Memoir on the radical cure of club-foot / by H. Scoutetten ; translated from the French by F. Campbell Stewart.

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MEDICAL AND SURGICAL

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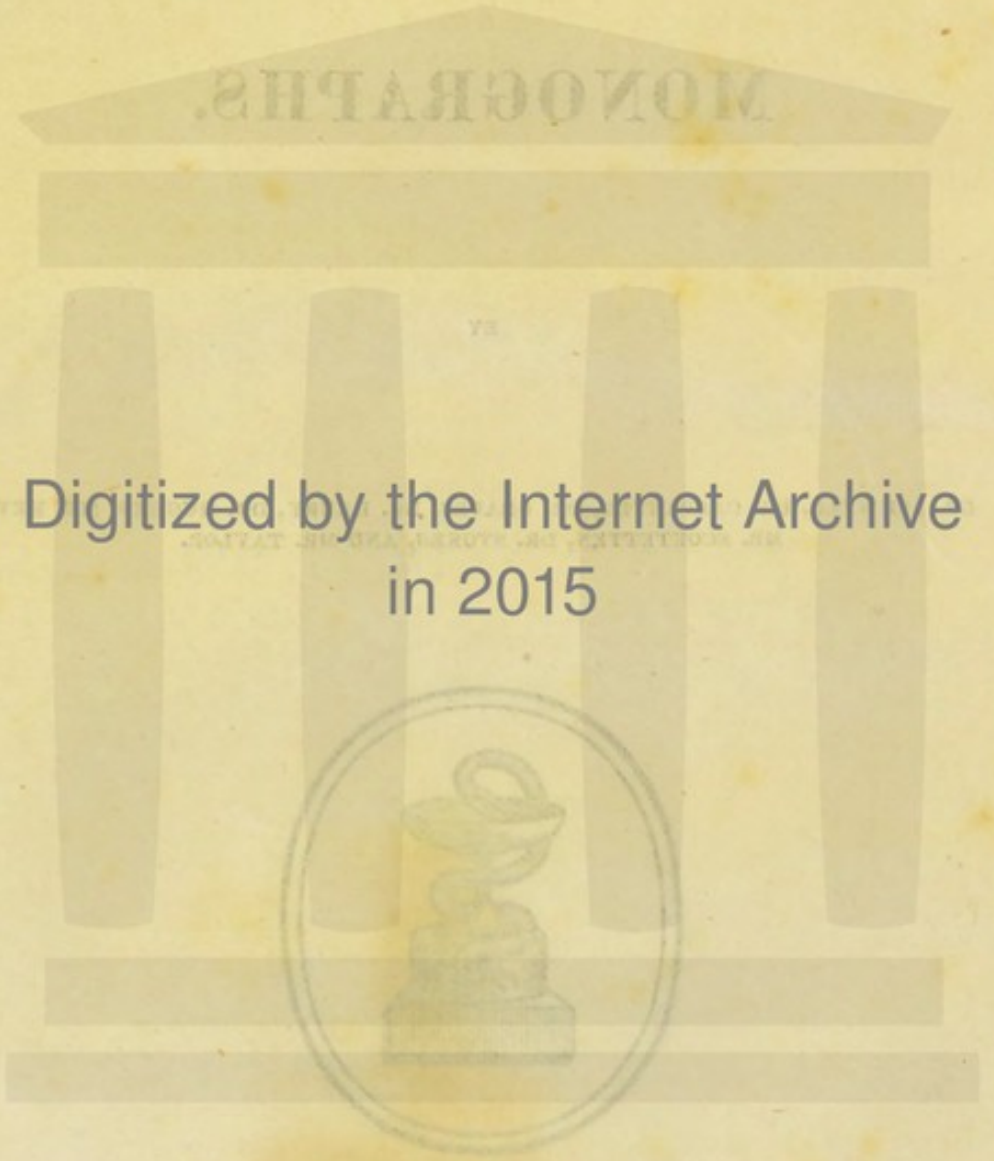


MEMOIR

ON THE

RADICAL CURE OF CLUB-FOOT.

BY H. SCOUTETTEN, D. M. P.

Professor of Medicine, Adjunct Professor in the Faculty of Strasburg, Professor of Operative Surgery, Member of the Academy of Natural Sciences of Berlin; of the Royal Medical Society of Copenhagen; of the Royal Academy of Metz; of the Royal Academy of Sciences of Toulouse; of the Society of Medical Emulation of Paris; of the Royal Society of Sciences of Lille; of the Society of Sciences of the Department of Lower Rhine; of the Royal Medical Society of Marseilles; of the Philosophico-Medical Society of Wurtzburg, &c.

WITH SIX PLATES.[1]

TRANSLATED FROM THE FRENCH.

BY F. CAMPBELL STEWART, M. D.

OF WILLIAMSBURG, VA.

To THOMAS HARRIS, M. D.

SURGEON, U. S. N.

THE INDEFATIGABLE PROMOTER OF SURGICAL SCIENCE,

THIS TRANSLATION IS RESPECTFULLY DEDICATED BY HIS

WARM FRIEND AND FORMER PUPIL.

PREFACE.

The great success obtained by European surgeons in the treatment of distortions of the feet, by simply dividing the tendons of such muscles as may by their contraction have occasioned an anormal deviation, has attracted the attention of some of our most eminent physicians and surgeons, and, in many instances, the operations have been repeated in this country, and so far with uniform success. Such operations, however, have as yet been principally confined to the larger cities, where every facility is afforded for the fabrication of such machines and other apparatus as are essential to the success of the after-treatment, and where able assistance is always at hand in case of accident.

The operation itself, as now practised, has been but recently introduced, and all the information on the subject, which has been afforded to members of the profession, located at a distance from the great medical emporia, has been a casual, and often incomplete re-

[1] Originally published as a separate work in 8vo., pp. 118. Paris and London, 1838.

port, generally of the result only of cases treated—furnished them through the medium of our numerous scientific periodicals.

Until the publication, during the past winter, of a very small memoir, entitled *a lecture* on "loxarthrus, or club-foot," by a surgeon of Philadelphia, who has had numerous opportunities of treating the disease, and who, from his constant success, may be regarded as one of the most experienced of our surgeons in this branch, no systematic notice had been taken in this country of the malady and its treatment. In France two works on the subject recently appeared nearly simultaneously, the one by a celebrated Parisian orthopedist, and the other by a no less distinguished surgeon of Strasburg—and thinking that there was a demand for accurate knowledge on so important a subject, I undertook the translation of the treatise of M. Scoutetten, which is now offered to the profession.

If asked why I have given the preference to this work over that of M. Duval, I should be at a loss to answer, inasmuch as both authors have done ample justice to the subject, and both works are accompanied by engravings illustrating the varieties of the disease, and by cases. Perhaps the great quantity of cases introduced into the work of Duval, which swell it out to a much larger size than that of Scoutetten, and the number of engravings (no less than seventy-eight) interspersed through its pages, the republication of which would make the book costly, have occasioned my preference of the latter memoir.

It is confidently asserted that all the information required for practical purposes is included in the following pages, and so minute has our author been in his descriptions of the surgical anatomy and *modus operandi*, that any well-informed surgeon may now, with perfect safety, undertake the task of rectifying club-feet.

One word in reference to the terms used for distinguishing the varieties of the disease. It will be perceived that our author has abandoned the expressions *varus*, *valgus*, and *pes equinus*, which he considers incorrect, and has substituted a very simple nomenclature, derived from the actual position of the parts. It is much to be regretted that so great a discrepancy should exist in our scientific vocabulary, and such a number of expressions used, as are likely to confuse.

M. Duval has added to the difficulty, by introducing terms with Greek derivations. His appellations for the varieties of the deformity are *strephendopodia*, *strephexopodia*, *strephypopodia*, *strephanopodia*, and *strephocatopodia*.[1]

This unacceptable innovation is the more to be regretted, as the author can find no better reason for relinquishing the other appellatives, which he acknowledges to be "*clear and positive*," than

[1] From στρέφω, *to turn* or *twist*,—and πούς, ποδος, *foot*, with the addition of ἔνδον, *inwards*, ἔξω, *outwards*, ὑπὸ, *downwards*, ἄνω, *upwards*, and κάτω, *underneath*.

"*because they are a little periphrastic, and might appear to certain persons not to be sufficiently learned.*"[1]

It is to be hoped that American surgeons will conform to one set of phrases, and not use all indiscriminately. If there are objections to those used in the following pages—and I must confess that I cannot find them—let others be substituted, and invariably conformed to.

TRANSLATOR.

WILLIAMSBURG, VA., *August*, 1839.

MEMOIR

ON

THE RADICAL CURE OF CLUB-FOOT.

HISTORY.

WHEN the foot is deformed by the contraction of one or more of the muscles of the leg, or by a primitive mal-position of the bones of the tarsus, there results a disease which has been denominated by French physicians *club-foot*, (pied-bot.)

All the muscles of the leg are liable to retraction; but it is only the more powerful ones that are capable of modifying the form of the foot. No example has as yet been presented of a simultaneous retraction of all the muscles of the leg; most commonly one or two only are affected at a time.

There are four principal varieties of the disease, viz: *inverted*, *everted*, *phalangian*, and *calcanian club-foot.*

[2] A contraction of the solei and gastrocnemii muscles, (muscles solaire et jumeaux,) contributes to the developement of *inverted club-foot.* That of the peronei, often assisted by the gastrocnemii, causes the foot to be turned *outwards.*

Phalangian club-foot is occasioned by an energetic contraction of the gastrocnemii and solei muscles, aided, in some cases, by that of the flexors of the toes; and *calcanian club-foot*, under the influ-

[1] Traité pratique du Pied-bot. Paris, 1839, p. 13.

[2] Finding no term in use to express that deformity of the foot which does not permit it to touch the ground, except by the calcaneum, I have called it *calcanian club-foot*, and, consequently, I call *phalangian club-foot* that which touches the ground only by the phalanges. I replace with these last words that of *pes equinus*,—an improper expression, and which ought long since to have been abandoned. What is there in common between our foot when thus deformed, and the foot of a horse?

ence of the contractions of the tibialis anticus, assisted most generally by that of the tendons of the extensors of the toes. There are several intermediate forms of the disease, besides those four principal ones; they are, however, all more or less closely allied to the types indicated. All the above deformities may be either *congenital* or *accidental*.

