Traité Elémentaire d'Anatomie, p. 212.

their situation by strips of adhesive plaster, a compress, and firm bandage, or by means of two small splints, extending from the inferior third of the fore-arm to within a short distance of the extremity of the fingers. After this apparatus has been worn for some time, it may be proper to expose the part several times a day to a stream of cold water, or to rub it with a coarse salt towel.

STRUCTURE OF THE CARPO-METACARPAL ARTICULATIONS.

The carpo-metacarpal articulations are formed between the lower extremities of the bones of the carpus and the upper surfaces of those of the metacarpus. They are incrusted with cartilage, and strengthened by dorsal and palmar ligaments.

The metacarpal bone of the thumb is articulated on quite a different principle from that of the rest; for as it forms a hinge-joint, and admits of every kind of motion, except rotation, it is connected to the trapezium by a strong capsular ligament, which passes from the neck of the former to the articular surface of the latter.

Motions.—The four last metacarpal bones may be slightly approximated, and bent forwards; while that of the thumb, as just stated, is capable of every kind of motion, except rotation.

DISLOCATIONS OF THE CARPO-METACARPAL ARTICULATIONS.

The four last bones of the metacarpus are so intimately connected with each other and with the bones of the second row of the carpus, that they are, perhaps, never luxated except by the bursting of a gun, or other severe violence. Under these circumstances, the injury is generally so great as to render it necessary to have recourse to amputation. When this operation is indicated, the surgeon should always endeavour to save as many of the fingers as possible.

The metacarpal bone of the thumb appears to be capable of being luxated from the os trapezium, either forwards, backwards, inwards, or outwards; the second and third forms of the accident, however, are by far the most common.

A dislocation backwards is usually occasioned by external violence, as a severe blow or fall upon the radial edge of the hand, by which the metacarpal bone is suddenly and violently bent towards the palm or ulnar side.

The nature of this luxation may generally be recognised by the prominence on the radial side of the hand, caused by the luxated head of the bone; by the flexion of the thumb and metacarpal bone; and by the impossibility of extending them. The diagnosis, however, is sometimes rendered difficult, in consequence of the swelling which generally supervenes soon after the reception of the injury.

In reducing this dislocation, an assistant is to be requested to fix the hand, by taking hold of the wrist, and while another pulls at the thumb, the surgeon is to press upon the displaced head of the bone, and push it inwards, towards the palm, into its natural situation. When the bone is reduced, the part should be covered with a piece of linen, dipped in a solution of the acetate of lead, and a relapse is to be prevented by placing the hand in a carved splint, or applying a compress and a piece of strong paste-board along the radial surface of the bone, as recommended by Boyer.(*a*)

In the dislocation inwards, the metacarpal bone of the thumb is thrown between the trapezium and root of the metacarpal bone of the index finger, so as to bend the thumb backwards, and form a projection towards the palm of the hand. In order to accomplish the reduction, Sir Astley Cooper recommends the extension to be kept up for a considerable time, and the thumb to be inclined towards the palm of the hand, so as to relax the flexor muscles and diminish their resistance.(*b*)

(*a*) Boyer's Traité des Mal. Chir. T. 4. p. 268.

(*b*) On Dislocations, p. 371.

STRUCTURE OF THE METACARPO-PHALANGEAL ARTICULATIONS.

The metacarpo-phalangeal articulations are formed between the lower extremities of the four last metacarpal bones, and the upper extremities of the first phalanges of the fingers. Each of these joints is strengthened by three ligaments and a synovial membrane.

The lateral ligaments consist of dense fasciculi of fibres, and are of a rhomboïdal form. They arise from the sides of the metacarpal bones, and, passing downwards and forwards, are inserted into the contiguous extremities of the first phalanges of the fingers. The anterior ligaments are thin and membranous, and are situated in the intervals between the preceding, on the palmar aspect of the joints. The synovial membrane lines all the articular surfaces of the bones, and is reflected upon the ligaments which maintain them in contact.

Motions.—The motions of the metacarpo-phalangeal articulations consist of flexion, extension, and lateral inclination.

DISLOCATIONS OF THE METACARPO-PHALANGEAL ARTICULATIONS.

Luxation of the first phalanges of the fingers at their articulations with the bones of the metacarpus, is an accident of more frequent occurrence than is commonly supposed. The bones are usually displaced backwards, it being extremely difficult, if not impossible, for them to be dislocated forwards, on account of the disposition of the articular surfaces of the metacarpal bones.

Causes.—A dislocation backwards generally results from a severe fall or blow upon the back of the hand, or the digital extremity of the first phalanx, while the finger is immoderately flexed.

Symptoms.—The accident may be known by the tu-

mour, formed by the displaced head of the bone; by the flexion and shortening of the finger; by the impossibility of extending it; and by the pain accompanying every such attempt.

Reduction.—The reduction is effected by fixing the hand, and pulling at the luxated finger, at the same time that the metacarpal bone, by which it is naturally supported, is pushed backwards, by means of the thumb placed in the palm.

Treatment after the reduction.—When the reduction is completed, the joint is to be covered with a thin compress, dipped in a solution of the acetate of lead, and the hand is to be placed in a carved splint, and kept at rest until the lacerated ligaments have had time to become united.

STRUCTURE OF THE PHALANGEAL ARTICULATIONS.

The phalanges of the thumb and fingers are articulated with each other on the same principle as that which obtains in the metacarpo-phalangeal articulations; it is unnecessary, therefore, to repeat what has already been stated upon that subject.

Motions.—The phalangeal joints are capable of flexion and extension, but not of lateral inclination.

DISLOCATIONS OF THE PHALANGEAL ARTICULATIONS.

§ 1. LUXATION OF THE PHALANGEAL ARTICULATIONS OF THE FINGERS.

The second and third phalanges of the fingers, like the first, are susceptible of luxation backwards, an accident which is so easily understood as to render any further description unnecessary. The reduction is to be effected in the same manner as in the preceding case, only, that instead of fixing the hand, it will be proper to steady the first or second phalanx of the injured finger, by interlocking it firmly between the two fingers of an assistant.

§ II. LUXATION OF THE PHALANGEAL ARTICULATIONS OF THE THUMB.

The phalanges of the thumb are seldom dislocated in any other direction than backwards, displacement forwards or to either side being rendered extremely difficult on account of the disposition of the articular surfaces and the ligaments by which they are bound together.

LUXATION BACKWARDS.

Causes.—The chief cause of this accident is an excessive relaxation of the ligaments, or force applied to the thumb, while the joint is immoderately extended.

Symptoms.—In the dislocation of the thumb backwards, the base of the first phalanx glides behind the head of the metacarpal bone, so as to render it impossible either to bend or extend it; the second phalanx is in a bent position, an effect which is ascribable to the tense state of the tendon of the flexor longus pollicis; and there is a tumour in front of the joint, caused by the extremity of the metacarpal bone.

Prognosis.—The reduction of this dislocation is always attended with great difficulty, and if it be not accomplished within eight or ten days after the reception of the injury, the accident may generally be regarded as incurable. (*a*)

Reduction.—The means which were formerly employed by surgeons for the purpose of reducing dislocations of the thumb were often so severe as to inflict the most dreadful violence, or so insufficient as to leave the part in the situation into which it had been thrown at the moment of the accident. Instances, in fact, are not wanting, where the thumb has been dragged off during violent efforts to reduce it; but fortunately for the sufferings of mankind, and for the credit of our science, these cases are few, and can not, in

(*a*) Boyer on the Bones, p. 263.

the present advanced state of surgery, be expected to occur again, except in the hands of the ignorant and fearless charlatan.

In speaking upon this subject, I shall briefly describe the principal methods that have been recommended by modern surgeons, leaving it to the intelligent practitioner to adapt them to the circumstances of each particular case.

The late and much lamented Mr. Hey of Leeds, who paid considerable attention to this subject, in consequence of the difficulties which he experienced during the early part of his professional career, states(*a*) that he has sometimes effected a reduction without the aid of extension, merely by pressure applied to the luxated extremity of the first phalanx, situated upon the back part of the metacarpal bone; Desault suggested the idea of accomplishing the reduction, in difficult cases, by making an incision behind the extremity of the dislocated bone, and introducing a spatula, or other suitable lever; while others again, as Mr. Evans, have advised making an incision down upon the end of the bone, and removing it with the saw. Every one of these methods, however, is liable to some objection—that of Mr. Hay on account of its insufficiency, and those of Desault and Evans on account of their unnecessary severity. The methods of Mr. Charles Bell and Sir Astley Cooper, which I shall now proceed to notice, are therefore decidedly preferable, they being almost always attended with success.

Having bathed the hand for a considerable time in warm water, in order to relax the parts, and defended the first phalanx with a piece of buckskin or wet wash-leather, a portion of tape, about two yards in length, is to be secured to the thumb by means of the clove-hitch knot;(*b*) and whilst an assistant makes the counter-extension by placing his index and middle fingers between the thumb and fore-

(*a*) Practical Observations in Surgery, p. 328-9.—Second edition.

(*b*) The clove-hitch knot "is a loop composed of two circles, with the ends between them."

finger of the patient, the surgeon restores the bones to their natural relations by gently pulling the first phalanx from the metacarpal bone downwards or towards the palm of the hand, so as to describe a semi-circular sweep. When this plan fails it will be proper to bend the arm round a bed-post, to carry a piece of strong worsted tape between the metacarpal bone of the thumb and index-finger, and apply the multiplied pulley.(*a*) Should this mode of treatment, however, also prove ineffectual, in spite of the most powerful and best devised efforts of the surgeon, we should at once resort to the ingenious plan suggested by Mr. Charles Bell, which is to divide one of the lateral ligaments of the joint by insinuating a couching needle obliquely under the skin.(*b*) This operation has been repeatedly executed, both in this country and in Europe, and experience has fully demonstrated its utility.

When the second phalanx of the thumb is dislocated it may be replaced upon the same principle as the phalanges of the fingers; it will be unnecessary, therefore, to repeat what has already been said upon that subject.

Remark.—In compound or complicated dislocations of the thumb, where there is much difficulty in the reduction, and the wound is large, Sir Astley Cooper recommends sawing off the extremity of the bone, in preference to bruising the part by long-continued extension.

Treatment after the reduction.—Having accomplished the reduction, the thumb is to be kept at rest, and be treated upon the same principle as the dislocations of the other joints.

(*a*) Sir Astley Cooper's Treatise on Dislocations, p. 374-5.

(*b*) Operative Surgery, vol. ii. p. 299. Hartford, 1816.

Article 3.—*Of Dislocations of the Inferior Extremities.*

STRUCTURE OF THE ILIO-FEMORAL ARTICULATION.

The ilio-femoral articulation or hip-joint is formed by the cotyloïd cavity of the os innominatum and the large rounded head of the os femoris. The articular surfaces are every where covered with cartilage, excepting at the shallow fossa which lodges the adipose substance at the bottom of the cavity, and a little below the central point of the head of the femur, which marks the insertion of the inter-articular ligament. In the natural state these parts are strengthened by three ligaments and a synovial membrane.

Cotyloïd ligament.—The cotyloïd ligament is a triangular fibro-cartilaginous ring encircling the cotyloïd cavity, and serving the purpose of increasing its depth, and completing its margin, where it is deficient. It is connected to the bony edge of the cavity, by a thick broad base, but its apex is free and a little inclined inwards. Its external surface is in contact with the capsular ligament, and its internal with the synovial membrane.

Capsular ligament.—The capsular ligament of the hip-joint is the thickest and strongest in the body, and represents a kind of shut sac with two openings. It arises from the circumference of the cotyloïd cavity, and passes downwards and outwards to be inserted into the prominent line which extends from one trochanter to the other, so as to include both the head and neck of the os femoris. It descends lower down on the anterior than on the posterior part of the neck of the bone, and is thicker and stronger above and behind than in any other portion of its extent. Anteriorly it is strengthened by a band of ligamentous fibres, by the psoas, iliacus internus, and cruris muscles; posteriorly, by the gemini, the pyriformis, and obturator internus;

internally, by the pectineus, and obturator externus, and superiorly, by the gluteus minimus.

Inter-articular ligament.—The inter-articular ligament, or ligamentum teres, is a dense triangular fasciculus of fibres, which arises from the depression on the head of the femur, and is inserted into the lower edge of the cotyloïd ligament where it passes over the notch in the acetabutum.

Remark.—The ligamentum teres has generally been described, but improperly, as arising from the bottom of the cotyloïd cavity; and this mistake has been made by anatomists of the highest respectability, especially by Sir Astley Cooper,(*a*) Dr. Monro,(*b*) and Messrs. John and Charles Bell.(*c*) In this country, it is generally supposed to have been first accurately described by the late Dr. Wistar, of the University of Pennsylvania; but it is highly probable that this gentleman borrowed his description from Dr. J. C. A. Mayer, who gave a very correct account of it in his excellent work on anatomy, published at Leipzip, in 1783.(*d*)

Synovial membrane.—The synovial membrane invests the contiguous surfaces of all the parts which enter into the composition of the hip-joint, and gives them a smooth, shining appearance. After having lined the cotyloïd cavity and the internal surface of the capsular ligament, it is reflected upon the head and neck of the os femoris, and terminates by investing the inter-articular ligament in the form of a funnel-shaped process.

The synovial membrane of the hip-joint is extremely vascular, and is supplied with blood from the smaller branches of the obturator artery.

Motions.—The ilio-femoral articulation being a true ball and socket joint, is capable of flexion, extension, adduction, circumduction, and rotation inwards and outwards.

(*a*) On Dislocations, p. 35.

(*b*) Elements of Anatomy, vol. i. p. 338.

(*c*) The Anatomy and Physiology of the Human Body, vol. i. p. 301.

(*d*) Beschreibung des Ganzen Menschlichten Körpers, in acht bänder, Erster Band, p. 326–7.

DISLOCATIONS OF THE ILIO-FEMORAL ARTICULATION.

The head of the os femoris may be thrown from the cotyloïd cavity upwards and outwards on the dorsum of the ilium; downwards and inwards into the foramen ovale; upwards and forwards on the body of the os pubis; and backwards into the ischiatic notch.

The dislocations upwards and outwards, and downwards and inwards, are by far the most common; a difference which is probably owing more to the direction in which the thigh is placed at the reception of the injury, than to the anatomical structure of the hip-joint.

§ I. LUXATION UPWARDS AND OUTWARDS.

Causes.—The luxation of the hip-joint upwards and outwards is usually caused by a fall upon the foot or knee, while the thigh is pushed forwards and obliquely inwards.

Symptoms.—The luxated limb is from one inch to two inches and a half shorter than the other; the knee and foot are turned inwards, and the toe rests against the tarsus of the other foot; the natural rotundity of the hip is destroyed; the trochanter major is carried upwards and inwards, and is approximated towards the antero-superior spinous process of the ilium; the foot is incapable of being turned outwards, and every attempt to do so occasions severe pain; the thigh can be slightly bent across the other, but the natural length of the limb can not be restored without reducing the dislocation.

In this accident, the head of the thigh-bone is lodged under the glutæus minimus, in the fossa of the os ilium; the capsular and inter-articular ligaments are lacerated; the quadratus femoris, obturator, and gemini muscles are put upon the stretch; but the psoas magnus and iliacus internus, as well as the other muscles which are inserted into the trochanter minor, are relaxed.

Diagnosis.—As this luxation is sometimes liable to be confounded with fracture of the neck of the os femoris, it may not be uninstructive to point out the marks by which they may be discriminated. In a fracture of the neck of the thigh-bone, the limb, although shortened from one to two inches by the contraction of the muscles, can always be restored to its natural length, by a slight degree of extension; the knee and foot are generally everted; the trochanter is drawn backwards; and when the limb is rotated, a crepitus may often be perceived, which ceases when rotation is performed in the shortened position of the limb. (*a*)

Prognosis.—When the head of the femur is dislocated upwards and outwards, the surgeon generally experiences some difficulty in replacing it; but when this has been once effected, the patient is usually able to walk about in the course of three or four weeks. We should never, however, promise too speedy a recovery, care being taken always to regulate our judgment according to the difficulty of the reduction, and the local and constitutional symptoms which follow the accident. It may be stated also, that, as the interarticular ligament is always torn, and never completely unites, the joint must necessarily remain weak, and be particularly liable to a recurrence of the accident.

Reduction.—In the luxation upwards and outwards, the patient is to be placed on his back upon a firm table, or a strong four-posted bed, covered with a mattress or two or three blankets, and a folded sheet or strong band is to be passed between the pudendum and the upper and inner part of the sound limb. One of the ends of this band is to be carried over the groin, and the other over the buttock, and both are to be tied together where they meet over the crista of the ilium, and secured to a post or to a staple in the wall. Another sheet or table-cloth, folded longitudinally, is then to be applied just above the spine of the ilium, and its ends,

(*a*) Sir Astley Cooper's Surgical Essays, Part 1. p. 20.

being carried round to the opposite side of the pelvis, are to be twisted together and given to one or more assistants. This contrivance is absolutely necessary, in order to prevent the extending force from drawing down the side of the pelvis on which the dislocated bone is situated. The extending means are to be applied either immediately above the malleoli, as recommended by the French, above the condyles of the femur as is customary in England, or just below the knee, as suggested by Dr. Physick, and practised by some of the surgeons of this country. Whichever of these methods be employed, care should always be taken to interpose a piece of flannel or soft buckskin between the limb and the extending band, to prevent the parts from being chaffed, or otherwise injured by the pressure. The number of assistants for making extension and counter-extension must vary according to the circumstances of the case, and the muscular power of the patient. When every thing is arranged, the counter-extending band is to be drawn in the line of the body, and while an assistant bends the knee and uses the leg and foot as a lever, in order to rotate the head of the os femoris, the surgeon presses upon the trochanter major, and thus endeavours to direct the head of the bone towards the cotyloïd cavity. In recent cases, this simple plan is often attended with complete success, but it sometimes fails, and we are then obliged to resort to pulleys.

In using the pulleys, the patient may be laid upon his back on the floor or upon a firm table, between two strong posts, about ten feet from each other, in which two staples are fixed. A strong sheet or band is then to be passed between the pudendum and the sound thigh, in the manner already stated, and its ends being brought together are to be secured to the staple behind the patient's head. Another band is next to be carried across the upper part of the pelvis, as in the preceding case, and given to one or two assistants. All that now remains, is to fix the extending band, which is done by applying a piece of soft buckskin, or a wet linen

roller immediately above the knee, and buckling over this a leather strap, having two other straps with rings at right angles with the circular part. This object may also be accomplished by placing over the buckskin the middle or central part of two towels, one on the outside, the other on the inside, parallel with the limb. After they have been secured by a few turns of a wet roller, their four ends are to be tied together so as to form two loops; and the knee is to be slightly bent, and brought across the lower part of the other thigh. The pulleys being now fixed to the other staple and to the straps or loops above the knee, the surgeon pulls slightly at the cord, and as soon as he perceives that every part of the bandage is put upon the stretch, and the patient begins to evince symptoms of pain, his efforts are to be relaxed, to allow the muscles time to become fatigued. Having thus waited for a moment, he is to draw again at the cord, so as to increase the extension a little farther, when his efforts are to be again intermitted. Taking care to proceed in this gentle and gradual manner, until the head of the bone has reached the margin of the cotyloïd cavity, he then gives the pulley to an assistant, and, while he keeps up exactly the same degree of extension, the surgeon is to rotate the knee and foot gently outwards, and as this is done, the head of the bone slips softly into its place. Should there be any difficulty in getting the bone over the brim of the cotyloïd cavity, it will be necessary to lift it up by placing the arm under it near the joint. By adopting this plan, the surgeon will seldom, if ever, be foiled in his attempts.(*a*)

Remark.—In reducing this luxation, Boyer(*b*) recommends the extension to be made obliquely from without inwards, and a little from behind forwards. Mr. Hey,(*c*) on the contrary, advises it to be made in a right line with the trunk of the body. It need scarcely be remarked,

(*a*) Sir Astley Cooper on Dislocations, p. 38.—Surgical Essays, p. 21-2.

(*b*) Traité des Maladies Chirurgicales, T. 4. p. 301.

(*c*) Practical Observations in Surgery, p. 199.

that the latter method is a bad one, and that it should always be studiously avoided.

Treatment after the reduction.—When the head of the bone has resumed its original position, which may always be known by the disappearance of the symptoms, and by comparing the length of the limbs, a return of the accident is to be prevented by keeping the thighs together by means of a bandage placed a little above the knees. The patient should be confined in his bed for about three weeks, his hip should be covered with a large cloth, dipped in a solution of the acetate of lead; and if there be much pain and constitutional disturbance, he should be treated according to the nature of the symptoms. If he be strong, robust, and plethoric, it will be advisable to resort to general and local bleeding, and to the use of saline purgatives; but if he be weak, and possessed of much morbid sensibility, our treatment must consist of soothing applications and of anodyne remedies.

As soon as the pain has in some measure subsided, the limb should be gently moved, and the hip should be rubbed with a coarse cloth or the salt towel.

§ II. LUXATION DOWNWARDS AND INWARDS.

Causes.—The head of the thigh-bone may be dislocated downwards and inwards, by a fall upon the feet or knees, while the thighs are considerably separated from each other, and inclined obliquely backwards.

Symptoms.—The upper and back part of the head and neck of the os femoris form a hard tumour towards the external side of the foramen ovale; the trochanter major is less prominent than in the natural state, and is removed farther from the antero-superior spinous process of the ilium; the limb is about two inches longer than the other; the body is bent forwards; the knee is widely separated from the other, and can not, without great pain and difficulty, be brought near the axis of the body; the glutæi muscles are drawn

downwards, considerably flattened, and put upon the stretch; the pyriformis is elongated and tense; the inter-articular and lower part of the capsular ligament are torn through; and the triceps muscle forms a firm mass, which extends from the os pubis to below the middle of the thigh.

Diagnosis.—The diagnostic or characteristic signs of this dislocation are the separated state of the knees, the bent position of the body, and the increased length of the limb. The foot, although widely separated from the other, is neither turned inwards nor outwards, and can not be considered as a diagnostic sign of the accident.(*a*)

Prognosis.—In the luxation downwards and inwards, the reduction may generally be more easily accomplished than in that upwards and outwards, owing to the elongated state of the muscles. In other respects, however, the prognosis is very nearly the same.

Reduction.—When the thigh-bone is dislocated into the foramen ovale, the reduction may often be effected in a very simple and easy manner. All, in fact, that is necessary, is to put the patient upon his back, to pass a folded sheet or table-cloth between the scrotum and the upper part of the luxated thigh, and to fix its ends to a staple in the wall. The counter-extending band is then to be put upon the stretch, while the surgeon, taking hold of the ankle of the dislocated limb, and drawing it over the other leg, directs the head of the bone to its socket. As a general rule, however, it will be necessary to place the patient upon the opposite side, and to secure the ends of the counter-extending band to the ring of a pulley. A bandage is then to be carried round the upper part of the pelvis, in such a manner as to pass over the anterior portion of the counter-extending band, and its ends are to be tied together and given to one or two assistants. When every thing is thus arranged, the assistants are to be desired to draw the thigh upwards, while

(*a*) Sir Astley Cooper on Dislocations, p. 52-3.

the surgeon, who is to take hold of the ankle in order to carry the leg across the other, and prevent the lower part of the limb from being pulled up, endeavours to throw the head of the bone outwards towards the cotyloïd cavity. In this step of the reduction, great care should be taken not to carry the leg too far over the other; as, by neglecting this precaution, there will be danger of forcing the head of the os femoris behind the cotyloïd cavity into the ischiatic notch, from which it will be difficult to remove it.(*a*)

Treatment after the reduction.—The treatment, after the reduction has been accomplished, is to be conducted upon the same principle as in the dislocation upwards and outwards.

§ III. LUXATION UPWARDS AND FORWARDS.

Causes.—The luxation upwards and forwards may happen by falling upon the ground while the leg and thigh are carried backwards, and there is a heavy weight upon the shoulders, as in the case related by Desault, or by putting the foot into a ditch or unexpected hollow, at the same time that the body is thrown backwards.

Symptoms.—The posterior part of the head and neck of the thigh-bone rests upon the horizontal ramus of the pubis, above the level of Poupart's ligament, and on the external side of the femoral vessels; the limb is an inch shorter than the other; the knee and foot are turned outwards, and every attempt to rotate them inwards is attended with pain; the head of the bone can be distinctly felt in its new situation, and can be seen to move on bending the thigh; the interarticular and upper portion of the capsular ligament are lacerated; the quadratus, pyriformis, glutæi, gemini, and obturator muscles are tense and elongated; but all the other muscles around the joint are relaxed; the limb is bent a lit-

(*a*) Sir Astley Cooper on Dislocations, p. 54.

tle forwards and outwards; and the femoral vessels are pushed inwards, out of their natural course.(*a*)

Remark.—In a case of dislocation upwards and forwards, which came under the care of Dr. Physick, in 1805, the head of the femur was situated below Poupart's ligament, and the luxated limb was a little longer than the other.(*b*)

Diagnosis.—This accident may always be distinguished from a fracture of the cervix femoris by the impossibility of rotating the limb, and by the hard tumour in the groin, formed by the head of the bone.

Prognosis.—Although the luxation upwards and forwards is generally accompanied with considerable contusion and laceration; it is usually easy of reduction, and is seldom followed by any serious accident.

Reduction.—In reducing this dislocation, the patient is to be placed upon his side on a table, covered with a mattress or blankets, and a folded sheet carried between the scrotum and the inner part of the thigh, is to be fixed to a staple, a little before the line of the body. The pulleys are then to be secured to the strap or loops above the knee, as in the luxation upwards and outwards, the leg is to be bent to nearly a right angle with the thigh, and the extension is to be made in a line behind the axis of the body, so as to draw the os femoris backwards. After the extension has been for some time continued, a towel is to be passed under the upper part of the thigh, and while an assistant depresses the knee, so as to rotate the limb inwards, the surgeon applies one hand upon the pelvis, and lifts the head of the bone over the pubes and edge of the cotyloïd cavity.(*c*)

Remark.—In the reduction of this dislocation, Professor Boyer recom-

(*a*) Delpech's Precis Elémentaire des Mal. Chir. T. 3. p. 114.—Sir Astley Cooper on Dislocations, p. 73.—S. Cooper's First Lines, vol. ii. p. 480.

(*b*) Dorsey's Surgery, vol. i. p. 271.

(*c*) Sir Astley Cooper on Dislocations, p. 75.—Surgical Essays, 32-4.

mends the extension to be made in a line nearly parallel with the axis of the body.

Treatment after the reduction.—The after-treatment is the same as in the preceding cases.

§ IV. LUXATION BACKWARDS.

Causes.—The luxation backwards into the ischiatic notch commonly results from falls, or from violence applied to the foot or knee, when the trunk is bent forwards upon the thigh, or when the thigh is inclined towards the abdomen.

Symptoms.—The head of the femur is situated upon the pyriformis muscle, behind the cotyloïd cavity, and between the sacro-sciatic ligaments and the convex surface of the os ilium; the limb is usually about half an inch shorter than the other, and is so firmly fixed that it is almost impossible either to bend or rotate it; the knee and foot are inclined inwards, and the toe rests against the inside of the opposite foot, the trochanter major is behind its usual place, and the head of the bone is so deeply seated in the ischiatic notch, that it is very difficult to feel it, except in thin, emaciated persons, the thigh inclines a little forwards, and the knee is slightly bent; the inter-articular and capsular ligaments are torn; the psoas, iliacus internus, and obturator muscles are in a state of tension; and when the case is examined as the patient stands up, the heel is raised from the ground, while the toe touches it.(*a*)

Diagnosis.—The characteristic signs of this luxation are the situation of the head of the bone behind the cotyloïd cavity, its impaction into the ischiatic notch, and the difficulty or utter impossibility of bending or rotating the limb.

Prognosis.—The dislocation of the head of the femur backwards, into the ischiatic notch, is said to be more diffi-

(*a*) Sir Astley Cooper on Dislocations, p. 62.—Delpech, op. cit. T. 3. p. 113.

cult to detect and reduce than any other of the ilio-femoral articulation. These differences are to be attributed chiefly to the trifling diminution in the length of the limb, and to the depth at which the head of the bone is situated behind the acetabulum.

Reduction.—In reducing this dislocation, the patient is to be placed upon his side on a table, the pelvis is to be fixed by passing a folded sheet or band between the scrotum and the inner part of the thigh, and the leather-strap is to be secured above the knee, in the manner already stated in the preceding paragraphs. The extension is then to be made downwards and forwards, across the middle of the other thigh, measuring from the pubes to the knee, while the surgeon with a napkin or rounded towel, placed immediately below the trochanter minor, pulls the head of the os femoris towards the cotyloïd cavity, and lifts it into its proper place.(*a*)

Remark.—The reduction of this luxation may also sometimes be accomplished by making the extension in a right line with the body, at the same time that the head of the bone is pushed towards its natural situation by means of the hand, as in the case which came under the care of Mr. Lucas, an eminent surgeon of London.

Treatment after the reduction.—The same as in the dislocation upwards and outwards.

CONGENITAL LUXATION OF THE ILIO-FEMORAL ARTICULATION.

Congenital luxation of the hip-joint was first noticed by Voigtel, in his work on Pathological Anatomy, published at Halle, in 1804. Since that time, however, the disease has claimed the attention of several very able writers, particu-

(*a*) Sir Astley Cooper on Dislocations, p. 63-4.—Surgical Essays, p. 29-30.

larly of Paletta and Dupuytren, both of whom have made it an object of specific investigation.

Differences according to sex.—The complaint is most frequently observed in female children, especially in those who are of a scrofulous or lymphatic habit; but for what reason, it is difficult to decide.

Causes.—Luxations of this kind are generally owing to a shortness, total want, or extremely oblique direction of the neck of the thigh-bone;(*a*) to a partial or total obliteration of the cotyloïd cavity; or to a deficiency, great elongation, or entire want of the ligamentum teres.(*b*)

Symptoms.—The limb is shortened; the head of the femur rests upon the dorsum ilii; the trochanter major projects unnaturally; the leg inclines obliquely inwards; and the motions of the joint, particularly those of abduction and rotation, are constrained and imperfect. The muscles of the upper part of the thigh are retracted, or drawn towards the crest of the ilium; the limb is thin, wasted, and out of all proportion to the rest of the body; the upper part of the trunk is thrown backwards, whilst the lumbar portion of the vertebral column projects as much forwards; the pubis is placed almost horizontally upon the femur; and the ball of the foot only touches the ground.

In the recumbent posture, when the weight of the trunk is removed, and the muscles become relaxed, most of the symptoms of the dislocation disappear, and the limb may be shortened or elongated at pleasure.

In walking, the body is inclined towards the sound side, and the head of the dislocated femur sinks towards the cotyloïd cavity, by its own weight. As the age of the patient increases, the limb becomes shorter, in consequence of the head of the femur ascending higher up, towards the crista of the ilium; the obliquity of the bones augments; and the

(*a*) Paletta de Clandicatione Congenita, p. 32.

(*b*) Voigtel's Handbuch der Pathologischen Anatomie, B. 1, s. 354.

power of locomotion, already so restricted, is completely destroyed.

Diagnosis.—Congenital dislocation of the hip-joint may be distinguished from other accidents or diseases, by the obliquity of one or both of the femurs, by the disease being observed at or soon after birth, by the absence of pain, swelling, and ulceration, and by the head of the os femoris being displaced without any external violence.

Morbid alterations.—The cotyloïd cavity is partially obliterated, or even entirely wanting; the head of the femur is slightly flattened on its antero-internal surface, and is lodged in a superficial kind of cavity on the dorsum ilii; the ligamentum teres is elongated, partially worn away, or even altogether wanting.

Prognosis.—The prognosis is always unfavourable, as the patient either dies young, or remains permanently lame and deformed.

Treatment.—The treatment of this luxation can only be palliative; and as the weight of the trunk is the main agent in aggravating the displacement, repose is obviously indicated; but it is not necessary to confine the patient to the recumbent posture; for, in the act of sitting, there is no stress on the femur, the body resting entirely on the tuberosities of the ischia. Dupuytren, to whom we are indebted for most of the preceding remarks, also advises the cold bath, and the application of a bandage which shall encircle the pelvis, confine the trochanters, and keep them of a uniform height, thus binding the ill-adapted parts together, and preventing that continued motion to which they are exposed. This practice, as justly observed by this able and judicious surgeon, though it certainly will not cure the complaint, will give much support to the hip-joints, and thus prevent the progress of the displacement.

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Consult Dupuytren's Paper in the French Journals.—Voigtel's Handbuch der Pathologischen Anatomie. B. 1. s. 304.—Paletta de Clandicatione Congenita.—Cooper's First Lines of the Practice of Surgery, vol. ii. p. 523. Philadelphia, 1828.

STRUCTURE OF THE FEMORO-TIBIAL ARTICULATION.

The femoro-tibial articulation or knee-joint is formed by the condyles of the os femoris above, by the head of the tibia below, and by the posterior surface of the patella in front. The articular surfaces of the bones are tipped with cartilage, invested by synovial membrane, and strengthened by numerous ligaments.

Ligamentum patellæ.—The ligamentum patellæ is the strong band of tendinous fibres which extends from the inferior edge of the patella to the anterior tuberosity of the tibia. Its anterior surface is covered by the skin and a prolongation of the fascia lata; its posterior is in contact with the adipose substance and synovial membrane of the joint. The fibres of this ligament pass from above downwards, in parallel lines, and are connected together by transverse or oblique fibrilla.