Such mal-formations of the foot as those just spoken of, were known to physicians of the most remote antiquity. The Greeks called Ϛλαισὸς the foot turned outwards, and ῥαιϐὸς, that inwards. Hippocrates, however, employed the word Κυλλὸς.[1] The Latins commonly used the words *varus* to signify the variety *inwards*, and *valgus* that *outwards*. Plautus, *in Milite*, uses occasionally the words *compernis*, *pætus*, and *brochus*.[2] C. Hoffman, however, is of opinion that this is a mistake,—that the sense of the two expressions should be inverted, and the name of *valgus* given to that deformity commonly known as *varus*;[3] his opinion, however, has not prevailed. The Greek words were still further latinised, and the expressions *blæssus*, or *blæsus*, have been in use.

Hippocrates was not satisfied with merely indicating the evil; he also pointed out the means of combating it. Having described with great care the mode of applying the bandage, he insists that the foot must be *gradually* brought back towards its normal position: *neque magnâ vi, sed leniter cogantur*.[4] After the bandage has been applied, he (Hippocrates) recommends that the foot should be kept in its proper position by means of a leaden shoe, made in the form of those of Chio; and if that prove insufficient, he gives the model of boots which are to be applied.

This passage, from the father of medicine, presents another example of the power of his genius; for, instead of neglecting a disease, which might have seemed to him of but little importance, he describes its very forms and varieties, points out clearly the rules to be followed in the treatment, and during a period of more than two thousand years, the most expert of his successors have but reproduced his ideas and precepts. Celsus, so often remarkable for the exactitude and excellence of his descriptions, does not even mention the name of the disease under consideration, and it is not until the time of Marcus Aurelius Severinus that we find a treatise published on the subject of club-foot.[5] His description and treatment leave much to be wished for; it is, in fact, far inferior to that of Hippocrates.

Ambrose Paré,[6] after advising some tonic remedy, the formula

[1] Περὶ ἄρθρων.

[2] See M. A. Severinus *de gibbis, valgis, varis*, cap. 11.

[3] Castelli Lexicon, p. 106, verb. *blæsus*.

[4] Hippocratis opera; interprete Foësio: de articulis, sect. vi. p. 98, 99, editio Francofurti, 1595.

[5] De reconditâ abcessuum naturâ: lib. vi. de gibbis, valgis, varis et aliis ab internâ vi varie luxatis.

[6] Works of Amb. Paré, lib. xxiii. chap. xi.

for which is to be found in M. A. Severinus also, gives a model of boots, such as he proposes for remedying the disease. Dionis[1] appears to have been still less inspired than his predecessors, for he has the hardihood to advise, for maintaining the foot in its proper position, an iron boot, which had been previously proposed by Fabricius of Acquapendente.

Important publications, however, were made about the beginning of the eighteenth century, and men, none of whom were without merit, devoted themselves to the study of the treatment of the disease, and enriched science with useful discoveries.

Venel, a physician of Orbe, in the canton of Berne, established, about the year 1780, an hospital destined exclusively for the reception of children with deformed feet; he performed a number of fortunate cures, which quickly drew attention to him. Venel concealed his method, but it was divulged in 1790. Ehrmann, of Frankfort-on-the-Maine, learned it from a young physician of the name of Wantzel, who had been cured of a distorted foot in Venel's institution. He confided the secret to Augustus Bruckner, of Gotha, who, at a later period revealed all the details.[2] Wantzel himself, after the lapse of several years, published a dissertation on the subject. In England, many physicians also directed their attention to the rectifying of club-feet. Jackson, following the example of Venel, published a memoir, in which he describes many cures obtained by means of apparatus, which he claimed as his own invention, but the construction of which he kept a profound secret.[3] About the same time, in France, Tiphaisne and Verdier, surgeon-bandagists, boasted, through the public journals, of their success in the treatment of the malady by the aid of newly-invented machines. Until that period empiricism, and often ignorance, had experimented upon such unfortunate individuals as were affected with club-foot, for neither anatomy nor physiology had then sanctioned the theories which directed the operations of the orthopedists. Fortunately, it was not long before science obtained the victory, and ignorance no longer triumphed.

At the commencement of the nineteenth century, Scarpa published his admirable treatise on the disease.[4] The illustrious Professor of Pavia did not follow the common route; he did not seek to remedy it, before making himself familiar with the malady, but strove first to find out the cause of the deformity, and when he had been successful, showed conclusively, what no one had done

[1] Cours d'opérations de chirurg. 8vo. édition, p. 774.

[2] Ueber einwärts gedrehte Füsse, und deren Behandlung besonders nach Dr. Venel's Methode.

[3] Dissert. de talipedibus varis, in 4to. Tubingæ, 1798.

[4] Memoria chirurgica sul piedi torti congeniti dei fanciulli, et sulla maniera di corregere questa difformità: con tavol. Pavia, 1803, in 4to. This treatise exists in the French language, in the Memoirs of Physiology and Practical Surgery, by Ant. Scarpa. Translation of J. B. Léveillé. Paris, 1804.

before him, that the bones of the tarsus in such cases are never luxated, but only partially separated from their mutual contact, and turned according to their smallest axis.[1] The knowledge of this important anatomical fact ought to have led Scarpa to conceive a good apparatus for treating the disease, which in fact he did, and succeeded as well as such a plan of treatment admitted of.

At a more recent period, Boyer[2] invented a machine simpler than that of Scarpa, and he succeeded with it in restoring feet most singularly distorted inwards. It was not yet exactly known what was the process of Venel, when M. Louis d'Ivernois, a pupil of the successor to that orthopedist, published an account of it in 1817.[3]

Before doing so, however, M. d'Ivernois had submitted the machine of Venel to the Society *du Cercle Médical*, which appointed M. Capuron to report on it.[4] Useful improvements were the result of this investigation, which contributed to the success obtained by the author.

The remarkable work of Delpech, entitled *de l'orthomorphie*,[5] terminated this series of useful publications on the reducing of club-foot by means of machines. In it the author treats with much talent of the etiology of the disease, and proposes the employment of a new apparatus, of which he gives a representation in one of the last plates. Delpech by no means restricted himself in this work to indicating machines as our only resource in the treatment of the malady under consideration, for he recurred to the proposition which he had before made[6] of cutting the tendo Achillis, after all means of extension shall have been found to fail. This was the era at which an immense progress, I might almost say revolution, in the treatment of the disease commenced.

Although Delpech may not have been the first physician to whom the idea occurred of resorting to the section of the tendo Achillis for obtaining the cure of club-foot, it must nevertheless be admitted that he is the first who ventured to propose the operation as a useful and sometimes indispensable resource in certain cases—who established the method, and laid down regular precepts.[7] This much credit certainly belongs to him, and French surgeons should defend his claims to it. What if the operation was performed for the first time in 1784 in the presence of Thilenius,[8] a physician of the

[1] P. 114. Translation of Léveillé.
[2] Traité des maladies chirurgicales, t. iv. p. 613, 2e édit.
[3] Essai sur la torsion des pieds, in 8vo. Paris.
[4] Gazette de Santé, p. 178, Aug. 1814.
[5] De l'orthomorphie par rapport à l'espèce humaine, in 8vo. Paris, 1828; t. ii. p. 321.
[6] Précis élémentaire des maladies réputées chirurgicales, in 8vo. Paris, 1816, t. i. p. 669.
[7] Chirurgie clinique de Montpellier, in 4to. 1823.—Mémoire sur les pièds-bots: le malade fut opéré en 1816.
[8] Thilenius, chirurgische Bemerkungen, 1784.

environs of Francfort, and afterwards by Michaelis,[1] and Sartorius in 1812?[2] They were isolated cases, and of no value, inasmuch as they were destitute of a scientific theory. The operation as reported by Delpech, was in general received unfavourably. The editor of a journal of the day, in speaking of it, is astonished that the author *had seriously proposed such an operation.* Other editors were of opinion that it should never be performed, but they discussed the point scientifically and in a becoming manner.

Many years had elapsed without any attention being paid to the subject by operative surgeons, when suddenly there appeared in Rust's journal,[3] a memoir of Dr. Louis Stromeyer, surgeon to the King of Hanover, indicating a new process of operating the section of the tendo Achillis, in the treatment of club-foot. In this memoir, two remarkable cases, cured by means of his plan of treatment, are related. The first of the two operations was performed on the 28th of February, 1831, and the second, on the 12th of June, 1832. On the 29th April, 1834, M. Stromeyer wrote a letter to the editor of the *Archives générales*,[4] communicating the result of four new cases in which he had operated, three of which had been attended with success.

These happy results obtained by the Hanoverian surgeon, awakened promptly the attention of the Parisian orthopedists: MM. Bouvier and Duval[5] repeatedly divided the tendon, and their success soon surpassed that of Dr. Stromeyer. These, with the remarkable cures that have been obtained by myself, and which I shall presently detail, include, I think, all that has been achieved, up to the present time, in this important department of orthopedic surgery.

The section of the tendo Achillis is henceforth an established fact; it is an achievement of science destined to give new éclat to surgery, by the benefits that those unfortunate individuals affected with deformities of the feet will experience from it.

If we look back to the facts contained in the annals of medicine, we are astonished to find that this important discovery was not made at an earlier period,—a discovery reserved to adorn the nineteenth century. The fact had been established by Molinelli[6] in the

[1] Michaelis, in Hufeland's Journal; anno 1811, 6tes Heft.—This surgeon after all did not make a complete division of the tendon, but only incised it partially.

[2] Sartorius, in Siebold's Journal; 3ter Band.

[3] Rust's Magasin für die gesammte Heilkunde.--39e vol., and Gazette Médicale, Sept. 1833, p. 673. This same memoir, translated entire by Dr. Richelot, will be found in the Archives générales de Médecine, 1834, tome 1er.

[4] Arch. Gén. t. ii. p. 194,—1834.

[5] Bouvier.—Mémoire lu à l'Académie des Sciences, séance du 12 Sept. 1836, et Académie de Médecine, 26 Novem. 1826.—Voy. Bulletin de l'Académie de Médecine, 15 Décem. 1836. Duval.—Académie royale de Médecine, 17 Janvier. 1837, Bulletin, Janvier, 1837, p. 304.

[6] Comment. Academ. Scientiar: Bononiens. t. ii, par. 1. page 189—196, and memoirs to serve as a history of the 18th century, by Paul Avignon,

history of the Academy of Bologna, that contrary to the generally received opinion of that period, wounds of the tendo Achillis would heal with facility. He reports four cases in which the tendon was cut transversely, and notwithstanding the wounds were complicated, they healed kindly. Hoin,[1] an expert surgeon of Dijon, with a view of establishing the fact, instituted a series of experiments, the result of which was in perfect accordance with what had been stated by Molinelli. He divided both partially and wholly the tendo Achillis of cats and dogs, and although the animals were left entirely to themselves, and no precautions taken to exclude the air, all the wounds healed perfectly.

In order to complete our history, we may add that the division of tendons for the purpose of curing distorted members, is a fact which has been for a long time known to veterinary surgeons. I have even been assured that in Limousin[2] the operation is frequently performed, and by the most ignorant men, those wholly strangers to science. See an extract from a publication of MM. Miquel and Debeaux[3] in 1826.

"It is long since the practice of dividing the flexor tendons of the feet, in cases of vicious inclination of the members, was adopted, although no one has as yet been at the trouble of prescribing precise rules for performing the operation methodically. Probably timidity in some, and want of success in others, has heretofore prevented veterinarians from making known their operative process. We know that some practitioners succeeded by this means, and long before ourselves, in restoring limbs which had altogether lost their perpendicularity. Our object in communicating the result of our labours is to simplify and render more familiar, an operation which may prove to be as advantageous to *human surgery*, as to that of animals."

We will but remark, with regard to the above passage from the memoir cited, that human and veterinary surgery are so nearly allied in some respects, that they frequently progress hand in hand towards discovery, and that notwithstanding certain pretensions, it would be a thing almost impossible to discover to whom belongs the credit of having been the first to form the idea of dividing the tendo Achillis. But we again repeat,—this is not the most important point; the idea is essential and even indispensable, but the true founder of a method is he who lays down the rules to be followed, and points out the cases where it is applicable.

Notwithstanding the astonishing success following the division of the tendon, M. Jules Guérin is of opinion that the operation may be entirely dispensed with in the cases of very young children, and softened plaster substituted in lieu of the present containing appa-

[1] Journal de Médecine, Janv. 1769, pp. 56—78.

[2] [Lately a French province. Transl.]

[3] Observations on club-foot; Journal pratique de Médecine vétérinaire, Paris, 1826; p. 202; and same journal, 1828, p. 283, observations of M. Blanc, and 1830, p. 246, Obs. of M. Bouissy.

ratus. This is only a new application of the plaster which has been for some time in use in Germany, in the treatment of fractures.[1]

The following is M. Guérin's process. The deformed member having been previously smeared over with some oleaginous substance, and surrounded with a roller bandage of flannel, is properly placed and suspended on transverse bands in a carved splint; the foot is then subjected to an opposing lateral extension, the object and result of which is to produce torsion and reversion in an opposite direction to the existing torsion. Plaster is then poured around the member, which is kept in a fixed position until it hardens. As soon as it has become completely solidified, the limb is removed from the splint, and the envelope cut with a knife, so as to leave one layer of plaster only, of the thickness of three or four lines, around the leg and foot. This dressing is renewed every eight days.[2]

M. Jules Guérin exhibited to the Academy several young persons whom he had succeeded in curing by this plan of treatment.

We have now completed the exposition of the different modes of treatment which have been employed for combating deformities of the feet. We have done this in the character of a reciting historian, and not as a judge. This latter character we shall assume hereafter, when we have to appreciate the value of the respective methods employed for treating club-foot.

Let us now devote our attention to the pathological anatomy of the diseased organs.

ANATOMY OF CLUB-FOOT.

I reject from the historyof this complaint, every accidental deformity whether occasioned by a general disease, or the result of accident. It appears to me to be a singular error to arrange in this class, distortion of the feet brought on by rachitis, gout, rheumatism, white-swelling or a luxation badly reduced or not reduced at all.

The talent for description, as evinced in the work of Scarpa,[3] cannot be too much admired. It is truly to this illustrious professor, that we are indebted for our first precise notions with regard to the pathological alterations presented by the disease. If new researches have made known some omissions, and detected a few er-

[1] Professor Dieffenbach has often used this plaster, and one of his pupils has published a dissertation on the subject entitled, "De cruribus fractis gypso liquefacto curandis." Joan. Aug. Muttray. Berolini, Sept. 1831.

[2] Letter sent to the "Académie royale de Médecine," 19th April, 1836.—Gazette Médicale, 23d April, 1836, p. 268.

[3] Op. cit.

rors,[1] it must still be admitted that his work has served as the basis of such anatomical descriptions as have lately appeared.[2]

If in the present state of our knowledge, we cannot affirm that the causes which give rise to congenital club-foot are identically the same with those which occasion the accidental variety, we must nevertheless admit that there is the greatest analogy between their effects. I have frequently compared the limbs of children, some of whom had been deformed form birth, and others by accident; and it has always been impossible for me to detect their distinctive characters. What remarks, then, we may have to make on the one, will most generally apply to the other also.

Accidental club-foot is almost invariably occasioned by convulsions, or a chronic inflammation of the tissues, and in some rare cases by a defect of innervation in the spinal marrow. Whatever may be the exciting cause, the following is the progress of the disease.

A month or two after an attack of convulsions, the tendo Achillis becomes stiff and prominent, and the point of the foot is depressed with difficulty. This state of things may continue for a long time without becoming more aggravated. It lasted for more than a year in the case of an interesting little girl of eight years of age, who became paralytic after an attack of follicular enteritis. Finally the calf of the leg becomes atrophied, or rather, it is not developed proportionately with the other muscles of the body. The belly of the muscle being short and thin, the tendinous portion appears to be longer than it naturally should be. These appearances are very perceptible in children who are afflicted with but one club-foot. The contraction of the tendo Achillis, causes the elevation of the calcaneum in a direct manner, and if this elevation is to the extent of half an inch,—and it is sometimes several inches without lateral deviation,—it constitutes our *phalangian* variety of the disease. Most frequently, however, as the malady becomes more and more developed, the posterior edge of the calcaneum is forced to take an inward turn,[3] the inner edge of the foot scarcely touches the ground, and this is the period when, if the child is allowed to walk, the weight of the body increases the deformity.

The external ligament of the tibio-astragalian articulation becomes elongated, the astragalus and scaphoides are drawn along with the calcaneum, to which they adhere by powerful ligaments; the back of the foot becomes convex; the sole concave, and furrowed by numerous transverse and oblique wrinkles. The big toe is separated from the others, and turned towards the inner edge of the foot. The plantar aponeurosis becomes contracted, and the muscles of the foot which are inserted into it draw the toes backwards;

[1] Cruveilheir, Anatomie-pathologique du Corps humain; 2e livraison, Paris, 1830.

[2] Dissert. sur le Pied-bot, par Ch. Help. Strasb. 20 Juin, 1836.

[3] See plate ii.

at the same time the superior metatarso-phalangian ligaments become elongated, and the foot is nearly folded in two.[1] In this deplorable condition, children walk on the external edge, and sometimes on the back of the foot. The part on which they rest their weight becomes hard and callous, whilst the subjacent cellular tissue gets thickened; it still, however, preserves its softness and elasticity. It is not uncommon for mucous bursæ to form in it. The leg and thigh generally preserve their natural form, but it is not rare to find one or the other knee inclined more or less inwards or outwards, the tibiæ bent, and the malleolus internus imperfectly developed. When both feet are deformed, their points touch, and often overlap each other; the patient experiences great difficulty in walking, is obliged to raise his feet alternately, and to carry the one above, and in advance of the other, so as to be constantly describing a semicircle. Falls are consequently very frequent, and in order to avoid them, the child, when he walks, keeps his body in a constant state of agitation, he seems to be always seeking his equilibrium. Frequently the trunk is carried slightly forward, whilst the pelvis is thrown backwards. In the *calcanian* variety of the disease, this position is inevitable, and is occasionally very decided. The weight of the body, and badly designed or ill-constructed shoes, frequently occasion inflammation and ulceration of the compressed parts. These ulcerations are interminable;—the osseous tissue becomes swollen, and oftentimes carious; the leg is completely atrophied, and abscesses form in it, which eventually open and suppurate ad infinitum. Rest may remedy a portion of these evils, but they are sure promptly to reappear under the influence of locomotion.

The *phalangian* and *calcanian* variety of club-foot are attended with fewer evil consequences than the others.

Let us now see what are the changes discoverable by a dissection of the diseased parts. To commence, let us examine the pathological anatomy of inverted club-foot. On elevating the skin, we are first struck with the atrophied condition of the muscles, particularly the gastrocnemius and soleus; the fibres of the muscles will be rarely found to extend lower down than half of the tibia, whereas in a normal state they descend at least two-thirds of the way. The tendo Achillis is long, tense, and attenuated comparatively with the age of the patient; the superior aponeurotic portion is especially remarkable for its tenuity. The muscles are frequently found to have degenerated into a soft fatty state. The cellular tissue is condensed and small in quantity. No trace of adipose matter is to be found in the legs of many individuals, unless it be on the sole of the foot. The nerves are, according to my own observation, reduced in size, and the arteries are evidently so. The posterior tibial artery is nearer to the internal edge of the tendon, especially in young children, than it is in a normal state. In many

[1] See plate ii.

ing. In this instance the calcaneum was slightly elevated above the ground; the position of the astragalus remained unaltered; the articulation of the scaphoides with the three cuneiforms was not at all separated. The scaphoides in turning around from without inwards, had been drawn along by the tendon of the peroneus longus, the insertion of which is at the inferior face of the first cuneiform. The tendons of the peronei muscles, and more particularly that of the peroneus longus, were stiff and tense, and seemed evidently to be the principal cause of the deviation outwards.

The articular relations are but little deranged in the case of *phalangian club-foot*, even when very forcibly developed. I once saw a man of twenty-five years of age, in whom all the articulations of the foot, with the exception of the metatarso-phalangian, had retained their normal position. It is these last, in fact, which bear the whole weight of the body. Gradually the toes become bent, and the heads of the metatarsi are directed downwards: the luxation is now nearly complete, and the bones of the metatarsus form almost a right angle with the toes. Frequently the ligaments of the astragalo-scaphoidian articulation become elongated, and the head of the astragalus projects—or rather, all the articulations of the tarsus yield at once, and the foot becoming hollow, turns inwards, and takes an intermediate position between phalangian and inverted club-foot, and then it is, that the displacements, described in treating of this last variety of deformity, are perceptible.