Femoro-tibial ligament.—The femoro-tibial or internal lateral ligament is of a triangular form, being narrow above and broad below. It arises from the posterior part of the internal condyle of the os femoris, and is inserted into the upper and inner edge of the head of the tibia.

Femoro-fibular ligament.—The femoro-fibular or external lateral ligament arises from the tuberosity of the external condyle of the femur, and is inserted into the head of the fibula. It consists of a rounded cork-like fasciculus of fibres, which descend in a vertical direction, and are strengthened by transverse bands.

Posteriorly to this, but parallel with it, is another ligament, which passes from the postero-external part of the outer condyle to the same point of the fibula, and is denominated the short femoro-fibular or external lateral ligament. It is smaller and weaker than the preceding, and appears to be merely accessory to it.

Use.—The use of the lateral ligaments is to strengthen the knee-joint, to restrict its lateral motions, and to keep the semi-lunar cartilages in their proper situation.(*a*)

Posterior ligament of Winslow.—This ligament, which was first pointed out by Winslow, and afterwards more accurately described by the celebrated Weitbrecht,(*b*) arises from the external condyle of the os femoris, and passing obliquely downwards and inwards, is inserted into the internal tuberosity of the tibia: it is frequently called the posterior, oblique, or popliteal ligament: its principal use is to protect the popliteal vessels, to strengthen the capsule of the knee, and to confine the os femoris during the motion of extension.

Crucial or oblique ligaments.—The crucial or oblique ligaments are situated in the back part of the joint, externally to the synovial membrane. They arise in the hollow between the condyles of the os femoris, and passing obliquely downwards so as to decussate each other somewhat like the lines of the letter X, are inserted into the upper and back part of the tibia. They are usually distinguished by the names of anterior and posterior crucial ligaments.

The anterior crucial ligament arises from the postero-internal part of the external condyle, and passes obliquely downwards and inwards to be inserted into the fossa in front of the spine or protuberance on the head of the tibia. The posterior ligament is more perpendicular; it arises from the

(*a*) Mayer's Beschriebung des ganzein Menschlichen Körpers, 2 Band. p. 352.

(*b*) Syndesmologia, p. 148.

root of the internal condyle, and passes downwards and outwards to be implanted into the rough fossa on the posterior part of the tibia, between its two cup-like hollows, and behind the protuberance which separates these hollows from each other.

Use.—The crucial ligaments are always relaxed when the knee is flexed, but when the joint is extended they are put upon the stretch. They add greatly to the strength and security of the femoro-tibial articulation, the anterior preventing the leg from going too far forwards, and the posterior from being carried too far back upon the thigh.

Semi-lunar cartilages.—The semi-lunar cartilages, so called from their crescent-shaped appearance, are two lamellæ of fibro-cartilage, situated between the cup-like hollows of the tibia and the condyles of the os femoris. The late Mr. John Bell has shrewdly compared them, in shape, to the label of a wine decanter; and by bearing this in mind we shall always have a tolerably correct idea of their appearance. They are concave above, slightly convex or nearly flat below, thin at their middle, and thick at their circumference. The internal one is elongated from before backwards, and is nearly of a semi-circular form. Its anterior cornu is connected with the anterior crucial ligament, and is inserted into the fossa in front of the protuberance of the head of the tibia; while its posterior is in relation with the posterior crucial ligament, and is implanted into the rough fossa or depression behind this protuberance.

The external semi-lunar cartilage forms nearly a complete circle, being larger before than behind. Its external edge is connected behind with the popliteus muscle, in the middle with the femoro-fibular ligament, and in front with the tibia. The inter-articular cartilages are of a fibrous structure, and are connected to each other at their inner cornua by a small transverse ligament. They are intended to form a kind of socket for the condyles of the femur, and to facilitate the motions of the knee-joint.

Synovial membrane.—The synovial membrane, after having covered the upper and lower surfaces of the inter-articular cartilages and the internal and external lateral ligaments, lines the whole articular surface of the tibia, and is reflected upon the internal part of the ligamentum patellæ, from which it is separated by an enormous quantity of adipose substance.(*a*) On each side of this, beneath the patella, is a fold of the synovial membrane, called ligamentum alare minus and ligamentum alare majus; and a funnel-shaped process, improperly called ligamentum mucosum, runs along the centre of the joint, from the lower border of the patella to the margin of the inter-condyloïd fossa. The synovial membrane is then continued upon the inner surface of the tendons of the extensor muscles, and after having invested the condyles of the femur and formed a cul-de-sac between them, it extends backwards upon the internal surface of the crucial ligaments and the posterior ligament of Winslow, and terminates upon the upper surface of the semi-lunar cartilages, from whence we commenced our description.

Motions.—The femoro-tibial articulation is a ginglimus or hinge-joint, and is, therefore, only capable of flexion, extension, and a slight degree of motion to either side, during the flexed position of the leg.

DISLOCATIONS OF THE FEMORO-TIBIAL ARTICULATION.

I.—DISLOCATIONS OF THE PATELLA.

The patella may be dislocated upwards, outwards, and inwards, or to either side. The lateral luxations, however, though by far the most frequent, are seldom complete, unless they result from extreme relaxation of the ligaments of the joint.

(*a*) Boismont's Traité Elem. d'Anatomie, p. 223.

§ 1. LUXATION UPWARDS.

Causes.—Luxation upwards always depends upon a rupture of the ligamentum patellæ, occasioned by the action of the rectus femoris muscle, or by severe violence applied to the anterior part of the knee.

Symptoms.—The patella is drawn upon the anterior part of the os femoris, two or three inches above the joint, and may be readily moved from one side to the other; there is a hollow or depression immediately above the tubercle of the tibia, caused by the absence of the ligamentum patellæ; and the patient experiences an inability to sustain the weight of the body upon the injured limb.

Remark.—In a case of luxation of both patellæ upwards, which came under the notice of Dr. Gibson, in the Philadelphia Alms House, "the patient retained the use of his limbs nearly perfect, except when he attempted to walk up or down stairs."(*a*)

Prognosis.—When the patella is dislocated upwards, the reduction may always be easily effected; but it generally requires great attention, both on the part of the patient and the surgeon, to accomplish a perfect cure.

Reduction.—In reducing this luxation, the leg should be extended, and the thigh flexed upon the pelvis. The upper portion of the ligamentum patellæ may then be easily brought down, and put in contact with the lower; but to keep it in this position is by no means so easy. The best way, however, to effect this is to keep the leg permanently extended upon a splint, from two to three inches wide, and long enough to extend from the upper part of the thigh to the heel; a roller is to be applied round the foot and leg, to prevent them from swelling; and the leather strap, described in the article on fractures of the patella, is to be buckled round the lower part of the thigh, and so secured as to maintain the ends of the lacerated ligament in apposition.

(*a*) Institutes of Surgery, vol. ii. p. 40.

Treatment after the reduction.—As this accident is usually followed by a considerable degree of inflammation and swelling, it will generally be necessary, before applying the apparatus just mentioned, to cover the knee with a piece of linen wet with a lotion composed of liq. plumbi acet. dilut. ℥iv, and sp. vin. ℥i, and to make use of general and local bleeding. As soon, however, as the parts are able to bear the least pressure, no time should be lost in restoring the patella to its natural situation, and retaining it there by the means already pointed out. In about a month or five weeks the knee should be gently bent, and the motion should be gradually increased until the ends of the ruptured ligament have completely united.

§ II. LATERAL LUXATION.

Causes.—The patella may be dislocated outwards or inwards by a relaxation of the ligaments of the joint; by a blow on the external or internal side of that bone; or by a fall upon the knee while the joint is directed inwards or outwards, and the foot outwards or inwards.

Symptoms.—In the dislocation outwards, the patella is removed from the anterior part of the knee, and a depression is felt at the place where it is usually situated; the leg is extended, and can not be bent without greatly augmenting the sufferings of the patient; the external edge of the patella presents backwards, the internal, on the contrary, is directed forwards, the inner margin of the articular pulley can be distinctly felt under the skin; and when the patient attempts to walk, he is unable to support the weight of the body upon his leg. The characteristic signs of the accident are the extended position of the leg, the depression in the natural situation of the bone, and the projection on the side of the external condyle of the os femoris.

When the patella is dislocated inwards, it forms a considerable tumour upon the internal condyle of the femur; the

leg is extended and very painful on being bent; the outer condyle may be distinctly felt under the skin; and the internal edge of the patella is turned backwards, and its outer one forwards. When the dislocation is complete, which is seldom the case, it will be sufficiently manifest by the large prominence on the internal condyle, and by the depression in the natural situation of the bone.(*a*)

Prognosis.—Lateral luxations of the patella may generally be easily reduced, and, unless much injury has been done to the ligaments of the joint, they are seldom attended with any very serious consequences. Where the bone is permitted to remain in its unnatural situation the knee becomes weakened, the leg slightly bent, and the patient is unable to make proper use of his limb.

Reduction.—In order to restore the patella to its proper situation, whether it is displaced inwards or outwards, the patient is to be placed upon his back, and an assistant is to raise the leg by lifting it at the heel. When the extensor muscles of the thigh have been thus fully relaxed, the surgeon raises the inner edge of the patella over the condyle of the femur, by pressing upon the edge of the bone most remote from the joint. By this manœuvre the patella will be immediately drawn into its natural situation by the action of the muscles. The mode of reduction, then, consists in extending the leg, flexing the thigh upon the pelvis, and pushing the luxated bone back to its original situation.

In a case of dislocation of the patella outwards, in which the reduction was attended with a great deal of difficulty, Mr. Young, of England, finally succeeded in restoring the bone to its natural situation, by placing the patient's ankle upon his shoulder, grasping the patella with the fingers of his right hand, and pushing it forwards by pressing against its outer edge with the ball of his left thumb.

(*a*) Delpech's Precis Elémentaire des Mal. Chir. T. 3. p. 126. Boyer's Traité des Mal. Chir. T. 4. p. 351.

Remark.—Cases of lateral dislocations of the patella have sometimes occurred, in which the reduction was so difficult, as almost to foil the best-directed efforts of the surgeon. Boyer states that the celebrated Sabatier once failed in an attempt of this kind, and that he himself met with nearly a similar fate. The late Dr. Dorsey also informs us, that he was once called to a young lady, who had dislocated her patella in stepping into bed, and though he saw her within five minutes after the accident, he did not succeed in effecting the reduction until after many fruitless efforts.

Treatment after the reduction.—After having effected the reduction, the joint should be covered with a linen cloth, dipped frequently in a solution of the acetate of lead, and recourse should be had to the usual antiphlogistic means. The limbs should be kept perfectly at rest upon a chair, covered with a firm pillow, and as soon as the violence of the inflammation and swelling has abated, a bandage should be applied round the foot and leg. If there be any disposition to a recurrence of the accident, in consequence of the relaxation of the ligamentum patellæ, or the shape of the condyles of the os femoris, the patient should by all means wear a laced-knee-cap, with a strap and buckle above and below the patella.

II.—DISLOCATIONS OF THE TIBIA.

The tibia may be thrown from the condyles of the femur in four different directions, namely, forwards, backwards, inwards, and outwards, or to either side. The luxations inwards and outwards, are the most frequent, and are always incomplete, on account of the extent of the articular surfaces, and the strength of the parts surrounding the femoro-tibial articulation.

Besides these four species, there is another, which was first accurately described by Mr. Hey, and is called *sub-luxation:* it will be spoken of more particularly hereafter

§ I. LUXATION FORWARDS.

Causes.—The tibia may be pushed before the condyles of the os femoris by a severe fall upon the foot, while the limb is in a bent position, or by force applied to the antero-inferior part of the thigh, while the ligaments of the joint are relaxed.

Symptoms.—The tibia is elevated; the thigh-bone is depressed, and thrown somewhat laterally, as well as backwards; the patella and tibia are drawn forwards by the action of the rectus muscle; and the condyles of the femur exert so much pressure upon the popliteal vessels, as to interrupt the pulsation of the anterior tibial artery on the instep. (*a*)

Prognosis.—The violence necessary to produce this luxation, is generally so great, as to rupture most of the ligaments of the joint, and inflict such severe and extensive injury upon the surrounding parts, as to render it requisite to have recourse to amputation. This, however, is not always the case; and whenever there is the least chance of saving the limb it should by no means be neglected.

Reduction.—The reduction of this dislocation is effected by extending the thigh, drawing away the leg, and inclining the tibia a little downwards.

Treatment after the reduction.—The after-treatment consists principally in keeping the limb at rest, in a slightly flexed position, upon a pillow, in covering the knee with light cloths wrung out of a solution of the acetate of lead, in applying leeches to the surrounding parts, and in having recourse strictly to antiphlogistic measures, modified according to the violence of the symptoms, and the age and constitution of the patient. As soon as the pain and swelling have somewhat subsided, a splint should be applied behind the knee, and the limb carefully bandaged. When the liga-

(*a*) Sir Astley Cooper on Dislocations, p. 149.

ments have grown together, and the danger of the inflammation is over, which will usually be in about three weeks, the joint should be gently moved to prevent inflammation. It will also be proper at this period to begin rubbing the parts with volatile liniment, rough flannel, or the salt-towel.

§ II. LUXATION BACKWARDS.

Causes.—The usual causes of this dislocation are blows or falls upon the foot or knee.

Remark.—Displacement of the tibia backwards is so difficult, that the possibility of its occurrence seems to have been called in question by many of the older surgeons. That this accident, however, sometimes takes place, is fully proved by the concurrent testimony of Heister, Sir Astley Cooper, and other distinguished writers.

Symptoms.—Luxation backwards is evinced by the shortened state of the limb; by the depression immediately above the patella; by the projection of the condyles of the os femoris; by the large tumour in the popliteal region, caused by the head of the tibia; and by the leg being bent to a very acute angle with the thigh.(*a*)

Prognosis.—The reduction of this dislocation may generally be easily accomplished, and the patient may even perfectly recover the use of his joint; but in some cases the injury is so great as to render it requisite to remove the limb by amputation. Sir Astley Cooper mentions a case of luxation backwards, communicated to him by Dr. Walshman, in which the patient laid aside his crutches in about five weeks, being able to use the injured limb as well as the other.

Reduction.—In the case which came under the care of Dr. Walshman, the bone was restored to its natural situation by making counter-extension at the upper part of the

(*a*) Sir Astley Cooper on Dislocation, p. 150. Boyer's Traité des Mal. Chir. T. 4. p. 369.

thigh, and extension a little above the ankle, at the same time that the head of the tibia was pushed from behind forwards towards the joint.

Treatment after the reduction.—The after treatment is to be conducted upon the same principles as in the preceding case.

§ III. LATERAL LUXATION.

Causes.—The head of the tibia may be displaced outwards or inwards by a fall from a gig or wagon, during which the thigh-bone is violently twisted, while the leg itself is firmly fixed; or by great force or pressure applied to the inferior and lateral part of the leg, while the knee rests upon a hard resisting body, and the side of the trunk is inclined downwards.

Symptoms.—In the dislocation inwards, the internal condyle of the os femoris is forced upon the external semi-lunar cartilage; the tibia projects, and forms a tumour, at the internal side of the knee; and there is a perceptible depression under the external condyle, caused by the removal of the outer portion of the head of the tibia. In the displacement outwards, on the contrary, the external condyle of the femur is thrown upon the internal semi-lunar cartilage, or, according to Sir Astley Cooper, rather behind it, and the head of the tibia forms a remarkable projection at the external side of the joint.

Prognosis.—The reduction of a lateral dislocation of the head of the tibia is always very easy, on account of the great laceration of the ligaments; in general, the patient recovers the use of his joint; but in some instances, the injury of the soft parts is so severe as to give rise to anchylosis, or even more serious mischief.

Reduction.—This may be effected by placing the patient in a recumbent posture, making counter-extension at the upper part of the thigh, and extension at the ankle; at the

same time that the head of the tibia is pushed from within outwards or from without inwards, according to the nature of the displacement.

Treatment after the reduction.—The same as in the dislocation backwards or forwards.

§ IV. SUB-LUXATION OF THE FEMORO-TIBIAL ARTICULATION.

Causes.—Sub-luxation of the knee-joint is generally caused by a twist of the limb; by striking the toes against a stone or other projecting body, while the foot is everted; or by accidentally slipping in walking, so as to turn the foot inwards and the thigh outwards. Mr. Hey is of opinion, that the complaint may result from relaxation of the semi-lunar cartilages, or from an unequal tension of the crucial or lateral ligaments.(*a*)

Symptoms.—When the disorder has taken place without contusion of the soft parts, the shape of the joint appears to be unaltered, or if there be any difference, it is owing to a relaxation of the ligamentum patellæ; the leg may be readily bent or extended by the hands of the surgeon; and though the patient is always compelled to keep his limb in a slightly flexed position, he is able, when he sits upon a chair, to move the affected joint quite as well as the other. Although, in general, the form and size of the knee remain unaltered, yet they are sometimes remarkably changed, in consequence of the accident being complicated with other diseases.

Prognosis.—The accident is always extremely liable to recur after it has once taken place; the joint usually remains for some time in a weakened condition, and in some instances the patient is unable to recover the full use of it.

Reduction.—In reducing this luxation, the patient is to

(*a*) Hey's Practical Observations, p. 333.

be placed upon an elevated seat, the joint is to be extended by applying one hand immediately above the knee, and during the continuance of the extension the leg is to be suddenly carried backwards, so as to form as acute an angle with the thigh as possible. By this management, the pressure of the condyles of the os femoris is removed, and the cartilages are enabled to slip into their natural situation. This mode of reduction, however, is sometimes unsuccessful; and under these circumstances, the ingenuity of the patient is often more effectual than that of the surgeon. Sir Astley Cooper mentions the case of a gentleman who used to accomplish the reduction by sitting upon the floor, and then bending the thigh inwards and pulling the foot outwards.

Treatment after the reduction.—When the reduction is accomplished, a return of the accident is to be prevented by applying a laced cap, furnished with strong leather straps, tightly round the knee, or by means of a piece of cloth with four rollers attached to it, which are to be fastened above and below the patella.

STRUCTURE OF THE SUPERIOR FIBULO-TIBIAL ARTICULATION.

This articulation is formed by the depression on the external side of the head of the tibia, and the flat corresponding surface on the upper extremity of the fibula. The articular surfaces are incrusted with cartilage, lined by synovial membrane, and retained in contact by two ligaments.

Anterior ligament.—The anterior ligament arises from the internal tuberosity of the tibia, and passes obliquely downwards and outwards to be inserted into the head of the fibula. It is broad and flat, and is strengthened by the tendon of the biceps muscle.

Posterior ligament.—The posterior ligament, stronger and thicker than the preceding, arises from the posterior

surface of the cavity of the tibia, and is inserted into the back part of the head of the fibula.

Synovial membrane.—The synovial membrane invests the articular surfaces of the bones and the ligaments just described.

Motions.—The fibulo-tibial articulation has a slight degree of motion from before backwards, but lateral motion appears to be entirely wanting.

DISLOCATIONS OF THE FIBULO-TIBIAL ARTICULATION.

Notwithstanding the slight degree of motion observable in this articulation, the fibula may be dislocated either by violence or in consequence of the relaxation of the ligaments by which it is connected to the tibia. The head of the bone is usually thrown backwards, and is easily restored to its natural situation by flexing the limb and making pressure from behind forwards. It is extremely difficult, however, to keep it in its place, on account of its great tendency to slip behind the tibia. When the accident has been produced by violence, this disposition should be counteracted by applying a firm compress over the head of the fibula, and a splint along the outside of the leg. But should it have resulted from a morbid condition of the ligaments, the part should be repeatedly blistered, to promote the absorption of the superabundant secretion of synovia; and a strap should be afterwards buckled round the upper part of the leg to confine the bone firmly in its place. (*a*)

Remark.—The inferior fibulo-tibial articulation does not appear to be subject to luxation, as I do not know of a single well authenticated case where this accident is stated to have taken place.

STRUCTURE OF THE TIBIO-TARSAL ARTICULATION.

The tibio-tarsal articulation, or ankle-joint, is effected be-

(*a*) Sir Astley Cooper, op. cit. p. 181-2.—Boyer's Traité des Mal. Chir. T. 4. p. 374.

tween the inferior concave surface of the tibia and fibula, and the superior convex surface of the astragalus. The contiguous surfaces of these bones are covered with cartilage, lined by synovial membrane, and maintained in situ by five ligaments.

Internal lateral ligament.—The internal lateral or deltoïd ligament is of a triangular form, being narrow above and broad below. It arises from the inferior margin of the internal malleolus, and passes downwards to be inserted into the internal side of the astragalus and os calcis.

Tibio-tarsal ligament.—The tibio-tarsal ligament, extends from the anterior part of the inferior extremity of the tibia, to the margin of the pulley-like surface of the astragalus. It consists of a broad membranous band, composed of irregular fibres.

External lateral ligament.—The external lateral or perpendicular ligament of the fibula, is a strong rounded fasciculus, which arises from the inferior extremity of the external malleolus, and is inserted into the upper part of the os calcis.

Anterior ligament of the fibula.—The anterior ligament of the fibula extends from the fore part of the external malleolus, downwards and inwards to the anterior margin of the articular surface of the astragalus.

Posterior ligament of the fibula.—The posterior ligament of the fibula passes obliquely backwards from the back part of the external malleolus, towards the corresponding part of the astragalus, where it is inserted in the margin of the groove for the tendon of the flexor longus pollicis.

Synovial membrane.—The synovial membrane, after having invested the articular surfaces of the tibia and fibula, extends upwards, and lines the inferior fibulo-tibial articulation. It is then reflected upon the cartilaginous surfaces of the two malleoli, covers all the ligaments of the tibio-tarsal articulation, and passes upon the superior convex surface of the astragalus.

Motions.—The ankle-joint is a perfect angular ginglimus, and is capable of flexion, extension, and lateral inclination.

DISLOCATIONS OF THE TIBIO-TARSAL ARTICULATION.

The tarsus, in its articulation with the bones of the leg, may be dislocated forwards or backwards, inwards or outwards; and either of these luxations may be complete or partial.

§ I. LUXATION FORWARDS.

Causes.—The accident is generally produced by a fall backwards, while the foot is firmly fixed upon the ground.

Symptoms.—The foot is elongated; the articular pulley-like surface of the astragalus is placed in front of the tibia; the heel is shortened; and the tendo-achilles is closely approximated to the posterior surface of the leg.(*a*) The diagnostic signs are the shortened state of the heel, and the lengthened state of the anterior part of the foot.

Prognosis.—Although in general the reduction of this dislocation may be effected without much difficulty, yet as the accident is always accompanied with a laceration of the anterior and external lateral ligaments, and with considerable injury to the adjacent parts, the patient must necessarily have a tardy recovery, and can not always expect to regain the perfect use of his joint. In some cases, in fact, it may be necessary to resort to amputation; but this should never be done until it has been fully ascertained that there is no other chance of saving the limb or the life of the patient. The general rule, therefore, which was formerly laid down by J. L. Petit, to amputate in all kinds of dislocations of the foot, before the expiration of twenty-four hours, is as ridicu-

(*a*) Delpech's Precis Elém. des Mal. Chir. T. 3. p. 134. Boyer on the Bones, p. 287.

lous as it is absurd. It might, indeed, have suited the times in which this great surgeon lived; but at the present day, we are guided by better principles, and rewarded with more happy results.

Reduction.—Having placed the patient in a recumbent posture upon a mattress, and bent the leg to a right angle with the thigh, to relax the gastrocnemii muscles, an assistant, taking hold of the lower part of the leg, gradually pushes it forwards, while the surgeon, grasping the foot, pushes it in an opposite direction, and thus accomplishes the reduction.

Treatment after the reduction.—The after-treatment consists in placing the foot upon a pillow, and using such measures as are best calculated to insure the recovery of the patient. These means, it need scarcely be said, are rest, cold evaporating lotions, general and local bleeding, and anodyne and laxative medicines. When the violence of the symptoms has subsided, a long splint is to be applied along each side of the leg, and the foot is to be kept perfectly quiet for three or four weeks; when the joint is to be gently moved, to prevent anchylosis.

§ II. LUXATION BACKWARDS.

Causes.—Luxation of the ankle-joint backwards, usually arises from falling on the feet, while the leg is greatly bent, and the body inclined forwards; or from violence applied to the postero-inferior part of the leg, while the foot is immoderately extended, and rests upon the lower part of its dorsal surface.

Symptoms.—The anterior part of the foot is shortened; the heel is firmly fixed and more prominent than naturally; the toes are pointed downwards; the tendo-achilles is removed from the posterior surface of the leg; the lower extremity of the tibia forms a hard prominence at the upper part of the middle of the tarsus, under the tendons on the dorsal region of the foot; and the articular pulley-like sur-

face of the astragalus, is distinguishable at the sides, and towards the back part of the tibia. The accident is ordinarily accompanied with fracture of the inferior extremity of the fibula, and a partial laceration of the ligaments of the joint.(*a*)

Prognosis.—The prognosis of this dislocation is generally more favourable than in the dislocation forwards, on account of the comparatively slight degree of injury inflicted upon the ligaments and adjacent parts. After the articular surfaces have been restored to their natural relations, which is always done with considerable difficulty, the fracture of the fibula, in fact, claims our chief attention, and if we can succeed in effecting a perfect reunion between its broken ends, and keeping the foot in its proper place, the patient will usually be able, after some time, to use his limb with little or no inconvenience.

Reduction.—In reducing this luxation the patient is to be placed upon his back, and the leg is to be bent, to relax the muscles of the calf. An assistant, grasping the inferior part of the thigh, is then to draw it towards the body, and while another assistant pulls the foot in a line a little before the axis of the leg, the surgeon pushes back the tibia into its original situation.

Treatment after the reduction.—The reduction being completed, a many-tailed bandage, dipped in a solution of the acetate of lead, is to be tightly applied round the leg and foot, and the patient is to be treated upon the same principle as in the dislocation forwards. The heel is to be elevated upon a pillow, and a recurrence of the accident is to be prevented by keeping the foot at a right angle with the leg, by means of two long splints, furnished with an equal number of well padded foot-pieces. This precaution is absolutely necessary, to keep the parts in contact during the

(*a*) Delpech, op. cit. T. 3. p. 134.—Sir Astley Cooper, op. cit. p. 186.

time required, for the fragments of the fibula and the lacerated ligaments of the joint to become firmly reunited.

M. Dupuytren prefers keeping the limb in the bent posture, and applying an apparatus which is calculated to propel the foot forwards, and the inferior extremity of the tibia backwards.(*a*) An account of this apparatus will be found in the article on fractures of the bones of the leg.

The fibula will usually be united in about four or five weeks, when it will be proper to commence passive motion.

Remark.—When the foot is partially luxated backwards, one half of the articular surface of the tibia rests upon the os naviculare, and the other upon the astragalus. The foot is pointed downwards, and the patient experiences great difficulty in attempting to put it flat upon the ground; the fibula is fractured, and the heel is drawn up. By a careful examination of the joint, the surgeon will commonly be able to detect the nature of the injury, and should immediately proceed to restore the foot to its natural position, according to the principles just laid down.

§ III. LUXATION INWARDS.

Causes.—The accident is generally occasioned by the wheel of a carriage passing over the leg, or by a violent twist of the foot inwards in falling or jumping.

Symptoms.—The articular surface of the astragalus is placed below the internal malleolus;(*b*) the foot is thrown inwards, and its outer edge rests upon the ground; the external malleolus forms a very large projection under the integuments of the ankle; the internal lateral ligaments are lacerated, or torn from the bones; and the inner malleolus is obliquely fractured, and separated from the shaft of the tibia. Sometimes the violence is so great as to fracture the astragalus, and splinter the inferior extremity of the fibula.(*c*)

(*a*) Annuaire Med. Chir. p. 188.

(*b*) Delpech's Precis Elém. des Mal. Chir. T. 3. p. 133.

(*c*) Sir Astley Cooper, op. cit. p. 189.

Prognosis.—The dislocation inwards is generally highly dangerous, being always attended with severe contusion of the integuments, considerable laceration of the ligaments, and great injury to the bones. The reduction is often extremely difficult; and ten or twelve weeks are ordinarily required to effect a cure.

Reduction.—In reducing this luxation, the patient is to be placed upon his back, and the leg is to be bent to a right angle with the thigh. The ham is then to be steadied by an assistant, and while another grasps the foot and makes extension in the axis of the leg, the surgeon presses the astragalus outwards, towards the lower end of the tibia.

Treatment after the reduction.—When the reduction is completed, the foot is to be prevented from being twisted inwards, or pointed downwards, by the application of proper splints along the outer and inner parts of the leg; and a pad is to be placed upon the fibula immediately above the external malleolus, to keep the articular surfaces in their natural situation, as well as to raise and support the lower part of the leg. The general and local treatment is to be regulated according to the violence of the symptoms, and the age and constitution of the patient. The joint may be gently moved in about six weeks after the accident, and the patient be allowed to walk upon crutches.

§ IV. LUXATION OUTWARDS.

Causes.—Luxation outwards is commonly produced, according to the observations of Sir Astley Cooper, by jumping from a height, or by suddenly checking the motions of the foot, while the toes are turned outwards, and the trunk is carried forwards.

Symptoms.—The foot is easily rotated on its axis; the internal malleolus is thrown inwards, and forms a remarkable projection under the integuments; a considerable depression is felt above the outer ankle; the inner edge of the

foot rests upon the ground; the articular pulley-like surface of the astragalus is situated below the outer malleolus; the external lateral ligament is lacerated; and the fibula is broken about two or three inches above the joint. Occasionally there is also a fracture of the lower end of the tibia, especially when the injury has been caused by jumping from a considerable height.

Prognosis.—A dislocation of the foot outwards is always a serious event; and as it can never take place without a fracture of the fibula, it must evidently require great attention, on the part of the practitioner, to enable the patient to regain the perfect use of his limb. The reduction, if early attended to, may generally be easily effected; and if no untoward circumstances occur, the motion of the joint may commonly be restored in about three months.

Reduction.—Having placed the patient upon a mattress on the side on which the injury has been sustained, and relaxed the muscles of the calf by bending the leg to a right angle with the thigh, an assistant is to grasp the foot, and while he gradually draws it in a line with the leg, the surgeon fixes the thigh, and pushes the tibia into its original situation.

Treatment after the reduction.—A return of the dislocation is to be prevented by keeping the limb in a bent position, applying a many-tailed bandage round the joint, and placing a splint along each side of the leg. The pain and inflammation, which must always necessarily follow such a severe accident are to be subdued by the usual local and constitutional remedies. The patient may be allowed to walk upon crutches in about five or six weeks, care being taken that the part be well supported with long strips of adhesive plaster, and the joint be frequently moved to prevent anchylosis.

STRUCTURE OF THE TARSAL ARTICULATIONS.

The articular surfaces of the tarsal bones are tipped with cartilage, and lined by synovial membrane. They are maintained in situation by strong fibrous bands, which are usually denominated plantar, dorsal, internal and external lateral ligaments.

DISLOCATION OF THE ASTRAGALUS.

The astragalus is articulated at its upper and lateral parts with the tibia and fibula; below with the os calcis; and in front with the os naviculare. A dislocation of the astragalus is always an occurrence of a very serious and embarrassing nature, especially if unattended with a wound in the integuments; for the reduction is generally extremely difficult, and sometimes utterly impossible. When the accident takes place, the astragalus is usually thrown upon the os naviculare, so as to form a protuberance under the skin of the instep, and this symptom is so decidedly characteristic of the nature of the case, that the practitioner is at once enabled to establish a clear diagnosis. When the bone is not tightly wedged between the tibia, os calcis, and os naviculare, the reduction may sometimes be effected, comparatively speaking, with ease, by fixing the knee, making extension at the foot, by placing one hand upon the heel, and the other in front of the instep, and pressing the foot inwards while counter pressure is made upon the lower extremity of the tibia, on the opposite side, by means of the knee. When this simple treatment is found unsuccessful, an incision is to be made down upon the displaced bone, and the reduction is to be accomplished by dividing some of the ligaments. But if, in spite of this operation, the bone still remains unreduced, it will be prudent to adopt the practice of Desault, Ferrand, Trye, Green, Dupuytren, and others,

and extract it altogether. This operation, however, has also its difficulties, as is exemplified in the case which came under the care of Professor Dupuytren, and in which this gentleman succeeded in removing the bone only after a long and tedious dissection. The difficulty arose from the pulley-like surface of the astragalus being turned downwards, while its posterior projecting part was hooked in the tibia. (*a*)

Treatment after the reduction.—When the bone has been replaced, the foot should be kept perfectly at rest, and be covered with cloths, dipped in a solution of the acetate of lead. The pain and swelling of the part are to be combated by the usual antiphlogistic means; and as soon as the violence of the symptoms has diminished, the foot should be bandaged, and a splint be placed along the outside of the leg. In case the bone has been extracted, the lips of the wound are to be brought into contact with strips of adhesive plaster; the rest of the treatment is to be conducted upon the principles just laid down.

DISLOCATIONS OF THE OS CUNEIFORM INTERNUM.

This accident has twice occurred in the practice of Sir Astley Cooper, and in both cases the bone remained unreduced. It is usually occasioned by a fall from a considerable height, and is characterized by a projection on the inside of the foot, and by a slight elevation of the bone, caused by the action of the tibialis anticus muscle.