Calcanian club-foot is occasioned by a powerful contraction of the anterior tibial muscles, the extensor proprius pollicis pedis, and in some instances, by that of the extensor communis digitorum pedis. The tendons form an evident protuberance under the skin; they present the appearance of cords stretched to their utmost, and resist energetically even a very forced attempt at extension. The inner edge of the foot becomes sensibly elevated above the outer, which occasions an oblique surface from before backwards, and from within outwards. The principal point where torsion takes place is at the articulation of the cuboides with the os calcis, and of the scaphoides with the astragalus. The articulations of the cuneiforms, however, are also implicated. As a consequence of these changes, all the articular surfaces of the bones of the tarsus become more or less separated from each other inferiorly; the inner tuberosity of the scaphoides has a tendency to become superior, and all the bones of the foot, with the exception of the os calcis being elevated, no longer touch the ground. In this state the dorsal surface of the foot forms an acute angle with the tibia.[1] Occasionally the point of the foot is slightly inclined outwards in consequence of a powerful contraction of the extensor communis digitorum pedis. It has appeared to me that this variety is attended with a

[1] See plate v.

greater degree of atrophy of the leg, than any of the other forms of the disease.

All the cases of calcanian club-foot that have come under my observation were congenital; at first they were trifling, but the deformity increased with the age of the patient. The knowledge of the foregoing anatomical and pathological facts will soon enable us to establish such rules as are indispensable for obtaining a radical cure of the malady.

ETIOLOGY.

What are the causes that give rise to the developement of club-foot? This is an important question, and one which has received various explanations. Ambrose Paré[1] has no hesitation in asserting that the deformity is occasioned by the mother's remaining for too long a time seated with her limbs crossed; or the nurse in carrying the child, by too long pressure from retaining it in one position, occasions the turning of the feet. Benjamin Bell[2] admits that a mal-formation of the articulations may occasionally give rise to the disease, but he considers this as a very rare cause. He is of opinion that the contraction of the muscles most frequently occasions it. But the chief cause, according to this author, is the form of the leg. "When it is curved outwards," says he, "the toes are inverted, and the side of the foot is turned under, or, if the curvature of the leg be considerable, nearly the whole sole of the foot will be turned upwards, and at every attempt at locomotion, the instep will press on the ground; when, however, on the contrary, the bones of the leg are curved inwards, the toes and sole of the foot will be thrown outwards and upwards." This is an error on the part of Mr. Bell, which is proved by every day's experience; it is quite common to meet with men having their limbs singularly distorted inwards and outwards, whose feet present none of the characters of club-foot.

Duverney[3] thought that the deformity was caused principally by an unequal degree of tension of the muscles and ligaments; "for," says he, "as these muscles and ligaments are so preternaturally stretched, they draw the foot towards them, whilst the opposing muscles and ligaments being to a certain extent in a state of relaxation can do naught, and are compelled to yield to whatever vicious direction the foot may take." This, we think, is looking at one side of the question only: it is, however, an important step towards the truth. Scarpa having congenital deformities only in view thinks

[1] Op. cit. p. 578.
[2] Cours complet de chirurgie, trad. de Bosquillon; tom. vi, page 168.
[3] Traité des maladies des os; tom. ii. chap. 3.

that Duverney is in the wrong, and that he mistakes the effect for the cause. Scarpa admits that the twisting of the bones of the tarsus is the first of the series of accidents, and that there results from it an approximation of the insertions of some muscles, and a separating of those of others from their point of attachment, and consequently a shortening of the first, and elongation of the second. He adds—"this defect of equilibrium between the two classes of muscular powers, which has just been indicated, contributes in a great measure to keep up the deformity arising from congenital-inverted club-foot, which increases proportionately as the patient advances in life. The action of the peronei muscles not being sufficient to counterbalance that of the two tibiales, the tibialis anticus especially,—these last are constantly dragging the body of the foot more and more upwards and inwards. Hence it is that the combined strength of the four above named muscles, not being sufficient to establish an equilibrium with the muscles of the calf of the leg, the tendo Achillis is necessarily kept on the stretch, and the tuberosity of the calcaneum into which it is inserted, is in the act of being constantly drawn upwards in an oblique direction, and from within outwards from the calf of the leg. Finally as the child advances in age and walks, the weight of the body presses more and more on the external edge of the foot."[1]

Thus, according to Scarpa, the primitive cause of the deformity is the peculiar conformation of the articular surfaces; the displacement and consequent contraction of the muscles being only secondary. This idea, if meant to convey a fact merely, is correct, but if adopted as a positive principle, it is certainly an error, and we are surprised at its having been committed by the expert anatomist who had just made known to the medical world the effects of the deformity in the disease, by proving from actual dissection, that displacement alone of the bones, without ever extending so far as luxation, constitutes the principal pathological derangement observable in the malady. How could he in fact account for the disease ever being accidental, by admitting, as the principal cause of the deformity, a deviation of the articular surfaces? Wrapped up in this error, it was impossible for him to account for the atrophy of the leg, an invariable condition to the complete formation of the disease! "Most generally," he says, "the leg is well formed, but thin, especially about its middle: it is not nourished proportionately with the rest of the body, and it appears to me impossible to give a plausible reason for this phenomenon. Can that condition of things which demands a reciprocity of harmony and connection between the parts as necessary to their perfect developement and growth, notwithstanding the acceleration of the circulation, and the distensible faculty possessed by the smaller vessels, be considered as sufficient? For it has been clearly proved that the want of exercise alone has no perceptible influence in inducing atrophy in

[1] Op. cit. p. 130, 131.

such cases, since experience has shown that this part (the leg) has grown, become fully developed, and strong, in children who have been kept in a perfect state of quiescence during as many months as the treatment may have continued."[1] This candid and frank confession of one of the greatest geniuses of modern surgery is greatly to be admired, and if we are not so reserved ourselves, it is because we consider that we are authorised by the increase of medical knowledge, and the desire of contributing one step to the advancement of science, to speak more decidedly. We shall soon venture to hazard our own explanation.

Delpech was better acquainted with the causes productive of the disease; he believed them to differ according as the malady was congenital or accidental. He thinks that accidental club-foot arises from muscular contractions, which are almost invariably occasioned by inflammatory action. In congenital club-foot, he considers the condition of the muscles as very different; so far from possessing that exuberance of vitality which belongs to them in the former case, they are dried up and withered—nutrition in their case is languid, and so far from assisting in the cure of the necessitous deformity, they rather contribute to its augmentation.[2]

Here is evidently a step gained—experience has been consulted, and the penetration of Delpech has discovered a part, at least, of the evil. This wise example would seem worthy of imitation, but this, I fear, will never be the case—direct observation will be abandoned, and indulgence given anew to theories which may be curious, indeed, but which will be found to be established on too weak a basis, to stand the test of a serious examination.

During the sitting of the Royal Academy of Medicine of Paris,[3] of the 26th November, 1836, M. Martin, surgeon orthopedist, recurring to an opinion often conceived, but always abandoned, and yet again renewed lately by M. Cruveilhier,[4] advanced the idea that the cause of the deformity in congenital club-foot is an absence of the liquor amnii; he brought forward, in support of his opinion, a series of curious cases. The following are the principal facts on which he relies for the support of the theory.

A child which had been born with both feet inverted, having been sent to him by Dupuytren, M. Martin was surprised to see it double itself up spontaneously, and assume the ovoidal form which it had presented in the cavity of the uterus; the thighs were flexed on the pelvis, and the legs on the thighs; the feet came voluntarily to apply themselves to the buttocks, and to cross one over the other in the form of club-foot; this spontaneous doubling was, according to M. Martin, a detection of nature, in the act of forming the disease. The mechanism of this deformity was to him as a ray of

[1] Op. cit. p. 113, 114.
[2] Orthomorphie, vol. ii. p. 322–325.
[3] Bulletin of the Academy, 15th November, 1836.
[4] Op. cit. p. 7.

light, for, evidently, it was the result of a direct pressure exercised by the uterus on the pelvic extremity of the fœtus.[1]

The author introduced this case, with sixty-one others, in defence of the theory. He proved that in every case there was a relative absence of the liquor amnii during some period or other of the pregnancy—that in consequence of such absence the womb exercised a direct pressure on the feet, and deformed them; that unvarying symptoms announced, during gestation, the existence of the deformity in question; that women uniformly experience about the fifth or sixth month, sometimes even later, a fixed and almost insupportable pain in the epigastrium, when the child occupies the vertical position; and in the hypochondriac region, when its position is transverse; which pains M. Martin refers to the pressure of the child's feet against the parietes of the womb; that constantly, also, the women complain of a troublesome weight on the perinæum and fundament; that the abdomen is generally smaller than in normal pregnancies; that if—what would appear contradictory—the birth of club-footed children is occasionally preceded by an abundant discharge of the liquor amnii, this fact is to be accounted for by the probability of the fluid's having been secreted in a large quantity only at a very late period, whereas, up to the eighth, or even ninth month, the quantity had been but small, and the reversion of the feet had already been effected prior to its increase; that, agreeably with this theory, twins should be more exposed to the accident than single-born children—a fact proven by experience.

All these theories appear to me to be incomplete and unsatisfactory, inasmuch as but one, or at most very few cases are adduced, from which general principles are drawn. If it were otherwise, why is the formation of accidental club-foot invariably overlooked? The fact is, it is neglected, because the mode of its developement is never in accordance with the system proposed; it is, however, of such frequent occurrence as to require that it should be taken into consideration.

In my opinion, it is impossible, in the present state of our knowledge, to establish any theory, which, embracing all the known facts, shall account satisfactorily for the formation of the disease. I believe that no such theory can ever be established, for the diversity in the causes which occasion deformity of the feet must, we think, ever prove an insurmountable barrier to the discovery of any single principle for the government of the whole.