In order to keep the bone in its situation, a roller, dipped in a mixture of spirits of wine and water, is to be passed round the foot; and when the pain and inflammation have subsided, its place is to be supplied by a leather-strap, which is to be worn until the ligaments have become properly reunited.

(*a*) Annuaire Med. Chir. des Hosp. de Paris 1819, p. 28.

DISLOCATIONS OF THE OS CALCIS AND ASTRAGALUS.

The transverse joint between the os calcis and astragalus, and the os naviculare and os cuboïdes is sometimes dislocated by heavy weights falling upon the foot. Under these circumstances, the foot is turned inwards upon the os calcis and the astragalus, and presents the appearance of a club-foot. In a case of this description, which came under the notice of Sir Astley Cooper, in Guy's Hospital, the reduction was effected by fixing the leg and heel, and drawing the anterior part of the foot outwards.

In the dislocations of the phalangeal articulations of the toes, the reduction is to be effected precisely in the same manner as in those of the fingers.

SECTION III.

OF WOUNDS OF THE JOINTS.

Definition.—Wounds of the joints are solutions of continuity of the ligaments which surround and connect the articular extremities of the bones.

Causes.—Injuries of this kind are ordinarily inflicted by musket balls, grape-shot, sharp pointed instruments, and similar causes.

Symptoms.—When any of the large joints have been opened by an incised, lacerated, or gun-shot wound, the nature of the accident is generally denoted by an immediate discharge of synovia, followed by great pain, tension, and swelling of the part, with very severe constitutional disturbance. The patient soon experiences fever, feels nauseous at his stomach, and becomes delirious; the limb is affected with œdema, and erythematous or erysipelatous swelling; the synovia increases in quantity, and exhibits a thin, glairy appearance; the ligaments swell, and become thickened;

suppuration is established, and matter is discharged from the whole surface of the synovial membrane; openings are formed in various parts of the skin; the bones become carious; the cheeks flushed; and the patient is gradually worn out with hectic fever. In some instances, however, the symptoms gradually subside, the joint becomes anchylosed, and the patient imperfectly recovers.

Prognosis.—Gun-shot and lacerated wounds of the joints are always dangerous, and are not unfrequently followed by fatal consequences. Simple incised wounds, on the contrary, generally assume a milder aspect, though many cases are on record in which the most alarming and fatal symptoms ensued. As a general rule, it may be stated, that the prognosis is more favourable where the wounded joint is small and superficial, when the incision is slight in extent and unaccompanied with contusion, when no large nerve or vessel has been injured, and when the air has been prevented from coming into contact with the synovial membrane, than it is under opposite circumstances.

Treatment.—The treatment of these wounds is simple; but it should be prompt and vigorous, in order to insure any considerable or permanent benefit. It consists, mainly, in approximating the edges of the incision, removing extraneous matter, excluding the admission of air, forbidding all motion of the joint, applying cold or warm lotions, and employing antiphlogistic remedies, strictly so called.

When a joint has been laid open by a sharp pointed instrument, as a knife or sabre, the first means to be adopted is to bring the lips of the wound together, and endeavour to retain them in apposition by strips of adhesive plaster. Sutures should always, if possible, be dispensed with; but if they become absolutely necessary, the greatest care should be taken not to pass them through the capsule of the joint; by neglecting this precaution, much irritation must be the inevitable consequence. After the part has been properly dressed, and put in the most favourable position for relax-

ing the muscles and promoting the circulation, the patient should be copiously bled, leeches should be applied around the wound, and the joint should be kept constantly covered with a thick compress, wrung out of a solution of opium and sugar of lead. The bowels are to be freely opened by purgative medicines, and the most rigid abstinence is to be enjoined.

In some instances, especially if the patient be young and fractious, it will be highly advantageous, in order to insure more perfect rest to the wounded joint, to make use of carved splints, lined with soft materials, and carefully adapted to the parts, so as to occasion no inconvenience.

In gun-shot wounds of the joints, the extraneous body should always be immediately withdrawn; or if it be so firmly embedded in the extremity of the bone that it can not be moved without great violence, it should be left until after the formation of matter, in the hope that it may then be brought away. The parts should be covered with emollient poultices, and the measures for obviating or subduing inflammation should be promptly and vigorously pursued. As soon as the wound begins to suppurate, and the patient's system feels the effects of the antiphlogistic treatment, a good nourishing diet, and tonic medicines, such as the mineral acids, bark, and wine, should be prescribed.

The same mode of treatment is applicable in cases of contused and lacerated wounds of the joints, especially when the soft parts have sustained so much injury that suppuration must necessarily be the result.

When the joints have been severely shattered by gun-shot or other violence, and the external wound is very large, or complicated with injury of the principal vessels or nerves of the limb, there can be no doubt as to the propriety of immediate amputation. As a general rule, it may be stated, that gun-shot wounds of the large joints of the extremities are almost invariably attended with fatal consequences, unless the surgeon speedily resort to the removal of the limb.

The same may be said, though in a more limited sense, of gun-shot injuries of the articulations of the fingers and toes, in which tetanus is extremely apt to ensue.

When the inflammatory symptoms are so severe and obstinate as to give reason to apprehend anchylosis or stiffness of the joint, it becomes a matter of great importance to put the limb in such a position as shall be least inconvenient to the patient. Hence, in wounds of the knee, the limb should always be kept permanently extended; while in those of the elbow, a contrary position should be assumed, and this for very obvious reasons.

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SECTION IV.

OF SPRAINS.

Definition.—A sprain is a more or less violent stretching or laceration of the ligaments, and other soft parts connected with or surrounding a joint.

Seat.—The joints which are most subject to it, are those which are strengthened by lateral ligaments, and which, consequently, admit only of flexion and extension; as the ankle and the wrist.

Causes.—Sprains are commonly the result of falls, or of the sudden extension of the joints, by which the parts are unexpectedly and forcibly bent.

Symptoms.—The symptoms which characterize these injuries, are more or less pain at the moment of the accident; swelling and tenderness of the integuments; discoloration of the skin, in consequence of the effusion of blood; loss of motion in the affected joint; and a sensation of crepitus on examining the injured part. The pain, at first, is frequently of the most excruciating kind; sometimes, indeed, so severe as to occasion fainting.

The accident may always be readily distinguished from luxation, by manual examination; by the form of the joint; by the history of the occasional cause; and by the patient being always able to use the joint, to a greater or less extent, immediately after the receipt of the injury.

Prognosis.—When the sprain is slight the pain gradually subsides, the swelling is resolved, and the motions of the joint are soon restored to their normal state. When the injury, however, is considerable, and the ligaments or other parts have been more or less lacerated, the case not unfrequently terminates in anchylosis, extensive inflammation, gangrene, and even death.

Treatment.—The chief indications in the treatment of these injuries are, first, to arrest the hemorrhage from the lacerated vessels; secondly, to prevent the occurrence of severe inflammation; thirdly, to promote the absorption of the effused matter; and fourth and lastly, to restore the motions of the injured parts.

The first object to be attended to is to keep the parts at rest, and to apply from twenty to thirty leeches over the situation of the injury. The position of the limb should be such as to relax the muscles which act upon the injured tendons, and at the same time, such as will favour the return of the blood to the heart. The local bleeding should be promoted by immersing the parts in warm water, or, what is still better, a warm solution of opium and the acetate of lead.

Should the pain and inflammation increase, in spite of

these means, recourse may be had to venesection and aperient medicines, in union with Dover's powder, or other diaphoretics. The joint should be kept constantly wet with cloths dipped in the opiate and saturnine solution to which I have just adverted, and the leeches should be repeated as often as the urgency of the symptoms may seem to indicate.

Occasionally much and decided benefit may be derived from the application of emollient poultices, the use of which is to be continued as long as the patient experiences pain, and the parts are tense and inflamed.

As soon as the inflammation has subsided, and the patient is free from pain, the joint should be frequently rubbed with turpentine, camphorated spirits of wine, or with mercurial, ammoniacal, or soap liniment; or the parts may be covered with strips of the emplastrum galbani, or of the emplastrum ammoniac cum hydrargyro. Cold bathing, salt frictions, or the application of a roller, are also sometimes found highly serviceable.

Should the disease prove obstinate, and be attended with occasional pain, much relief may be afforded by counter-irritants, either in the form of a blister, or the unguentum antimonii tartarizati.

In all cases great care should be taken not to move the joint too early; for so doing will only have a tendency to keep up the effects of the injury, and retard the patient's recovery. Rest, indeed, is of the utmost importance, and is essentially necessary to the speedy removal of the complaint.

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CHAPTER III.

OF THE DISEASES OF THE JOINTS.

SECTION I.

OF INFLAMMATION OF THE SYNOVIAL MEMBRANES.

Seat.—All the joints are liable to this disease, but that of the knee is perhaps more frequently affected with it than some of the others.

Differences according to age.—Inflammation of the synovial membranes, seldom occurs in childhood and old age, but most commonly in adult persons, or about the time when the body has arrived at full maturity: a feature in which it strongly resembles the rheumatic inflammation of the fibrous tissues.

Causes.—Idiopathic cases of this kind are not very common. The complaint usually originates from exposure to cold, from the presence of inter-articular cartilaginous concretions, or from mechanical violence, as sprains, contusions, blows, or falls. In some instances, however, it evidently arises from the effects of gout, rheumatism, small-pox, measles, or other eruptive fevers; from the long-continued use of mercury, or from a scrofulous or syphilitic state of the system.

Symptoms.—The symptoms are stiffness in the joint, which is greatest in the morning, and diminishes after exercise: pain and tenderness on moving the limb; swelling and fluctuation at the affected part; a pale glossy appearance of the skin; difficulty of moving the joint; inability of keeping the leg in an extended position; deformity and wasting of the limb; and a sense of heat within the joint.

As the disease progresses, the symptoms gradually increase in violence, giving rise to severe constitutional disturbance. Oftentimes the pain is very great, especially at some particular spot, and deprives the patient completely of sleep.

The complaint frequently comes on in a slow and gradual manner, and is characterized merely by a trifling enlargement of the joint, arising entirely from fluid collected in its cavity, with tenderness on pressure, and more or less pain on moving or extending the affected limb. At last, however, the parts assume a soft and swollen appearance; the limb becomes contracted; the motion of the joint is impaired; and all the symptoms are aggravated.

Morbid alterations.—Inflammation of the synovial membranes occasions an increase of vascularity and a preternatural secretion of synovia; a deposition of coagulating lymph, which generally covers the whole surface of the joint, and impedes its motions; a thickening of the membrane, or a conversion of it into a hard, grisly substance; and an effusion of a kind of sero-albuminous fluid into the adjacent cellular texture.

Prognosis.—In some instances, the inflammation gradually subsides, and the effused fluid being absorbed, the joint regains its natural figure and mobility; but, in other examples, the swelling and stiffness remain, and the patient is very liable to a return of the complaint, whenever he exposes himself to cold, or fatigues himself by exercise. Sometimes the inflammation extends to the cartilages, producing suppuration, ulceration, or entire destruction of their articular surfaces.

Treatment.—When the disease has arisen from the improper use of mercury, or from a scrofulous or syphilitic state of the system, sarsaparilla and alterative medicines will be indispensable; when from gout or rheumatism, colchicum, conjoined with opium and sudorifics. When the disease attacks several joints at the same time, or when, after leav-

ing one joint, it appears in another, small doses of mercury, given every evening, or every other evening, on going to bed, will be the most proper and successful practice.(*a*)

In the early or acute stage of this affection, general, and especially topical bleeding, are strongly indicated. The severity of the inflammation and the age and strength of the patient must determine with regard to the use of the lancet; but the employment of leeches may be said to be proper in almost all cases. This practice should be daily persisted in, until the acute inflammatory symptoms have entirely subsided. But, in conjunction with this treatment, a constant evaporation should be maintained from the surface of the joint by means of the saturnine lotion; or, if the swelling and tension be very great, fomentations and poultices may be used in its stead, as more likely to afford relief.

The treatment in the chronic stage, consists chiefly of local bleeding, by means of leeches or cups, cold lotions, and the repeated application of blisters. Perfect quietude is of essential importance, and is to be brought about by appropriate apparatus. When the disease begins to decline, the absorbent powers of the part affected, are to be invigorated by stimulating liniments, by manual friction, or camphorated mercurial ointment. The stiffness of the joint is to be removed by free but gentle exercise of the limb, and by pumpings of cold water.

The subject must not be dismissed without briefly alluding to the counter-irritation arising from the application of tartar emetic ointment to the integuments of the diseased joint; it is far preferable, at least in most cases, and especially in the chronic form of the complaint, to the counter-irritation resulting from the application of blisters. It causes less pain, is more agreeable to the patient, and the effects which it produces are more lasting and permanent.

(*a*) Good's Study of Medicine, vol. ii. p. 492.

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SECTION II.

OF HYDRARTHRUS.

Synonyma: Hydrarthron; hydrarthros; hydrarthrosis; hydrops articuli; dropsy of the joints.

Definition.—Hydrarthrus consists in a preternatural accumulation of the synovial fluid which lubricates the joints.

Seat.—The disease commonly occurs in the femoro-tibial articulation, and sometimes, though rarely, in the wrist, ankle, and shoulder joints.

Causes.—The proximate cause of this complaint apparently consists in a want of equilibrium between the secreting and absorbing vessels of the synovial membranes of the diarthrodial joints. The remote or exciting cause is more obscure; but, in general, it may be traced to chronic inflammation of the joints, exposure to severe cold or damp weather, violent exercise, and the presence of inter-articular concretions. Occasionally, also, it follows scrofula, rheumatism, gout, typhus and other fevers.

Character and quantity of the fluid.—The fluid is usually of a thin, glairy, or sero-oleaginous appearance; and varies in quantity from one to five or ten ounces: in some rare cases it amounts to a quart or more.

Symptoms.—Hydrarthrus is characterized by a general intumescence of the contour of the joints, and by a soft,

elastic, and irregularly circumscribed tumour. The skin ordinarily retains its natural colour, and the motions of the parts are rarely attended with pain or inconvenience. The swelling is accompanied by evident fluctuation, and is most conspicuous where the capsular ligaments of the joints are loose and superficial. In the wrist it is most apparent at the anterior and posterior parts of the joint; in the ankle, in front of the malleoli; in the shoulder, in the interspace between the deltoïd and great pectoral muscles.

Hydrarthrus of the femoro-tibial articulation is denoted by a dull pain in the knee; by an irregular, fluctuating tumour, which is most apparent at the sides of the patella; by a change in the natural form of the part; and by an alteration in the shape and consistence of the swelling on moving the leg. In extension, the tumour is softer, and imparts a more decided sensation of fluctuation, than in flexion, in which the swelling is tenser, broader, and more prominent at the sides of the knee.

Prognosis.—The prognosis in hydrops articuli is always more favourable when the swelling is recent and small, than when it is of long standing, large, and attended with a thickening or organic alteration of the synovial membrane. In the latter case, the disease is often obstinate and dangerous, as it is not unfrequently followed by anchylosis, or ulceration of the articular extremities of the bones.

Treatment.—The treatment of dropsy of the joints must be chiefly of a local nature, though sometimes it may be necessary to make use of constitutional remedies, especially of mercurial purgatives. The local applications which have been particularly extolled in the case before us, are dry frictions, electricity, fumigations with the vapour of vinegar or benzoin, mercurial frictions, sinapisms, blisters, and stimulating embrocations, as the volatile liniment, camphorated spirits, ether, and alcohol. These, however, are seldom productive of much benefit, the surgeon being obliged, in most cases, to place his reliance principally upon blister-

ing the part, and keeping up a discharge from the vesicated surface by means of the savine or tartar emetic ointment. The operation of the blister should be aided with a laced knee-cap, and a piece of oiled silk, or strips of adhesive plaster, and a moderately tight bandage.

Sinapisms, I believe, were first recommended in this disease by Tralles, an old French surgeon, and have lately again been highly extolled by Dr. Vilette, of Paris, who cites a very interesting case in confirmation of their efficacy. They are said to be more particularly useful in preventing a recurrence of the effusion, after the fluid has been evacuated by means of the trocar, as will be presently stated.

The disease may occasionally be removed by rubbing the joint three or four times daily, with an ointment composed of nearly equal parts of g. ammonia and oxymel of squills, as recommended by Michaelis,(*a*) a German physician; care being taken to bathe the limb previously, in a strong infusion of juniper-berries.

When hydrarthrus occurs as a symptomatic affection, or during the debility consequent upon typhus or bilious fever, it will either subside spontaneously, or remain as long as the cause by which it has been induced, continues to exert its pernicious influence.

Should the disease not yield under the treatment to which I have just alluded, or continue to increase so as gradually to impede the motions of the joint, accompanied with a wasting and shrinking of the limb, the surgeon should by all means endeavour to relieve the patient by a surgical operation. This step, however, is always a dangerous one, and is therefore, only warrantable, when it is absolutely indicated by the circumstances of the case.

Operation.—The operation consists in making a small superficial incision through the skin, at the most prominent part of the tumour, in separating the lips of the wound, and

(*a*) Richter's Biblioth. 6 Bd. 1. st.

in plunging a very delicate trocar, obliquely into the cavity of the joint.

Treatment after the operation.—When the fluid is completely evacuated, the canula should be withdrawn, and the limb should be put in an easy posture over three or four pillows, placed so as to form a kind of double inclined plane. The edges of the wound should be brought together, by a piece of adhesive plaster, and the joint should be kept constantly wet with a warm solution of the acetate of lead and of poppy-heads. Low diet should be enjoined, and all such measures should be carefully resorted to, as are calculated to obviate the direful consequences of inflammation.

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SECTION III.

OF INTER-ARTICULAR CARTILAGINOUS CONCRETIONS.

Synonyma: Moveable cartilages; loose substances in the joints; ecphymata cartilaginea.

Definition.—This disease, which has hitherto been almost universally known under the vague name of moveable cartilages, or loose substances in the joints, consists in a deposition and concretion of coagulable lymph, or cartilago-osseous matter. It was first pointed out by the celebrated

Ambrose Paré, in 1558, since whose time it has been made the subject of some very interesting papers by many of the most able and distinguished writers on surgery.

Seat.—Cartilaginous concretions may occur in any of the diarthrodial joints; but they are most frequently met with in the femoro-tibial articulation, and it is in it, that they give rise to those symptoms which not unfrequently demand the interference of the practitioner.

Causes.—In many cases the disorder makes its appearance without any assignable cause; in general, however, it seems to be owing to falls or blows upon the joint.

The proximate cause, as stated in giving the definition of the disease, consists in an effusion of coagulating lymph, or other matter, which becoming gradually vascular and organized, is at length detached from the adjoining living parts, and assumes the character of extraneous matter.

Remark.—According to Mr. Russell's observations, to whom we are indebted for many excellent remarks on the diseases of the knee, these preternatural cartilaginous substances, are owing to an inspissation of the synovial fluid; others impute them to the deposition of crystallized matter upon the surface of the affected joint; while others again, as Theden, regard them as nothing but articular glands, bruised in consequence of blows or falls.

Size and number.—The size of the inter-articular cartilaginous concretions varies from that of a pea to that of the patella, and their number from one to twenty-five.

Form and consistence.—They are commonly concave on one side, convex on the other, and of an irregularly oval form. But sometimes they are lenticular, rough in one part, and even in another, or are marked round their circumference by a kind of red striated appearance. They generally consist of a single mass, but occasionally they are divided into several lobules, which are connected together by a kind of condensed cellular or ligamentous substance. In some instances they are tough and tenacious, or soft like

ligament; but, in general, they are partly cartilaginous, and partly osseous, the bony part being in the centre, the cartilaginous on the surface.

Ordinarily, the inter-articular cartilaginous concretions are detached, and float loose in the interior of the joints; but in some cases they are connected to the adjacent parts by loose cellular substance, or by strong ligamentous bands.

Symptoms.—The symptoms which announce the presence of foreign bodies in the knee-joint, are often so well characterized that it is impossible to mistake them; sometimes, however, the nature of the disorder eludes the most careful examination. In many cases, especially if the extraneous body be large, the patient experiences but little inconvenience; but if it be rather small, and moves through the joint, or glides between the extremities of the bones, it gives rise to severe pain, and if the accident be often repeated, it induces inflammation in the synovial membrane, and occasions intolerable sufferings. When the foreign body gets behind the patella, and the patient is standing or walking, he is often seized with a sudden pain, and is obliged to sit down, in order to save himself from falling. During night, the least motion of the limb will sometimes cause great uneasiness, and rouse the patient from his sleep. Reimarus mentions the case of a man, who suffered violent pain, accompanied with an inability to move his leg, when the foreign body got to the side of the patella; and the late Benjamin Bell, of Edinburgh, asserts that he has known persons in whom the least motion of the limb would cause such a degree of pain as to produce fainting.

During the continuance of the pains, the knee is often more or less enlarged, the swelling, however, being never so great as to prevent the surgeon from feeling the extraneous body, which generally forms a projection under the integuments at the outer or inner part of the knee, and may be easily pushed from one side of the joint to the other.

Sometimes, the foreign substance slips into a particular

part of the joint, where it creates neither pain nor inconvenience, and the patient imagines he has got rid of his complaint. After some time, however, it is forced into another situation, thus causing a renewal of all the former symptoms.

Prognosis.—Although the complaint under consideration is not generally dangerous, yet, as it often obstructs or impedes the motions of the joints in which it makes its appearance, and can not be cured except by a surgical operation, which is itself sometimes attended with very distressing, nay even fatal consequences, the practitioner should always be extremely cautious in delivering a prognosis. The removal of the disease can never be effected by resolution; such an occurrence being wholly impossible from the very nature of the foreign body.

Treatment.—When the foreign body is moderately large, and does not occasion much pain or inconvenience, it will sometimes be advisable to fix it in its place, by wearing a well adapted laced knee-cap, or a compress and tolerably tight bandage. The relief thus afforded, however, is often merely temporary, and we are, therefore, generally compelled to have recourse to the knife.

Operation.—A few days prior to the operation, the patient should be confined to his bed, his bowels should be emptied by saline purgatives; and leeches, together with cold saturnine lotions, should be applied to his knee. The object of this preliminary treatment is simply this, to put the joint in the most favourable condition for bearing the operation, and to obviate, as far as possible, the ill effects of inflammation.

In performing the operation, the limb should be extended upon a table, in a horizontal position, and the foreign body being brought to the supero-internal part of the knee, should be fixed with the thumb and fore-finger of the left hand. The skin being now drawn over the patella, the surgeon carries his knife through the integuments in a longitudinal di-

rection, and makes an opening barely large enough to admit of the passage of the cartilage. When this has been extracted, which is always easily done with a pair of small forceps, or by compressing it between the fingers, the assistant removes his hand, and permits the skin to glide over the wound in the capsule, so as to close it up like a valve, and thus prevent the admission of air.

If the cartilage adhere to the articular surface of the joint, as is sometimes the case, it should be cut away with a bistoury or pair of scissors; and if there be any occasion to enlarge the incision in the integuments, it ought always to be done with the knife.

When there are several inter-articular cartilaginous bodies, they should all be extracted through the same opening, or, if this can not be done, they should be removed at a subsequent operation.

Treatment after the operation.—When the operation is finished, the edges of the incision are to be supported by adhesive strips, and the motion of the joint is to be prevent ed by means of a splint placed along the back part of the limb. Light compresses, dipped in a mixture of laudanum and water, in the proportion of one ounce of the former to a quart of the latter, should be kept constantly upon the parts, and the whole treatment should be rigorously antiphlogistic. The patient should not leave his bed before the fourteenth or fifteenth day, and the joint should not be moved until the wound has nearly or completely healed.

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SECTION IV.

OF FUNGUS ARTICULI.

Synonyma: Arthrosia hydrarthrus; arthrocele; arthropuosis; spina-ventosa; white-swelling; tumour albus.

Fungus articuli, or white-swelling, embraces three different diseases, viz., morbid alteration of the synovial membranes, ulceration of the diarthrodial cartilages, and scrofula of the cancellated structure of the articular extremities of the bones.

§ 1. MORBID ALTERATION OF THE SYNOVIAL MEMBRANES.

Seat.—This disease, according to the valuable researches of Mr. Brodie, is seldom met with in any of the joints, excepting that of the knee.

Differences according to age.—The affection generally takes place at or before the age of puberty, rarely at any other period of life; a circumstance which should be carefully borne in mind by the practitioner, as it will assist him materially in forming a ready diagnosis.

Causes.—The causes of this complaint, are commonly inexplicable; and the attempts that have been made to investigate them, have resulted in ingenious conjectures, rather than sound facts. Notwithstanding this, however, its origin, I think, may be fairly referred, in many cases, to violent and repeated attacks of inflammation, called into ac-

tion either by external injury, as a sprain, or contusion, or by internal causes, as gout or rheumatism.

Symptoms.—Morbid alteration or change of structure of the synovial membranes, generally commences with a sense of uneasiness in the affected part, accompanied with a slight degree of swelling and stiffness. In process of time the symptoms increase in intensity; the motions of the joint become more limited and painful; the parts augment in size; and the swelling becomes soft, elastic, and imparts a deceptive sensation of fluctuation. In most cases the patient experiences little or no pain, until matter has formed within the joint, and the articular cartilages have begun to ulcerate; notwithstanding, however, his constitution is gradually undermined, and he dies at length worn out by hectic.

If the disease be allowed to progress, and the patient's constitution be good, several years will often elapse before it reaches its most frightful crisis; and sometimes, though not frequently, it will remain indolent without any sensible alteration even for a much longer time.

Diagnosis.—With regard to the diagnosis of this disease, every source of difficulty may be removed by due attention to the history of the case, the gradual progress of the enlargement and stiffness of the affected part, the soft elastic swelling, and the absence of pain and fluctuation.

Morbid alterations.—The only changes which are observable in the early stage of the disease, are a loss of the natural organization of the synovial membrane, and a conversion of it into a thick pulpy substance, of a reddish or light brown colour, intersected by white membranous lines, varying from one fourth of an inch to an inch in thickness. At last, however, the disorder invades the whole joint, producing ulceration of the cartilages, wasting of the ligaments, caries of the cancellated structure of the bones, and collections of matter in different places. (*a*)

(*a*) See Brodie's Pathological and Surgical Observations on the Diseases of the Joints, p. 38.

Prognosis.—Morbid alteration of the synovial membranes is generally incurable. All that can be done, at least in the present state of our information, is to arrest, for a while, its progress; for in the end, the limb must be sacrificed for the preservation of the patient.

§ II. ULCERATION OF THE DIARTHRODIAL CARTILAGES.

Seat.—Ulceration of the articular cartilages forms the second variety or species of white-swelling: which is of most frequent occurrence in the ilio-femoral articulation, and is generally confined to a single joint; but occasionally it attacks two or even three, either in succession or at the same time.

Difference according to age.—The disease does not appear to be confined to any particular period of life; though, in a large majority of cases, it attacks young persons between the age of ten and thirty.

Causes.—The causes of ulceration of the diarthrodial cartilages may sometimes be traced to local injury, exposure to cold, or to a scrofulous taint of the system, but, in general, no satisfactory explanation can be given of them.

Symptoms.—As the symptoms of the disease of the ilio-femoral articulation, will be described in a future part of this work, I shall at present confine my remarks to the symptoms characterizing ulceration of the cartilages of the knee, as pointed out by Mr. Brodie and Mr. Scott, whose extensive knowledge of the complaint before us, entitles their observations to peculiar confidence. In the beginning of the disease, the patient often feels merely a slight degree of pain, which is inconstant in its duration, and is referred to various parts of the limb. The motions of the joint become gradually impaired, especially after exercise; the patient limps in walking, and is obliged to keep his knee in a flexed position; the heel is raised from the ground, and every attempt to move the limb by means of its own muscles

is attended with great pain and difficulty. After some time, the cellular tissue about the joint becomes inflamed and indurated, the pain increases, and the muscles of the affected limb are harassed by frequent spasmodic contractions. The pain is usually referred to the head of the tibia, and is aggravated whenever the articular surfaces of the joint are allowed to come into contact. The muscles around the joint are gradually attenuated, and, occasionally, there is a sensation of fluctuation, arising from an accumulation of synovia, or a collection of matter in the surrounding parts. If the disease proceed, the skin generally ulcerates, the ligaments are destroyed, and the joint becomes dislocated.(*a*)

Diagnosis.—Ulceration of the diarthrodial cartilages is sometimes confounded with other diseases, especially with inflammation and morbid change of structure of the synovial membranes; from which, however, it may be easily distinguished by the pain in the former being slight in the beginning, inconstant in its duration, and referred to different parts of the limb; by its becoming gradually more acute and permanent; by its being greater during the flexion and extension of the joint; by the absence of swelling during the early stage of the affection; and by the circumstance of the disease being aggravated during the starting of the limb at night, and when the ulcerated surfaces are rubbed against each other.

Morbid alterations.—The cartilages of the joint are either partially or totally destroyed, converted into a soft, pulpy, or lardacious substance, or removed by absorption. The ligaments are wasted or decomposed, and the articular extremities of the bones are affected with caries, and bathed in dark-coloured pus.

Prognosis.—Ulceration of the articular cartilages is sometimes capable of being cured by an appropriate course of treatment; but if the patient wait too long before he applies

(*a*) Good's Study of Medicine, by Cooper, vol. ii. p. 493.

for surgical aid, or if the disease be injudiciously managed from the commencement, it will either terminate in anchylosis, or give rise to a necessity of removing the limb by amputation.

§ III. SCROFULA OF THE ARTICULAR EXTREMITIES OF THE BONES.

Seat.—The joints most liable to this disease are the elbow and the knee, particularly the latter; those, on the contrary, which are least liable to it are the joints of the hip and shoulder. Occasionally it attacks several joints at the same time, or recurs in others after the one originally affected has been cured or removed. (*a*)

Difference according to age.—Scrofula of the cancellated structure of the bones is most frequently met with in children; and is by many regarded as the only genuine form of white swelling: it is rarely seen in individuals past the age of twenty-five or thirty.

Causes.—The causes of this affection appear to consist, in most cases, in a scrofulous taint or certain morbid condition of the general system.

Symptoms.—When the disease occurs in the knee-joint, it generally commences with a deep-seated, dull, heavy pain in the head of the tibia or about the centre of the articulation, attended or soon followed by a general swelling, which is at first hard and tense, but after a time, varying from a few weeks to several months, it becomes soft, puffy, and elastic. Sometimes the pain recurs at regular intervals; sometimes there are intermissions; and, in other instances, it continues without interruption. It is generally greatest when the diseased part is warm, and particularly when the patient is confined in bed. After exercise the joint feels weak, stiff, and somewhat fuller than usual; and, as the dis-

(*a*) Good, op. cit. vol. ii. p. 494.

ease proceeds, the patient gradually begins to limp, and gets in the habit of touching the ground only with his toes. The limb at length becomes permanently flexed, the knee enormously enlarged, and the integuments tense and glossy. The superficial veins present a varicose aspect, the limb becomes thin and wasted, and on touching the parts they impart a sensation of heat.

After some time, varying generally with the progress of the distemper, the cartilages ulcerate, and collections of matter form around the morbid joint. These at length burst, giving vent to a thin purulent matter, mixed with small portions of flaky, caseous, or curd-like substance. As the ulceration of the cartilages extends, the pain augments, the bones are rendered carious, and the patient's health is sensibly impaired. His appetite declines; his natural rest and sleep are interrupted; his face is flushed; his pulse small and frequent; his body weak and emaciated; and death, so long expected, and so anxiously desired, at last closes the scene.

Diagnosis.—Scrofula of the cancellated texture of the bones may generally be distinguished from other diseases of the joints, by its being attended with less pain, by the greater degree of external swelling, by the scrofulous or morbid condition of the general system, by a particular attention to the progress of the complaint, and by the peculiar nature of the matter which is discharged from the affected joint.

Morbid alterations.—On inspecting a scrofulous joint after death, it will commonly be found that the extremities of the bones which enter into its composition are preternaturally softened, and admit of being cut with the scalpel; that they are of a dark or red colour, bathed or filled with matter; and that the cartilaginous surfaces are eroded, ulcerated, or completely destroyed. The ligaments are either weakened or decomposed, the muscles greatly attenuated, and the cellular tissue is distended or infiltrated with serum or coagulable lymph.

Prognosis.—In the worst cases of this disease, the patient either dies of hectic, or is obliged to submit to the removal of his limb; in others, a curative process ensues, and the disease terminates either with or without anchylosis. In the joints of the hand and foot the chances of recovery are even less than in the larger joints;(*a*) and, frequently, after the limb has been amputated, the disease makes its appearance in some other organs, more essentially necessary to life.

Treatment of fungus articuli.—Whether we consider the frequency of this disease, or the distressing and even fatal consequences to which it so often leads, we have much cause for congratulating ourselves upon the great and important improvements that have recently been made in its treatment; which, instead of being empirical and irrational, as formerly, is now based upon the broad and solid principles of reason and philosophy.

In the early or acute stages of white swelling, blood letting and purgative medicines will generally prove eminently useful, especially if the pulse be full and hard, and the system has not been debilitated by the local disorder or the effects of former diseases. After the general inflammatory symptoms have subsided, the patient should be put upon an alterative course of treatment, consisting of small doses of calomel, corrosive sublimate, or blue pill, combined with sarsaparilla, aloes, or ipecacuanha. The bowels should be kept gently open by a combination of sulphur, cream of tartar, and jalap, or the sulphate of magnesia or potash; and if there be much gastric acidity, essential service may be derived from the carbonate of soda, given in doses of half a drachm three or four times a-day. The food should be plain, nutritious, and easy of digestion; and the patient, if possible, should reside at the sea-coast or in a pure dry atmo-

(*a*) Good's Study of Medicine, vol. ii. p. 494.

sphere. His body should be frequently rubbed with the salt towel, which will not only have a tendency to promote the cutaneous capillary circulation, but will greatly invigorate the digestive functions.