Let us now proceed to examine some cases. Eugène G—— was born in the month of May, 1836, with a slight deformity of both feet; so trivial was it, that it was capable of being rectified by the least manual effort, and occasionally the contraction of the anterior muscles of the leg alone would suffice to restore them to their normal position. The child's relatives paid great attention to the

[1] Bulletin, &c., sitting of 3d June, 1838.

deformity, and took every precaution for obtaining its rectification, but all to no purpose; the feet became daily more and more distorted, and the tendo Achillis was stiff, and protruded under the skin. Although a very strong child, it was unable to walk at the age of twenty-one months:—when it stood up, the feet invariably turned on their outer edge, and the heel abandoned the ground. I divided the tendo Achillis of both feet, and they instantly assumed their normal position; in fifteen days after the operation, the cure was complete.

What does this case prove? If I am not much mistaken, it shows that here there was an inequality of force between the flexor and extensor muscles of the feet, and that the gastrocnemii, being the most powerful, drew the heels upwards. To obviate every objection to my explanation, it must be borne in mind that all the muscles of the leg were well developed—there was not the slightest appearance of atrophy. If it is argued that, in this case, the deformity was occasioned by a primitive obliquity of the articular surfaces, I should like to know how the fact of the feet having been so easily reduced can be accounted for, and how, if it was, they retained their normal position after the section of the tendon.

There can be no doubt, then, but that the deviation in the above case, is solely attributable to an inequality of strength between the extensor and flexor muscles.

A young girl, named Ida Auvert, whose case will be found reported at length further on, was born with a club-foot of the right side; so great was the deformity at the time of birth, that her relatives, deeming it incurable, disregarded it entirely. When I saw her, there was apparently no heel, the astragalus was forcibly thrown outwards, and the scaphoides also, insomuch that its inner tuberosity, which had become superior, caused a protrusion under the skin. All attempts, even the most forcible, were insufficient to reduce the foot to its normal position; even after the division of the tendon, it could not be immediately rectified. Do not these facts prove that the deformity, in this case, was principally owing to a vicious disposition of the articular surfaces?

What influence has the position of the fœtus, as asserted by M. Cruveilhier, or its compression by the uterus, as MM. Stoltz[1] and Martin think, over the formation of the congenital variety of the disease? I think it possible, and when I look at the cases brought forward by the above authors in defence of their opinions, and the figure represented in the work of M. Cruveilhier,[2] I must allow both these causes to be of the number of those capable of contributing to the production of the disease. But to admit them to be the sole causes, and attempt by them to account for the formation of every variety of the disease, would be a gross error. M. Cru-

[1] Memoir on a peculiar species of club-foot.
[2] Patholog. Anat. plate 11, fig. 1, 2d book.

veilhier[1] undertook to refute the assertions of M. Martin, and—what is worthy of notice—a part of his objections may be urged against the system which is defended by himself, and which, after all, differs but slightly from that of M. Martin. "Is it clearly proven," says M. Cruveilhier, "that in every case of club-foot, there has been a deficiency of the liquor amnii. Has it not, on the contrary, been shown that in a large number of dry accouchements, as they are termed, the children have been born perfectly formed? Whilst, on the other hand, club-footed fœtuses have been seen surrounded by a very large quantity of the fluid." Nearly all the cases adduced by M. Martin were successively examined, and discredited by M. Cruveilhier.

Notwithstanding Cruveilhier's objections, we still think that the position of the fœtus in the womb, and a diminished quantity of the liquor amnii may be admitted among the number of causes productive of the disease.

There is yet another and fourth cause which may occasion congenital club-foot, viz. convulsions of the fœtus in utero. I have, on several occasions, seen children born, having their muscles wasted away and contracted, and which still seemed (at the time of birth) to be in a state of spasm. In some instances the feet, and occasionally the hands, were found to have deviated so much as to present all the characters of the disease under consideration. In the cases of many of them, the intellectual faculties remained in a state of torpor, approaching almost to imbecility, whilst the deformity of the feet, which at birth was imperceptible, or very slight, became developed with age. The following is a remarkable example.

G——, of a village in the neighbourhood of Metz, was born with a deviation of the feet, so slight as scarcely to be noticed. The child was thin, and of a diminutive stature; its intelligence did not progress with its age. By degrees the anterior muscles of the leg became contracted, and the tendons of the tibiales antici, and of the extensors of the toes, protruded perceptibly under the skin, which was elevated by them; the toes themselves became straightened, and were raised from the ground—all the bones of the tarsus were successively lifted up, and by the time that the child had attained its tenth year, the progress of contraction had rapidly increased; the feet formed very acute angles with the tibiæ, and it ended by becoming a confirmed case of club-foot.[2] The patient experienced the greatest difficulty in controlling the motions of the thoracic and pelvic extremities, which were kept in a constant state of agitation by the involuntary contractions of the muscles.

Does not the foregoing case prove the influence of encephalic and rachidian nervous disease over the developement of club-foot? The younger brother, also, of the child above mentioned, evidently stronger and more robust, was perfectly well formed at the time of

[1] Bulletin of the Royal Academy, Nos. 18 and 19, July, 1838.
[2] See plate 5.

birth—he continued so for seven years, and retained excellent health; within the last two years, however, without any visible or appreciable cause, the gastrocnemii muscles became contracted, and the os calcis ceased to touch the ground, whilst the feet were inverted. The right foot was found to have deviated rather more than the left. I operated on this child, and he is now completely cured.

The above cases give rise to a number of reflections. Is it not very remarkable that in that of the congenital calcanian club-foot, the disease should have increased so rapidly at the age of ten years, and that in the case of the other brother, with the inverted variety, it should have appeared, and become fully confirmed after a lapse of years, and that too without any known cause? Was it a chronic irritation of the muscles of the calf of the leg which caused the pathological change? Or, was it the result of morbid innervation?

These are questions difficult of resolution, and prove, in my opinion, that much yet remains unknown as to the etiology of the disease.

Accidental club-foot is frequently occasioned by infantile convulsions. At first, the deformity is slight, but it increases with the age of the patient, and may, as in the case of the congenital form, become highly aggravated. It is remarkable that convulsions seldom occasion the deformity of but one of the feet, and that if it happen in the case of children of four or five years of age, the cure will be more easily accomplished than if it had taken place at an earlier period. This difference is occasioned by many evident causes.

With these cases before us, is it not admissible to think—what we have already stated—that the fœtus experiencing convulsions *in utero*, congenital club-foot may arise under the influence of this cause? Although direct observation has not proved such to be the case, analogy would lead us to suppose that it should be so, and I have no hesitation in admitting it.

It finally remains for me to indicate a case reported by Delpech, of club-foot consecutive to a retraction of the plantar aponeurosis;[1] a remarkable, and as yet unique example.

On resuming the facts presented, we find that congenital, or accidental club-foot may be occasioned—

1st. By an inequality of force between the extensor and flexor muscles of the leg and foot.

2d. By an anormal position of the articular surfaces.

3d. By a mal-position of the fœtus *in utero*.

4th. By the pressure of that organ on the thin flexible members of the child.

5th. By convulsions *in utero*.

6th. By convulsions during early childhood.

7th. By a chronic inflammation of the muscles of the leg.

[1] Orthomorph.

8th. By defective innervation of the tibial nerves, caused by disease of the encephalon, or spinal marrow, without previous convulsions.

9th. By the contraction of the aponeurosis plantaris.

10th. By muscular contraction without any appreciable cause.

We must add to the above, the fact that club-feet often exist in monstrosities, and in some persons whose intellectual faculties are but imperfectly developed.

If we look for an explanation of the changes of nutrition brought about in limbs affected with this disease, we shall find it to be principally owing to a diminution in the caliber of the artery, which in some ancient cases has been found to have lost as much as two thirds of its diameter. This obstacle to the access of the reparative fluid accounts satisfactorily for the atrophy and diminished temperature of the diseased limb.

It has moreover been proven by M. Guérin that in all deformities of the osseous system, the arteries instead of adapting themselves—as is the case with the muscles—to the shortening of the space which they traverse, and running in a straight line along the chord of the curvature, adapt themselves to the curvatures, and follow them, or in cases where they are free, become more and more flexuous, in proportion as the distance, which they have to traverse, is more or less reduced. This fact is sensibly evident in cases of spinal deviation, and curvatures of the members. It is also worthy of remark that on the surface of the convexities of the arterial inflexions, the parietes of the vessels are almost invariably dilated.

The venous system is subject to the same laws that govern the arteries, as far as change of direction is concerned.

But M. J. Guérin has indicated a very important general fact with regard to it, which is—its marked preponderance, an increase which is general in all subjects labouring under strong and ancient spinal deviations, and local in deformities, arising from luxated members, or club-foot. The venous system is subject in all such cases to an increased developement, evinced either by a direct and general augmentation of the size and number of the venous vessels, or by the violet-like colour of the parts, where such increase has taken place. These facts with those relative to the reduction of size of the arteries, and the want of the power of hæmatosis in individuals labouring under spinal deviations, account, M. Guérin thinks, for the oily degeneration perceptible in all the tissues of such individuals, and also for the partial adipose transformation of parts suffering under partial deformities.

With regard to the muscular system, M. Guérin has been enabled, after repeated examinations, to establish as laws belonging to the diseased organism

1st. That in all deformities of long standing, the muscles instead of retaining their primitive relation with regard to the deformed portion of the skeleton, tend to contract, and hold a straight course between their points of insertion.—2d. That the transformation of

the muscles is either oleaginous or fibrous; oily when they are compressed and rendered inert; and fibrous where they are subjected to powerful traction.[1]

I shall conclude this chapter with a statistical enumeration of club-feet.

M. Bouvier[2] reports eighty cases either as having occurred in his own practice, or collected from various authors, out of which number two-fifths were double; one third were of the left foot, and a quarter of the right; out of sixty of these cases three-fifths were boys, and two-fifths, only, girls. Of sixty-one cases collected by M. Martin, twenty-six were double, and thirty-five simple; of the latter, eighteen were of the right, and seventeen of the left foot; as to sex, forty-five were boys, and sixteen girls. From this fact, M. Martin concludes, in opposition to the statistics furnished by Bouvier, that the deviation of the right foot, instead of being less frequent than that of the left, is on the contrary a little more so, and that if the proportion of boys is greater than that of girls, it is because they are generally much larger, and for that reason more exposed (according to the etiology of M. Martin) *ceteris paribus*, to the pressure of the womb. Of thirty-one cases collected from various authors by M. Held, the disease was nineteen times double; twice, more decided on one leg than on the other—and in one instance there was on one leg the inverted, and on the other calcanian club-foot.