In the advanced stages of the disease, when the constitution is irritable and enfeebled, much benefit will arise from tonic medicines, as the mineral acids, Peruvian bark, or the sulphate of quinine, preparations of steel or iron, and the compound decoction of sarsaparilla. The action of the skin should be promoted by wearing flannel clothing, and by the occasional employment of the warm bath, the temperature of which should not exceed 96 or 98 degrees of Fahrenheit's thermometer. It should be used about ten or twelve minutes at a time, in the middle of the day; but if it debilitate the patient by exciting excessive perspiration, it should by all means be discontinued. Under these circumstances, dry frictions, cold bathing, or sponging the body with spirits and water, will be worthy of trial, as proving sometimes highly useful, especially if they be soon followed by a general glow.

When the patient is harassed with pain and a debilitating diarrhœa, which so frequently prevail in the latter stages of this disease, and sometimes to a very frightful extent, his sufferings should be alleviated by anodyne remedies, given in such doses as will procure sleep and quiet the system.

Local treatment.—The first thing to be attended to in the treatment of fungus articuli, is to keep the affected limb perfectly at rest, and to prevent all such means as may have a tendency to create irritation in the diseased part. If the joint be hot and tender, and in a state of more or less acute inflammation, topical bleeding, cold saturnine lotions, or emollient and anodyne poultices should be employed. The quantity of blood taken away should always be considerable, but great care should be taken that it be accurately proportioned to the age and strength of the patient, and the activity of the local disorder. With this view, twenty or

thirty leeches may be applied to the part; or from ten to fifteen ounces of blood may be taken away by cupping, care being taken that the operation be repeated at proper intervals, until the local inflammatory symptoms have either partially or completely disappeared.

When the disease has assumed the chronic form, much advantage may generally be derived from keeping up a slight but constant counter-irritation, by means of blisters, tartar emetic ointment, issues, or setons; or by rubbing the diseased joint with a liniment composed of half an ounce of camphor, two ounces of oil, and half an ounce of aqua ammoniæ. In all cases, however, great care should be taken not to irritate the parts too much, as so doing will only have a tendency to increase the evil and diminish the chances of affording permanent relief. The absorbent powers may also be efficaciously excited by frictions with dry flannel, or by rubbing the parts with a salt towel, a little flour, or powdered starch.

Iodine has of late been much praised as a remedy for white swelling, and some very encouraging accounts of its beneficial effects have recently been published by M. Maunoir, of Geneva, and Mr. Buchanan, of Hull. But whether the high encomiums that have already been bestowed upon it will be fully justified by more general and impartial experience, I am not prepared to say. It may be used either in the form of an ointment, or in that of a tincture, in the proportion of one drachm of iodine to three ounces of rectified spirits of wine.

Sometimes the disorder may be materially diminished, or even entirely removed, by encircling the parts with strips of adhesive plaster, or by applying moderate pressure by means of a roller, keeping, at the same time, the skin constantly moist with a piece of oiled silk, or a mixture of spirits and water.

An ingenious mode of treatment, founded upon the principle of keeping up a moderate and uniform support of the

affected part, has lately been recommended to the notice of the profession by Mr. Scott, of England. It consists "in cleaning the joint, suppose the knee, with a solution of brown soap and warm water, in thoroughly drying the parts, and then rubbing them with a sponge soaked in camphorated spirits of wine, until the skin begins to feel warm, smarts somewhat, and looks red. It is then covered with a soft cerate, made of equal parts of the ceratum saponis and the unguentum hydrargyri fortius cum camphorâ. This is thickly spread on large square pieces of lint, and applied entirely around the joint, extending at least six inches above and below the point at which the condyles of the femur are opposed to the head of the tibia; over this, to the same extent, the limb is to be uniformly supported by strips of calico, spread with the empl. plumbi of the London Pharmacopœia. These strips are about an inch and a half broad, and vary in length; some are fifteen inches, others a foot, others half these two lengths, and the shorter or longer are selected according to the size of the part around which they are to be applied. This is the only difficult part of the process. This adhesive bandage ought to be so applied as to preclude the motion of the joint, prevent the feeble coats of the blood-vessels from being distended by the gravitation of their contents in the erect posture, and thereby promote their contraction. Over this adhesive plaster, thus applied, comes an additional covering of empl. saponis, spread on thick leather, and cut into four broad pieces, one for the front, another for the back, and the others for the sides of the joint. Lastly, the whole is secured by means of a calico bandage, which is put on very gently, and rather for the purpose of securing the plaster, and giving greater thickness and security to the whole, than for the purpose of compressing the joint. This is an important point, as otherwise an application which almost invariably affords security and ease, may occasion pain, with all its attendant mischief."

When the skin is thick and indolent, and can not be suf-

ficiently excited by the applications just mentioned, Mr. Scott recommends rubbing the parts with a small quantity of tartar emetic ointment, previously to the application of the cerate, though this, as he justly remarks, is seldom necessary.

This apparatus, which should be reapplied once about every ten or fifteen days, as circumstances may indicate, is calculated to keep the parts perfectly at rest, to support and secure them from external injury, and to excite the vessels on the surface of the skin, and keep them in a constant state of augmented action.

Whatever mode of treatment be employed, it is always of the utmost importance to keep the parts perfectly at rest, and to prevent all motion of the limb by means of pasteboard or thin wooden splints.

When abscesses form within the joint, they may be allowed either to burst spontaneously, as advised by the late Dr. Albers, of Bremen, or they may be opened by a small incision, as proposed by Mr. Lloyd and Professor Langenbeck.

When the local disorder has progressed so far as to preclude all possibility of effecting a cure, and the patient's health is gradually declining, there can be no other resource than to remove the limb by amputation, or to cut off the ends of the diseased bones, in the manner pointed in a preceding part of this work.

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SECTION V.

OF FEMORO-COXALGIA.

Synonyma: Morbus coxarius; arthropuosis; coxagra; ischias; coxalgia; coxarthrocace; hip-disease; spontaneous or secondary luxation of the os femoris; scrofulous caries or abscess of the hip-joint.

Definition.—The term femoro-coxalgia, appears to have been invented by Baron Larrey, of France, having been first employed by him to designate a chronic inflammation or ulceration of the cartilages of the ilio-femoral articulation.

History.—Femoro-coxalgia was first noticed by the venerable Hippocrates, more than two thousand years ago. The disease, however, scarcely received any attention from the early systematic and practical writers on medicine and surgery; and, excepting the account given of it by J. L. Petit, in the Memoirs of the Academy of Sciences for 1722, little was known either with regard to its pathology or treatment, until the close of the eighteenth, and the commencement of the present century, when the subject was more fully investigated by Ford and Falconer of England, and by

Albers and Wirth of Germany. The most complete treatises which have since appeared, are those of Mr. Brodie of London, of Dr. Volpi of Italy, and of professor Rust of Vienna, in which may be found much original, correct, and useful information.

Division, and differences according to age.—The disease may be divided into two species or varieties, the rheumatic and the scrofulous. The first variety occurs most frequently in adults and old persons; the second, in children and youth, between the age of ten and twenty.

Causes.—Much time has been spent by pathologists in enumerating the several causes from which coxalgia is supposed to originate. Without following them in details, let it suffice to state that it is often occasioned by external violence, such as falls, blows, or contusions; by long-continued fatigue, as from rapid and protracted marches; by lying down upon the damp ground in warm weather; and by exposure to cold and moisture. In some cases it arises from rheumatic inflammation, puerperal fever;(*a*) the ill effects of mercury,(*b*) or syphilis,(*c*) but in the majority of examples, it is attributable to a scrofulous state of the system; and hence its frequency among weak and delicate children.

Symptoms.—Femoro-coxalgia is generally extremely insidious in its attack, being seldom attended with those alarming symptoms which are observed in white-swelling, or some of the other diseases of the joints. In the incipient stage of the affection, the patient often experiences merely a slight degree of pain or weakness in the knee, and shows signs of general debility. In a short time, however, the whole limb becomes sensibly emaciated; pain is felt in the groin and head of the os femoris; and the weight of the body is almost wholly supported upon the sound thigh and leg. The affected limb is generally directed forwards, somewhat flexed at the knee,

(*a*) Gervino on the Diseases of Children, p. 282, London, 1829.

(*b*) Albers' Abhandlungen über die Coxalgie, s. 19.

(*c*) Rust's Arthrokakologie, s. 57.

and considerably elongated; and when the patient stands upon both feet, the buttock on the injured side appears less full and round than the other, and somewhat swelled towards the thigh.

After some time, the patient commonly gets in the habit of leaning upon the sound leg, and turning the other out, the toes only touching the ground. The pelvis is inclined towards the affected side; and the pain becomes more local, constant and severe. In many cases it is extremely acute; causing great constitutional irritation, want of appetite and sleep. During the night it is particularly severe, when the rest is often disturbed by sudden starting and twitchings of the limb. Very frequently the knee is the sole seat of the pain, or it may extend from the hip downwards, so as to lead to mistaken notions concerning the true nature of the disease. Let the pain be located, however, where it will, the least motion or pressure upon the trochanter major will greatly augment it; a circumstance which should always be borne in mind, in examining a patient in whom this disease is supposed to exist; for there is seldom any external mark which would lead to its detection, more especially in its incipient stage.

Every motion of the limb, but especially that of abduction, causes more or less severe pain, the patient experiencing a sensation of friction resulting from the contact of the unequal surfaces of the articulation. This circumstance, as has been truly remarked by Mr. Brodie, is deserving of particular attention, as no one should ever give an opinion respecting the nature of a disease connected with the hip-joint, without having first placed the patient in the recumbent posture, on an even surface, and applied his hand to the heel so as to press the head of the thigh-bone against the cavity of the acetabulum. If this experiment excites pain, the presumption is strong that the cartilages are in a diseased condition.

The elongation of the affected limb, one of the most re-

markable symptoms of coxalgia, commonly varies from one to four inches, and is occasioned by the obliquity of the pelvis, a partial destruction of the ligaments of the joint, or a great laxity of the muscles connected with the hip.(*a*) Another remarkable and very curious occurrence, is the wasting of the glutæi muscles, giving the nates of the diseased side the appearance of being flatter and wider than that of the other. Oftentimes, however, this appearance is altogether deceptive, no real difference being discoverable in the breadth of the two nates on accurate measurement.

These symptoms, in addition to an enlargement of the lymphatic glands, with a slight tumefaction in the groin, constitute the first stage of the disease; those of the second stage are equally characteristic, and will next claim our attention.

When the complaint has reached the second stage, the parts which surround the joint becomes tense and highly painful; the skin assumes a red, purplish appearance; and symptoms of inflammatory fever prevail. After the severity of the pain has abated, an abscess makes its appearance in the vicinity of the joint, and is speedily followed by hectic symptoms. In the meantime, the cartilaginous investments of the articulation are destroyed by ulceration, the bones are rendered carious and crumble away, and the head of the femur being partially or totally absorbed, the shaft is drawn upwards by the action of the muscles, and the limb is thus considerably shortened.(*b*) During these different changes, the constitution is gradually undermined by a slow, exhausting fever, and the patient is in danger of falling a prey to the ravages of the disease.

Sometimes the head of the os femoris is dislocated, and the disease terminates in anchylosis, without any abscess whatever. Most frequently, however, there are extensive

(*a*) Crowther on White-swelling, p. 266.

(*b*) Gibson's Institutes of Surgery, vol. ii. p. 39.

collections of matter communicating either with the cavity of the pelvis, or opening externally. In the latter case, the matter is usually of a thin unhealthy appearance, and continues to discharge a long time after the abscess has burst.(*a*)

Morbid alterations.—The morbid alterations observed in those who die of this disease, are various. In the early stage, the cartilages of the joint are more or less eroded, the ligaments are thickened, and the surrounding soft parts usually exhibit marks of inflammation, with an effusion of coagulating lymph into the cellular tissue. After some time the cartilaginous and osseous portions of the acetabulum are either partially or totally removed by absorption, and the same fate is experienced by the cartilage covering the head of the femur, the inter-articular ligament, and capsule of the joint. Occasionally, indeed, the head and neck of the thigh-bone, as well as the acetabulum, are completely annihilated, though in most cases the bones of the pelvis are much more diseased than the os femoris.(*b*)

Prognosis.—The chances of recovery in femoro-coxalgia vary with many circumstances which hardly admit of precise detail; such as the natural strength of the constitution, the time which the disease has lasted, and the attentions of those about the patient. In its incipient stage, it is sometimes not difficult of cure; but when, commencing gradually, it has at length come to disorder the whole system, it seldom terminates without a complete anchylosis of the joint. It not unfrequently remains stationary for a time, and then recurs perhaps with even increased violence, not merely from irregularities in diet or fatigue from exercise, but at a moment probably when the greatest attention is paid to diet and regimen, and the affected limb is kept perfectly quiet. Under the best management, indeed, coxalgia often proves fatal, the constitution being unable to bear up under the exhaustion consequent upon long continued excitement.

(*a*) Cooper's Surgical Dictionary, p. 769.

(*b*) Ford on the Diseases of the Hip-joint, p. 107.

Treatment of femoro-coxalgia.—The treatment of femoro-coxalgia naturally divides itself into general and local; but as the means for improving the general health, and correcting the morbid diathesis of the system, pointed out under the head of white swelling, are in every respect applicable to the disease of the hip-joint, I shall at once proceed to a consideration of the local means; premising, however, that when the complaint has reached the second stage, the general treatment should always be less active, and the diet more simple, inirritant, and generous.

Local means.—As rest is of primary importance in every disease connected with the joints, the position of the body and limb should always be such as will be best calculated to fulfil this object, as well as to promote the comfort of the patient. In coxalgia, the supine posture is the one generally preferred, with the feet and shoulders a little elevated. In many cases, the most decided benefit will be experienced by placing the affected limb over a double inclined plane, so constructed that the inclinations may be varied or changed at pleasure, or by extending a splint from the hip to the heel. I am aware that many practitioners object to confining their patients at all, and that they prefer allowing them to exercise in the open air, upon crutches. Such practice, however must often prove highly detrimental, inasmuch as it is extremely difficult, and frequently impossible, to prevent motion in the diseased joint, while the patient is walking about; an object of the highest importance in the treatment of this disease.

If the patient suffer much pain, and the parts are red and inflamed, warm saturnine or anodyne fomentations, and the application of leeches will be highly proper; but, as the principal indication is to suspend the morbid action that is going on within the joint, recourse should be had, as early as possible, to counter-irritation. This object may generally be effected by the employment of blisters, issues, and setons. Should the surgeon be called in the commencement of the disease, a blister will often afford complete relief, and if the

discharge be kept up for a considerable time by savine or tartar emetic ointment, nothing more is necessary. The complaint, however, is generally too far advanced to admit of so speedy a cure, before surgical aid is asked; and in this case, a large caustic issue is a much better remedy. It should be made in the hollow immediately behind and below the trochanter major, or on the outside of the joint, at the anterior edge of the tensor vaginæ femoris muscle, and should be kept open by rubbing it two or three times a week with the potassa fusa, or sulphate of copper.

Setons are sometimes highly useful, especially when the pain is very severe, though they are perhaps less calculated to effect a permanent cure than caustic issues. The best situation for applying them is the groin, directly over the trunk of the anterior crural nerve.

Some surgeons are partial to the counter-irritation arising from the application of the actual cautery, either in the form of the hot iron or the moxa; and, judging from the success which is said to have attended it in the practice of some of the French and German practitioners, there can be no doubt of its efficacy. Professor Rust, who is unquestionably the most able writer upon coxalgia of the present day, is particularly favourable to the use of this remedy, and speaks of its utility in the strongest terms. It should always, however, be used with great caution, especially in young children and irritable persons. Generally speaking, the moxa is more particularly applicable to the scrofulous variety, while the hot iron is more adapted to the rheumatic form of the disease.

Frictions with mercurial ointment, as recommended by Professor Fritz of Prague,(*a*) are also sometimes useful, more especially in the incipient stage of the complaint; but whether they will entirely supersede the employment of the moxa or hot iron, as asserted by this gentleman, is extremely doubtful.

(*a*) Medic. Chirurgische Zeitung, 1828.

If, under this mode of treatment, the patient gradually recovers, great caution is requisite, lest by too early a use of the limb a relapse be occasioned. Many months, in fact, should elapse before a free use of it be allowed. If, however, the morbid action be not subdued, suppuration, which forms the commencement of the second stage of the disease, will be the necessary and almost certain consequence.