Twenty-one cases have come under my own observation, thirteen of which were boys, and eight girls; nine of them had both feet deformed; out of the twelve subjects who had but one foot diseased, seven were of the right, and five of the left foot. The disease was fifteen times congenital, and six times accidental. I have never met with a case of double club-foot that was accidental.

With such contradictory results furnished by partial statistics, it must be acknowledged that science is not as yet possessed of a sufficient number of cases, to establish general laws with regard to the forms of the disease, and its relative frequency in the two sexes, either when one or both feet are affected with the deformity.

Is the disease now under consideration capable of becoming hereditary? In the present state of the science we are not authorised in affirming such to be the fact—but the following cases may be adduced in favour of such a supposition.

At Mardigny, in Switzerland, four brothers of the name of Vaullion, whose history is given by M. d'Ivernois, were all born with the feet twisted inwards.

M. Helt, also, speaks of a family living in the environs of Lauterbourg, which numbers six children, all of whom were afflicted

[1] Extract from the report made to the Royal Academy of Sciences, by M. Double, 21st August, 1837.

[2] Dict. de Méd. et Chirg. prat. art. Pied-bot.

with a congenital torsion of the feet. Here the disease was evidently hereditary, or at least it may be supposed so, as one of the parents was afflicted with the same deformity. I have already cited the cases of the two brothers G..., one of whom presented two calcanian, and the other, two inverted club-feet; there are two sisters, however, belonging to the same family, in whom no deformity is as yet perceptible. On the other hand, however, I know many fathers of families, who have either congenital or accidental club-feet, and whose children are perfectly well formed. There is a man of fifty years of age, now living in the town of Metz, both of whose feet are horribly distorted inwards, and who has nevertheless two perfectly formed daughters.

SURGICAL ANATOMY.

The surgeon who proposes practising the section of the tendo Achillis should devote his most careful attention to the tibio-tarsal region. The most serious accidents may result from a neglect of the anatomical relations of the parts. A large artery and important veins are likely to be wounded during the operation, unless it is performed with every precaution that prudence would prescribe.

But to return to our subject. We limit the tibio-tarsal region to all those parts placed from the distance of one inch above the malleoli, to the tarso-metatarsal articulations. This region regarded as a whole, presents on the inner side—1st, the malleolus internus, and above, and in advance of its point, a hollow which separates the tendon of the tibialis posticus from that of the tibialis anticus. 2d, on the outer side, the malleolus externus, separated from the back of the foot by a hollow which corresponds to the astragalo-calcanian excavation; that part behind, and inferior to the malleolus is prolonged into an apophysis, behind which the tendons of the lateral peronei muscles play; still further back, the tuberosity formed by the external face of the calcaneum will be perceived. 3d. In front, the instep is more or less convex, and there is nothing remarkable except the ridges formed by the tendons of the extensors of the toes. 4th. Posteriorly the skin is pushed backwards by the tendo Achillis, the protrusion of which occasions two lateral grooves or gutters, varying in depth according to the age of the patient, his embonpoint, and the degree of tension of the tendon. The skin presents even in this short space, very notable changes. Fine, thin, and but slightly elastic on the malleolus internus, it becomes quite thick on the instep, and in adults presents transverse wrinkles; large veins are distributed over, and colour it; near the malleolus externus it becomes more supple and elastic; the bed of

cellular tissue on which it rests, permits with great facility the immediate reunion of wounds of small extent—an important fact, and one to which we invite the most serious attention. At the posterior extremity, the skin becomes thickened and stiff, and that part about the calcaneum is often covered with callosities. The internal saphena vein and the nerve of the same name cling to the malleolus internus at a short distance from the tendon of the tibialis anticus; the vein even rests on this tendon, when it gets as high up as the articulation of the scaphoides with the first cuneiform. The malleolus has inserted on its front the extremity of the anterior annular ligament of the tarsus. The internal annular ligament arises from its posterior margin, and goes to be inserted into the inner tuberosity of the os calcis. This internal annular ligament, the continuation of the tibial aponeurosis, converts the tibio-calcanian interstice into a complete vault, and thus confines the tendons, vessels and nerves which pass from the posterior tibial region to the sole of the foot. This vault is divided by a partition which converts the posterior interosseous fossa into a canal. Its anterior portion is likewise divided into two, by a second partition very short and thick. The posterior one, the larger and much the less solid of the two, encloses the flexor proprius pollicis pedis, and the *posterior tibial vessels and nerves.* The anterior one, a very solid osteo-fibrous canal, is still further subdivided into two adjoining grooves, the one for the tendon of the flexor communis digitorum pedis, which is situated posteriorly, and the other for the tibialis posticus, which is in advance, and presents the appearance of being glued to the posterior face of the malleolus.

If it should so happen that the tibialis posticus should by its contraction offer any impediment to the foot's resuming its natural form, care must be taken not to divide it immediately at the back of the malleolus, for, at that point the tendon is enveloped in a fibrous sheath lined with synovial membrane—and a wound of these parts would almost inevitably be attended with serious inflammation which might be transmitted to the synovial capsule of the articulation. The only point, then, where it would be safe to divide this tendon, is immediately above the malleolus. This is an operation, however, which has never as yet been found necessary. The disposition of the parts is such, that it seems to me impossible that a section could be made of the flexor pollicis pedis alone, unless it should protrude so much under the skin as to render it readily accessible to the bistoury.

On the instep, the slightest contraction makes evident the tendons of the tibialis anticus, and extensores digitorum pedis. The tendon of the tibialis anticus muscle is separated from that of the extensor proprius pollicis pedis by a cellulo-adipose partition. These two tendons may be divided without danger, as they are not enclosed in a synovial sheath, and the pedal artery besides being deep-seated, is placed on the external side of the extensor proprius pollicis pedis.

The tendons of the lateral peronei muscles will be found situated *behind* the *malleolus externus;* arising from the external face of the fibula, they gradually turn around backwards; the sheath in which they are enclosed appears only to be a continuation of the aponeurotic canal, which kept them isolated on the leg. Having got behind the malleolus, they there hollow out a deep groove or canal, in which they are maintained by a resisting fibrous tissue which forms its posterior partition. Immediately above the malleolus externus, these tendons are placed directly under the skin, and this is the point to be selected in preference to every other for dividing them. It is impossible to avoid cutting the tendons of both the peroneus longus and medius at the same time, as they are too closely united for the instrument to divide one without the other also. This section, however, indispensably requisite in the case of everted club-foot, will be attended with no evil consequence, notwithstanding the presence of some of the muscular fibres which extend along with the tendon of the peroneus medius as low down as the bottom of the malleolus externus.

The vessels belonging to this region are too unimportant to render the operation at all serious. They are the external malleolar artery, some other very small branches of the anterior tibial, and (when they exist at all) the anterior and posterior branches of the fibular artery; the accompanying veins are also unimportant; one only is deserving of being mentioned, viz. the external saphena; having like the internal saphena, come from the back of the foot, it winds about in the sub-cutaneous cellular bed, and passes behind the malleolus to get into the fibulo-calcanian fossa.

The external *saphena nerve* is the only one to be seen in the vicinity of the malleolus externus, and the cutting of its small branches would have no deleterious effect on the success of the operation. The division of the external saphena vein, without being at all a serious accident would be the worst that could happen.

Let us now examine the posterior part of the leg; the tendo Achillis is there made evident by its strength, size, and the manner in which it is inserted into the os calcis—an insertion which occupies only the inferior half of the posterior face of that bone, its upper half being separated from it by a synovial bursa of considerable extent.

At that point where the tendo Achillis becomes detached from the fleshy fibres of the soleus and gastrocnemius muscles, its transverse diameter is generally about ten or twelve lines, varying in different individuals. It soon contracts, however, and presents the appearance of a large and nearly round cord. At the distance of half an inch from the os calcis, the tendon again enlarges, and the flattening of its fibres increases to such an extent as to admit of their embracing the whole of the posterior face of that bone. This is the point where the bursa mucosa is located. If the tendon be examined anteriorly, it will be found that the fleshy fibres accompany it much lower down, than they do posteriorly, the conse-

quence is that that portion of the tendon which is completely isolated, is not more than two inches in length. The knowledge of this fact is very important to the success of the operation, for if you cut too high up, you fall necessarily on the fleshy fibres which may inflame and give rise to dreadful suppurations. If on the other hand, the bistoury be carried too low down, the bursa mucosa may be opened, and the synovia which would escape from it, would offer a serious obstacle to a speedy cure.

In order that the division may be made under the most favourable circumstances, that point must be selected which would correspond with the middle of the malleolus externus, supposing a line to be drawn transversely. The abundant supply of cellulo-adipose lining which surrounds the tendon is a fortunate circumstance, inasmuch as it facilitates a speedy cure ; it forms a true sheath into which are emptied the fluids which are to serve as the medium of reunion between the divided extremities. When the tendon is cut, an interesting phenomenon occurs by an instant opposition being made to the ingress of the air, which is prevented from coming in contact with the tendon ; it so happens that the moment when the instrument divides the tendon, it contracts with force, and draws along with it the adherent cellular sheath, which being pulled from below upwards, closes like a button hole after the instrument. The relation borne by the posterior tibial vessels and nerves to the tendo Achillis merits particular attention. In the adult the posterior tibial artery runs superiorly along the tendo Achillis, from which, however, it is separated by a considerable body of cellular tissue. About the height of the malleolus internus, the artery turns aside to run inwards and downwards, and finally sinks down into the tibio-calcanian fossa. This artery is accompanied by the tibial vein, which most commonly has two trunks, one situated on the external and posterior sides of the artery, and the other on its inner side. The tibial nerve is placed in front of, and on the outer edge of the arterial vessel, but it is not uncommon to find it situated on the inner side of the artery, which it pushes off towards the tendo Achillis. I have, whilst writing, an example of the kind in view.

The tibial artery furnishes a number of branches, all of which, however, are unimportant, with the exception of the one destined to anastomose with the external malleolar ; it passes obliquely from above downwards in front of the tendo Achillis. This branch may be wounded, if the instrument is depressed in too upright a manner at the surface of the tissues. In young persons the position of the parts is essentially different from what we find them in adults ; the abundance of adipose cellular tissue, the smallness of size of the tendo Achillis, and the slight degree of energy possessed by the muscles, cause the leg to present inferiorly a form almost exactly cylindrical ; the artery is proportionately larger than at a more advanced age, and the aponeurotic fibres which cover and protect it behind the malleolus externus, scarcely exist as yet at all ; the artery may also be felt, beating very superficially under the skin.

The veins large and gorged with blood surround nearly the whole circumference of the artery. The incomplete developement of the member causes an approximation of all its component parts; and from this source there arises a real difficulty and even danger, in as far as the division of the artery is dangerous, when the operation is performed imprudently, or when a departure is made from the rules which we shall presently lay down. These difficulties are still further augmented by the changes induced in the inferior portion of the leg, when the club-foot is completely formed. All these facts should be carefully noted—they are of the utmost importance to the operative surgeon.

The tendo Achillis, instead of running perpendicularly, as to the axis of the leg, deviates inwards, in order to reach the posterior extremity of the os calcis, and consequently it approximates more nearly to the artery than it otherwise would do. This, subservient to the rule so happily established by M. Guérin, becomes more and more flexuous in proportion as the distance which it has to run is more or less reduced; it follows the direction of curvature of the limb, and the artery and tendon are in almost immediate contact.

The venous system follows the same course, as to change of direction, as the arteries; it is also greatly preponderant—which circumstance, joined to the diminished size of the artery, is extremely fortunate for the protection of the latter from being wounded by cutting instruments.

These anatomical remarks lead us to conclude that, in order to avoid wounding the artery, we must necessarily attack the tendon at its inner edge, and keep as near to it as possible.

THERAPEUTIC INDICATIONS.

Treatment.

The deformity so often serious—caused by the developement of club-foot, the difficulty of walking, and the misfortunes which accompany it, promptly impress the relatives, and at a later period the patient himself, with the desire to remedy the defect. Most persons do not hesitate to make every sacrifice that such a dreadful infirmity may be removed. But, until the present day, how many anxious hopes have been disappointed! How much expense, courage, and patience have been expended for doubtful and unsatisfactory results! This was not because physicians misunderstood the indications to be fulfilled in the treatment—the object was evident—the indications are simple—they are reduced to merely *re-establishing the form and functions* of the diseased foot. The labours of many physicians have been directed towards this object

alone, and some happy results attest that they were well acquainted with the nature of the disease, whilst a great number of failures also proves that they had not been so fortunate as to discover the proper mode of treatment. Let the causes of the disease be what they may, the fundamental pathological derangements are reduced to the contraction of one or more of the muscles of the leg, and to a more or less extended deviation of the articular surfaces. This is the evil. Is it always curable? Up to what age is it capable of being remedied? And what are the circumstances that may render the cure impracticable? These are important questions, which we must examine prior to the establishment of the methodus medendi. The astonishing success recently obtained in the cases of individuals whose feet were horridly deformed, and who had been afflicted for a long time with large callosities, ulcers, wasting away, atrophy, and almost an entire paralysis of the lower extremities—a success which is daily multiplied, enables us to assert that, in almost every instance, club-foot is curable. Advanced age is, however, an obstacle; the operation will probably prove unsuccessful, if the bones have acquired their full size and hardness, or if ancylosis exist, or if the articular surfaces, worn away by rubbing and pressure, have lost that bony polish which permits them to slide over one another with such facility, and the thickness which would oppose itself to the return of the foot to its natural shape. We must never despair, however, as there are instances of cures having been accomplished in the cases of individuals of forty years of age and upwards. There would be an evident contra-indication to undertake the treatment, should the patient be paralysed in both his lower extremities in consequence of disease of the spinal marrow, and I have met with one example of this kind; or if there should exist a congenital luxation of any one of the bones of the tarsus, as was the case in the patient spoken of by Professor Ehrmann. These occurrences are so rare, however, that it may now be considered as an established fact, confirmed by experience, that club-foot of every variety is almost always capable of being promptly cured.

The main object of the physicians of antiquity, and of Hippocrates in particular, was to oppose to the effect produced by the contracted mucles, machines, which might, by counteracting the evil tendency, restore the foot to its primitive natural shape. At a more recent period, M. A. Severinus and Ambrose Paré, had recourse to tonic remedies for the purpose of strengthening the diseased members. Benjamin Bell was of opinion that the most effectual remedy that could be opposed to the shortened and contracted muscles, was topical emollient applications kept up for a long time. But what reliance can be placed in frictions and exciting manipulations? What beneficial effect can vapour, shower, or emollient baths have on shortened and constantly contracted muscles, or a deviation of articular surfaces?

Such impotent means have always failed, or if they have occa-

sionally appeared to succeed, the credit is due to nature alone, which has so frequently accomplished, contrary to every expectation, most remarkable cures. M. Stoltz knew a boy, the son of poor parents, who had a very decided inversion of the foot, which was totally neglected until the time when he began to walk. At this period they had made for him the simplest kind of boot, which after a time was replaced by a common shoe, made to fit his deformity; he was nevertheless spontaneously cured, about the age of ten or twelve years. Having been habituated from his earliest childhood to the carrying of heavy burdens, the exercise compelled him to apply the sole of his foot firmly to the ground, and throw its point as much outwards as possible. These exertions finally re-established the muscular equilibrium and length,—and at the age of twenty years it was impossible to discover that he had ever laboured under the disease.

Richter relates a no less remarkable case of spontaneous cure. A young man, who had been afflicted from birth with a very marked double club-foot, learned the tailor's trade at the age of fourteen years. From that time he was kept constantly seated with his legs crossed, as is requisite in exercising that profession, and he was soon astonished to find that his feet were beginning to assume their natural shape. The cure progressed insensibly, but was finally completed. This happy result must evidently be attributed to the fact of the extensor and adductor muscles having been kept in a constant state of relaxation.[1]

These fortunate cures, purely accidental, are much too rare to authorise a temporising system as a therapeutic means. I am not aware that any physician has ever proposed such a course; on the contrary, energetic action has generally been advocated, and some authors have even gone so far as to recommend the application of iron boots. Venel, Bruckner, and D'Ivernois, with a greater prospect of success, proposed the combination of tonic and emollient medicaments, with apparatus so constructed as to act at the same time on both the elongated and contracted muscles.

It was soon perceived that the emollient applications possessed the serious inconvenience of rendering the skin too supple, and of softening it so much as to give rise to excoriations, serious inconveniences which counteracted the beneficial effects of the mechanical means used, and frequently rendered it necessary that they should be suspended.

All physicians had been taught by experience that the application of mechanical force was their only resource against deformities of the feet, and, until recently, this means comprised the whole therapeutic treatment. All the machines invented, had for their object the creation of a power, which, by acting on the foot, made to perform the office of a lever, might oppose the resistance caused by muscular action. These apparatus were exceedingly diversified in

[1] Held. Dissert. cit.

form, but they may all be referred to the two systems of dead and elastic forces. The first includes a great number of machines and some bandages, and the second, every oscillating apparatus, of the merits of which very opposite opinions have been expressed by physician orthopedists. Many modifications were made in the construction of the apparatus, occasioned by the varieties of vicious conformation, the peculiar views of the inventor, or to suit certain exigences of individual position or fortune.

As all these means are destined to the same end, we shall only speak of those which, by the simplicity or the success that has been obtained by their use, are still deserving of the attention of practitioners. The *appareils immovibles* of Larrey, Seutin, and Dieffenbach, recommend themselves to our notice in preference to all others on account of their simplicity. As the two first have been long known, and are accurately described in many works, we shall only name them. The following is the bandage used by the Berlin professor:—after having rectified the position of the member, M. Dieffenbach takes two pieces of adhesive plaster about one and a half times the length of the leg, and begins by applying one end obliquely below the calf of the leg; he then passes it around the malleolus externus, the back of the foot, and its sole, and returns it on the opposite side in such a manner, that the two ends are made to cross on the external side of the leg; the object of the application of these two pieces is to prevent the foot from falling downwards and inwards. He then places along the inner face of the leg a bandage folded in the form of a loop, which is made to correspond exactly with the external edge of the sole of the foot, whilst the two upper ends united extend just above the calf.

These pieces are fixed by means of the figure of 8 bandage, wound from without inwards in such a manner as to contribute still further to maintaining the sole of the foot in an outward position, but not so as to enclose the loop, which in the mean time remains free and loose. This being done, the operator takes a strong splint about an inch and a half broad, made long enough to extend to the upper third of the leg, and having, at the distance of an inch from its inferior extremity, a double excavation, to which is attached a small flattened head,—and bringing the loose loop to the outer side of the foot, he there confines with it the neck of the splint, which is afterwards applied to the outer side of the member in such a manner that its head shall extend beyond the surface of the sole. He now fixes the whole firmly, and concludes with enveloping all the limb in a bandage. By this apparatus the foot is not only restored to a proper position, but locomotion, in place of offering any impediment to its action, rather adds to its efficacy; for, whenever the foot is allowed to rest on the ground, the little head of the splint touches first. As its point of support, however, is not sufficiently broad, and is, moreover, situated without

the centre of gravity of the body, at every step that the patient takes, there results a movement of reversion outwards.

The apparatus is simple and well conceived, and it may be applicable to some cases where the deviation is but slight, and the deformity easily remedied by the action of the hand alone.

The plaster mould proposed by M. J. Guérin, the mode of applying which has already been shown, will succeed as well, under the same circumstances, as the bandage of Dieffenbach; it must be borne in mind, however, that these means, which are suited only to young subjects, are long in perfecting a cure, and that the patient, treated by them, is very apt to have a return of the disease in a short time after their removal. This is a matter of great importance, and it cannot be denied that the cures, obtained by such mechanical means alone, are uncertain, often incomplete, and always leave the patient liable to a recurrence of the deformity.

The ingenious apparatus invented by Scarpa, Boyer, Delpech, and M. Stœss, an orthopedist of Strasburg, have each been used successfully in some cases, whilst they have been very frequently found to fail in others, and it cannot be denied that many patients, having experienced from their use a very prompt but temporary amelioration of their condition, have had the misfortune to see their deformity reappear, after all their endeavours to combat it during months and even years of inconvenience, pain, and privations of every kind. All these apparatus then, are liable to objection, and the fact should not be concealed that there is occasionally danger in their use. No matter how well they may be constructed, there must always be some parts which rest on the member, which will occasion pressure, friction, pain, ulceration, and even gangrene of the skin. One of the objects of their application, is to extend the retracted organs,—and this must necessarily give rise to deep seated pains, inflammation, suppuration, and, consequently, muscular contraction. Doubtless the physician will take every precaution to prevent such evil consequences of extension and compression; he will accustom his patient gradually to the use of the apparatus, and allow him in the commencement intervals of repose. Notwithstanding every precaution, however, he will frequently witness the supervention of violent pains—a sure indication of the approach of the accidents so much to be apprehended. When they do supervene, no time should be lost in removing the apparatus altogether,—it ought to be done without a moment's hesitation,—and if, after two or three attempts, the pain is found always to recur, it should never be permanently reapplied. Experience has proved, that when constant pain is the result of extension, if such extension is not instantly arrested, instead of assisting, it will only throw new obstacles in the way of a cure.