In the second, as in the first stage of the complaint, our reliance is to be placed chiefly upon counter-irritants, especially upon the employment of issues, the moxa, and the hot iron. The moxa is particularly valuable; for, as Larrey observes, "the violent but gradual excitement which it communicates to the diseased parts, arrests the morbid process, and appears to augment the action of the absorbents; so that fluids, collected in the abscesses about the joint, are readily absorbed and thrown into the circulation." Drs. Albers and Langenbeck speak also very favourably of the value of this remedy, and state that its employment is rarely attended with much pain.(*a*)

The abscesses which form around the joint sometimes open spontaneously; but, generally speaking, they require to be opened with a thumb-lancet. When this is done, the limb should be wrapped up in a piece of flannel wrung out of hot water, and in this way be continued until the matter ceases to come away.(*b*) Great care should always be taken to avoid pressure upon the part, as this would be apt to excite violent inflammation in the joint. After the discharge has continued for a while, the morbid secretion will sometimes cease; but should this not be the case, recourse must be had to stimulating injections, remembering always that they be not too strong or of a very irritating nature. Corrosive sublimate, in the proportion of about ten grains to a pint of water, is one of the best forms that can be employed;

(*a*) Neue Biblioth. B. 2. s. 27.

(*b*) Brodie in the Medico-Chirurgical Transactions, vol. vi. p. 347.

if the discharge be very offensive, chloride of lime, or of soda, will be useful.

When the matter has been completely evacuated, the parts will become agglutinated together by adhesive inflammation, the abscess will be obliterated, and the patient will be restored to tolerably good health. The joint becomes anchylosed; and, as more or less deformity is usually the result, great care should always be taken, before adhesions be formed, to place the limb in the most favourable position for walking.

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SECTION VI.

OF LOXARTHRUS.

Synonyma: Loxarthros; loxarthrus inter-articularis; varus; club-foot.

Definition.—Loxarthrus is a Greek compound, signifying a congenital deformity or obliquity of the ankle and

tarsal joints. The disease is sometimes acquired or produced by local causes; but my attention will be directed more particularly to that form of the complaint which is observable at or soon after birth.

Causes.—The proximate cause of club-foot has been differently explained by different writers. By some, as Naumburg, it is supposed to depend upon a deviation of the astragalus outwards; by others, as Brückner, and Brüninghausen, upon a mal-position of the os naviculare, the astragalus, or os calcis; and by others again, as Jörg, and some of the more recent continental writers, upon a morbid action of the muscles of the leg. According to the investigations of Professor Scarpa, however, the immediate cause of the deformity, consists in a loss of the relative position of the bones of the tarsus, or in a partial removal from their mutual contact, and a twisting around their smaller axis. The displacement is most remarkable in the os calcis, os naviculare, and os cuboides, but it is never so great, or at least, very rarely, as to amount, properly speaking, to what may be termed a complete dislocation.(*a*)

The remote causes of loxarthrus are not very obvious, or very easily ascertained; and, though many attempts have been made to account for them, they are all, or at least most of them, so unsatisfactory as to be unworthy of a repetition.

Symptoms.—In congenital loxarthrus, the point of the foot is turned inwards and upwards, seldom outwards; the internal malleolus is nearly imperceptible; the external, on the contrary, being very prominent, and apparently, situated too far back; the posterior tuberosity of the heel is drawn upwards towards the calf of the leg, and is scarcely distinguishable: the sole of the foot is remarkably hollow, or, as it were, deeply furrowed in its longitudinal direction, while the back is very convex and unusually prominent; the toes generally present in a vertical position, and the great toe

(*a*) Scarpa on the Congenital Club-foot, p. 9.

being separated or removed from the rest, points upwards and inwards; the outer edge of the foot, which, in conjunction with the external malleolus, chiefly sustains the weight of the body, is of a semi-circular shape; and the tendo-achillis being pushed obliquely from the external to the internal side of the leg, is in a state of permanent tension.

Occasionally both limbs are affected, and the points of the feet form a very acute angle with the tibia, or approach so nearly as to touch each other. Hence, the patient walks with great difficulty, in consequence of the mutual interference of the toes.

In most cases the thigh and leg retain their natural shape; not unfrequently however, the one or other of the knees projects slightly inwards or outwards.(*a*)

Prognosis.—Congenital diseases or imperfections, at least those which are capable of removal, are seldom benefited by delay; and nowhere does this remark apply with more force than in the deformity arising from the complaint which forms the subject of the present article. Hence, the sooner the disease be attended to after birth, the more probable will be the chances of effectually removing it. The bones are not at this time completely formed, nor have the muscles sufficient power to augment the original derangement. After the age of puberty, or even before the patient has reached the twelfth or fourteenth year, I much doubt, whether, in most cases, any attempts to relieve him, would not only be useless, but highly dangerous.

Treatment.—The indication of cure in loxarthrus is to bring the foot gradually to its original position, and to keep it thus by means of splints and bandages, or appropriate apparatus.

If the deformity be slight and attended to soon after birth, we may sometimes succeed with a splint and cushion, applied along the outside of the leg; but if the disease has been neglected, or the child has begun to walk, before surgical

(*a*) Scarpa, op. cit. p. 8.

aid is asked, a different kind of contrivance will become necessary. A very simple apparatus is delineated in the work of Dr. Dorsey; it consists of a sheet-tin shoe, a perpendicular steel-rod, and a thin brass or iron plate, passing round the upper part of the leg. The shoe is covered with thin, soft leather, and to its sole is attached or soldered a projecting plate of tin, intended for making lateral pressure on the inner edge of the foot, and on the outer edge of the heel. A strap, the object of which is to compress the upper part of the foot, passes over the top of the instep, and is secured to a buckle on the opposite side. The steel splint passes up the leg, and prevents the ankle from turning inwards; a joint at its lower part allows some degree of extension and flexion to the foot.(*a*)

The only other apparatus which I shall describe, at present, is that of Dr. Colles, and an account of which is published in the first volume of the Dublin Hospital Reports of 1818. It is somewhat similar to that of Dr. Dorsey, but rather more complicated. It is composed of a chamois-leather shoe, completely open in front across the toes, and cut through in the middle, so as to admit of being laced. It has a tin sole adapted to the shape and size of that of the foot; having, however, two small projections, one opposite to the ball of the great toe, and another opposite to the outer ankle. Each of these projections has a longitudinal slit, designed to receive the shouldered end of a splint. The edges of the shoe are bound with tape or narrow riband; and to its heel, below the edging, are sewed two leather straps, long enough to cross once or twice on the instep.

The splints are made of strong tin, and are covered with chamois-leather: they are about one inch broad, and long enough to reach from the mortise-like slits in the sole of the shoe to near the knee.

The length of time that these machines should be worn

(*a*) Elements of Surgery, vol. ii. p. 359.

varies in different cases; but, generally speaking, it is from six to twelve months.

When the point of the foot is turned outwards, which, however, is a very rare occurrence in the congenital club-foot, the means of removing it will be easily understood, since the treatment is to be conducted precisely upon the same principles as when it is turned in the opposite direction.

I have not thought it proper to describe the complicated apparatus of Boyer, Scarpa, Brückner, Venel, or Göpel; because those of Dorsey and Colles, noticed above, are much more simple, and, if modified according to circumstances, will be applicable to every case of club-foot that is met with in practice.

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SECTION VII.

OF ANCHYLOSIS.

Definition.—By the term anchylosis, is implied a partial or total loss of motion of the diarthrodial joints.

Division.—The disease is either complete or incomplete; it is complete, when the extremities of the bones are so firmly united as to destroy all motion of the joint; incomplete, when they still admit of a slight degree of motion.

Causes.—Anchylosis generally arises from wounds of the capsular ligaments; from exostosis, or ossification of the cartilages; from inflammation of the synovial membranes; from eroded cartilages and carious bones; from dropsical or purulent effusions into the joint; from luxations which have remained long unreduced; and from fractures which involve the joint, or are situated near it. It may also originate from sprains, large abscesses, ulcers, burns, and, in fact, from any thing that prevents motion of the joint, and renders the ligaments and muscles about the affected part weak and rigid.

Morbid alterations.—If an anchylosed joint is examined after death, the ends of the bones are found united at one or more points, by a kind of white fibro-ligamentous substance;(*a*) and in this part the surfaces have lost their natural polish; but the parts which have not formed adhesions retain their white shining appearance, and their surfaces are moistened by a small quantity of synovial fluid, similar to that which is found in the healthy state.(*b*)

Prognosis.—Complete anchylosis is always incurable, but the incomplete or spurious form of the complaint is generally capable of being removed. In the latter, the difficulty of effecting a cure is always greater in the ginglimoïd, than in the orbicular joints, and in old individuals, than in young ones.(*c*)

Treatment.—Incomplete anchylosis may often be effectually removed in a few days or weeks, by gentle, frequent, and judicious movements of the affected joint, by pumpings of cold or warm water, and by saline frictions or other stim-

(*a*) Langenbeck's Neue Bibliothek. B. 1. s. 93.

(*b*) Boyer's Lectures on the Bones, p. 312.

(*c*) Boyer's Surgery, vol. ii. p. 369.

ulating articles, as soap and volatile liniments, camphorated alcohol, and the like. Rubbing the parts with rough flannel, and keeping them covered with oiled silk, will also greatly conduce to recovery. The moving of an anchylosed joint should never be intrusted to the patient himself, or to an inexperienced person; and the operation should always be performed slowly and without violence; otherwise there will be risk of occasioning severe pain, swelling, and inflammation, and even caries of the heads of the bones.

With regard to the true or complete form of the complaint, it does not admit of removal by any of the foregoing means; and as it is often essential towards the cure of some of the diseases of the joints, such, for instance, as coxalgia, or white swelling, it is evident that any attempt to overcome the rigidity by friction or movement of the part would be highly injurious.(*a*) It may be laid down, therefore, as a general rule, that "no attempt should ever be made to *cure*, though every possible exertion should often be made to prevent, a true anchylosis."

The false or preternatural joints which occur in cases of fractures, may be remedied in different ways. The most ancient method of treatment consists in forcibly rubbing the ends of the broken pieces together, so as to make them inflame, and assume a disposition to form callus. This plan appears to be coeval with the time of Celsus, by whom it was first suggested; it has received the approbation of the celebrated John Hunter, and many other distinguished modern practitioners. The practice, however, is often unsuccessful, and is only likely to answer in those cases of the complaint where there is reason to apprehend that the ends of the bones are not incrusted by a fibro-ligamentous substance.

Pressure has lately been strongly recommended as a means of cure in preternatural joints, or ununited fractures;

(*a*) Gibson's Institutes of Surgery, vol. ii. p. 54.

and a number of well attested cases, demonstrating its efficacy, have recently been published by Mr. Amesbury, Mr. Brodie, Dr. Wright, and other European and American surgeons. It is applied either by means of the tourniquet, or suitable bandages, the fractured limb being previously placed in a proper apparatus.

When the case is of long standing, and there is every cause for believing that the fragments have become united by a kind of ligamentous substance, we may have recourse to the one or other of the following methods, which, though they are often attended with considerable danger, should always be put in practice when the limb is disabled from performing its functions, and the patient is willing rather to run the risk of the operation, than to retain his infirmity. The first of these operations which I shall mention is the one which was first proposed by Mr. White, in 1760. It consists, briefly, in making a longitudinal incision, oppositely to the principal vessels and nerves, through the integuments which cover the fracture, in cutting away or rasping the ends of the fragments, and then treating the limbs precisely as if the case were a recent complicated fracture. This plan has been adopted by many eminent practitioners,(*a*) and has lately been successfully performed by Professor Langenbeck of Gottingen,(*b*) by Mr. Rowland of England,(*c*) by M. Viguerie, an eminent surgeon of Toulouse,(*d*) and by Dr. Hewson of Philadelphia.(*e*)

The other method of treatment to which I have alluded, was first put in practice in December, 1802, by Dr. Physick; it consists in introducing a seton through the preternatural joint, with a view of exciting inflammation, and bringing about a union between the ends of the broken

(*a*) Tavernier's Operative Surgery, translated by Dr. Gross, p. 376.
(*b*) Langenbeck's Neue Biblioth. B. 1. s. 95.
(*c*) Medico-Chirurgical Transactions, vol. ii. p. 47.
(*d*) Larrey's Mém. de Chir. Militaire, T. 2. p. 132.
(*e*) Gibson's Institutes of Surgery, vol. i. p. 361.

pieces. In performing the operation, the surgeon should be provided with a skein of silk and a long narrow seton needle, somewhat curved near the point. The limb should then be slightly extended, in order to separate the extremities of the fragments as much as possible from each other, while the surgeon passes the needle, armed with the silk, through the integuments and muscles, and between the bones, taking care to avoid all the large vessels and nerves. When the operation is finished, the apertures made by the seton should be covered with soft lint, and the limb should be again placed in a proper apparatus. When the parts have become perfectly consolidated, which usually happens in about four or five months, the seton should be withdrawn. (*a*)

The operation of Dr. Physick has now been performed by many of the most enlightened practitioners of the age, both in this country and in Europe, and may be regarded as no inconsiderable improvement in modern surgery; like every other practice of the kind, however, it is liable to occasional failures, though, in most cases, it will probably succeed.

A very ingenious, bold, and novel operation has lately been suggested and successfully practised by Dr. J. R. Barton, one of the surgeons and clinical lecturers of the Pennsylvania Hospital, for the relief of certain species of anchylosis. The patient, a sailor, aged twenty-one, had lost the use of his hip-joint, in consequence of an injury from a severe fall. The thigh was drawn up nearly to a right angle with the axis of the pelvis, and the knee turned inwards, and projected over the sound thigh; so that the outside of the foot presented forwards. In this condition the patient was admitted into the hospital, where various attempts were made to correct the malposition of the limb, but to no purpose. After much reflection upon the case, Dr. Barton was led to conclude that an artificial joint might possibly be

(*a*) Physick, in the New York Medical Repository, vol. i. p. 122.—Gibson, op. cit. p. 362.

formed by making a large incision through the soft parts, and then sawing through the lower part of the neck of the os femoris, a little above its root. Accordingly, on the 22d of November, 1826, Dr. Barton proceeded to the operation, by making a large crucial incision through the integuments and fascia, covering the most prominent part of the trochanter major, and raising the flaps, he cautiously detached the muscles in contact with this part of the bone, making thus a passage sufficiently large to admit of the easy introduction of the fore-fingers, both before and behind the bone. The bone was now divided transversely through the great trochanter, and part of the cervix femoris, by means of a strong narrow saw, constructed for the purpose. When the operation was finished, the edges of the wound were brought into contact, and kept in this position by strips of adhesive plaster and light dressings. The patient was then put to bed, and his limbs supported by means of Desault's fracture-apparatus.

In about twenty days after the operation, the limb was gently and cautiously moved in the direction of the natural movements of the sound hip-joint; but great care was taken not to continue the motion so long, or to repeat it so frequently, as to produce severe irritation. In this manner the limb was moved as often as the state of the parts would permit, at first at intervals of several days, and afterwards daily for about four months, at which time the artificial joint had acquired such a degree of motion, that the patient was able to walk about with merely the aid of a cane.

Dr. Barton, however, does not recommend this operation as applicable to every case of anchylosis, but expressly states that he believes it "justifiable only under the following circumstances, viz., where the patient's general health is good, and his constitution is sufficiently strong; where the rigidity is not confined to the soft parts, but is actually occasioned by a consolidation of the joint; where all the muscles and tendons that were essential to the ordinary movements of

the former joint are sound, and not incorporated by firm adhesions with the adjacent structure; where the disease, causing the deformity, has entirely subsided; where the operation can be performed through the original point of motion, or so near to it, that the use of most of the tendons and muscles will not be lost; and finally, where the deformity or inconvenience is such as will induce the patient to endure the pain, and run the risk of an operation."(*a*)

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THE END.

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The reader, it is hoped, will pardon the errors, literal as well as typographical, which will be found in the different parts of the work, as my distance from the press prevented me from examining any of the sheets before they were struck off.

ERRATA.

Page	Line	
3	1	*for* are styloïd, *read* are called styloïd.
3	3	*for* salious, *read* salient.
21	15	*for* pisciforme, *read* pisiforme.
42	30	*for* obscured, *read* obscure.
54	5	*for* those, *read* these.
105	1	*for* cause, *read* causes.
106	13	*for* one long, *read* long.
184	4	*for* generation, *read* degeneration.
191	33	*for* becomes, *read* become.
263	27	*for* herd, *read* head.
321	3	*for* inflammation, *read* anchylosis.
329	26	*for* tightly, *read* lightly.

Paris, Professor of Obstetrics, and of the Diseases of Women and Children, &c. &c. &c. By S. D. Gross, M.D.

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