These apparatus and bandages are much less relied on since the introduction of the practice of dividing the tendo Achillis in the treatment of the disease, and the time is not far distant when they will be almost entirely abandoned, with the exception of cases of

very slight deviation, where the least traction will suffice to reduce the foot, in which plaster, the apparatus of Larrey or of Dieffenbach may be applicable, and should always be employed; for every operation, no matter how unimportant it may seem to be, is attended with more or less danger. With the exception of such cases—I repeat—the section of the tendo Achillis will soon supersede the necessity for the application of all these costly, fatiguing, and uncertain means; and the machines will be found only in museums—illustrating the history of the art.

The dividing of the tendon is a simple operation—soon over, and generally very easy of performance, whilst at the same time it is unattended with danger. It has been the means of establishing more radical cures in the space of a few years, than had before been accomplished during ages. It is worthy, then, our most serious attention, and I will endeavour to describe it with the most minute care. First, as to the division of the tendo Achillis,—and before proceeding farther, it will be well to recur to some of the most important surgical facts. It will be recollected that the posterior tibial artery is placed at the inner edge of the tendon to which it is united, and by which it is sometimes even covered superiorly; it becomes detached about the middle of the tendon, and is entirely separated from it at the inferior portion, after which it runs along the centre of the groove formed between the tibia and os calcis. The artery is accompanied in all its course by large veins, and by the posterior tibial nerve. It has already been seen that these important organs do not retain their normal relations in cases of club-foot, more especially when the disease is far advanced,—the deviation of the foot causes them to approximate more closely to the tendon; the veins, which are pathologically distended—as well as the artery, form flexuosities, which cause them to occupy a larger space than in their normal state. The tendon itself merits a moment's attention; from being very broad at its superior part, it gradually decreases in size, until it forms a large and nearly round cord, whilst at the distance of twelve or fifteen lines from the heel, it again enlarges for the purpose of being inserted into the os calcis—to obtain which insertion, it has to pass through a broad mucous bursa.

We are warned by these facts that the instrument used for dividing the tendon, may wound the artery, the veins, or even the nerves; and such accidents are the more likely to happen, if the patient be young, and the disease far advanced. If the tendon is divided too high up, the danger will be increased; and if on the contrary, the section is made too low down, there will be danger of opening the bursa mucosa, which would allow the escape of the synovial liquor into the wound, the constant presence of which would hinder the cicatrisation and hardening of the plastic lymph interposed between the ends of the divided tendon. From these considerations we have been induced to lay down the following rules, which are precise, and must not be departed from in any

case, where the object is to perform with safety the section of the tendon.

1st. The point for dividing the tendon, in adults, is at the distance of fifteen lines above the os calcis. In infants it must be varied according to the child's age,—in the youngest subjects the point ought never to be less than five lines from the heel. In case these directions should be forgotten, it will be well to recollect that a line drawn transversely, so as to divide the malleolus externus, will give the exact height at which the section should be made.

2d. The tendon should invariably be divided from its inner edge, as, by so doing, the instrument will be interposed between it and the vessels and nerves.

3d. The incision should be small, and ought never to traverse the skin through and through; this precaution is necessary to prevent suppuration and exfoliation of the tendon.

What is the most suitable instrument for performing the operation? Each operator has had his own instruments, which have differed more or less from one another. Delpech made use of a bistoury, held flat, for dividing the skin, and passing behind the tendon;—and for cutting it, he used a small convex knife. M. Stromeyer employs a pointed bistoury—very narrow, and bent so as to present a convex edge.[1] M. Bouvier uses a lancet to make the opening in the skin, and then introduces a small straight knife scarcely larger than a cystitome.[2] M. Stœss also uses two instruments, a double edged bistoury—having the blade very narrow—and then a probe pointed bistoury bent to a very obtuse angle, and having only a small convex edge on the curved part.[3] In my own opinion, two instruments are not required for the performance of such a simple operation,—they serve only to increase the difficulties, and prolong the duration of the operation. Why should it be necessary to withdraw the cutting instrument at all, after it has traversed the tissues? If, by accident, any important part shall have been wounded, the necessity of having to introduce the second instrument, will prevent the surgeon from endeavouring instantly to remedy the evil.

For these reasons I have determined to make use of one instrument only in performing the operation. M. Duval also uses only one; I call the knife which I use, *Ténotome*:[4] it is a very simple instrument,[5] consisting of a blade nearly similar to that of a scalpel, inserted into a strong handle; the blade differs, however, from that of the scalpel, in its being more narrow, and having the point convex on both sides,—the curvature of the cut-

[1] Archives Méd. tome iv. page 103—104.
[2] Bulletin of the Academy, Dec. 1836, p. 200.
[3] Held, Dissert. p. 53.
[4] From τενων, tendon, and τομη, section.
[5] See plate vi.

ting edge commences near the point. I have adopted this form in order to avoid chafing the skin at its internal edge, as is apt to be the case, when the operation is performed with other knives; the back of the instrument is quite thick, and its curvature much greater than that of the point. I think it better that the back should be made thick, in order that it may be set firmly against the tendon, for in some individuals this offers very great resistance to the action of the instrument. The edge of the *ténotome* looks towards the broadest side of the handle; this disposition is made in order to afford a large surface for the fingers to rest on, and thus insure the instrument's being held firmly in the hands of the operator.

Position of the patient.—When the patient is a young child, I have him placed on his abdomen, and supported on the knees of an intelligent assistant. When an adult is to be operated on, I place him in the same position on a bed; one assistant holds firmly the lower part of the leg, whilst another seizes the foot and flexes it for the purpose of stretching the tendon, and making it prominent. If the patient is a child, I myself take charge of the foot, and move it in the manner indicated,—then holding the ténotome in my right hand, I apply its point against the tendon, whilst with the fingers of the left hand which are free, I stretch the skin by pulling it a little inwards. To execute the *first part* of the operation, I now thrust my instrument through the integuments, keeping it as near as possible to the tendon, and turn it from behind forwards, and from within outwards. When, by the depth the blade has penetrated, and sometimes by a slight external protrusion of the skin, I find that my instrument has passed beyond the tendon, I prepare to execute the *second part* of the operation. The handle of the tenotome being depressed, the edge of the blade is consequently firmly applied against the parts to be divided; I now move the instrument very slowly backwards and forwards,—a peculiar noise soon announces the separation of the tendinous fibres, and suddenly a quick, dull, crackling sound proclaims the entire division of the tendon. I immediately cease to press on the instrument, and withdraw it slowly from the wound, at the same time arranging carefully the integuments. A depression, varying in extent according to the degree of contraction of the muscular fibres, occupies the place where the tendon previously was. The operation, thus performed, is attended with but little pain, and I have frequently seen it borne by children without their uttering a single cry.

When the ténotome is withdrawn, a few drops of blood escape from the wound, scarcely ever, however, more than four and five. As soon as this is stopped I press the little wound lightly in order to expel that which may have accumulated under the integuments or in the tissues,—a precaution which I think useful, inasmuch as it prevents the formation of clots, the presence of which might give rise to irritation and suppuration. A small pledget spread with cerate being placed over the wound, a compress and bandage complete the dressing. I leave matters in this state for five or six days,

at the expiration of which time, the first dressing being removed, the wound is generally found to have healed, and now is the time for reducing the foot, which by-the-by will be frequently found to have already commenced, under the influence of the active contraction of the extensor muscles.

I commence this operation by enveloping the foot in one or more long compresses of several folds, and then apply a bandage of the breadth of two fingers around it, in the form of the figure of 8, which, descending from the external side of the leg, passes under the inner edge of the foot; such a disposition of the bandage is indispensable, as it tends to depress the inner edge of the foot, and elevate the external edge. Indeed it will sometimes be found sufficient of itself to maintain in a proper position club-feet that are not highly aggravated; the bandage being applied, I next arrange the apparatus for reduction.

This machine is very simple[1]; it is composed of a wooden sole larger than the foot, and perforated by several mortices; a strong leathern heel varying in height according to the age of the patient, but which should, nevertheless, in no case exceed an inch and a half, is fixed to the posterior part of the sole; and on the inside of this heel two leathern tongues, pierced with eyelet holes, are attached, which are intended to lace on the instep, in order to keep the heel in close contact with the sole;—two steel uprights with hinges at the height of the malleoli, and two arcs of circles placed transversely for the purpose of adding to the solidity of the uprights, embrace at their inferior extremity the sole, to which they are firmly secured by means of rivets. One of these uprights has attached to its outer side, and at the height of the malleolus, a ratchet with a double spring click (*double fourchette*) to stop it. This part of the apparatus is indispensable for keeping the foot at whatever degree of flexion may have been given to it. At first I had but one click (*fourchette*) behind, but I soon saw that it was frequently bent by blows or involuntary movements. These two clicks (*fourchettes*) are capable of being simultaneously separated by means of a fixed (*clef à demure*) but movable key, placed above, and at a short distance from the ratchet. All the metallic parts of the apparatus are lined with leather, and there are two leather straps to go around the upper part of the leg. When the foot is placed in this machine, and the two leather straps, destined to fix the heel, laced, I put an end of a bandage through one of the mortices of the sole, and pass it several times around the foot and the sole, for the purpose of keeping it flat, and endeavouring to bring it back to its normal position; the remainder of the bandage is made to describe the figure eight, by passing around the foot and the sole, but without including the metallic uprights. In the commencement the foot forms a right angle with the leg, but every six days I incline it on the leg by advancing the clicks (*fourchettes*) one tooth on the ratchet.

[1] See pl. vi—the figure represents an apparatus for a child of four years.

This simple and cheap apparatus might be replaced by that of Scarpa, by adding to the latter the ratchet and double spring click (*double fourchette*) for the purpose of opposing any quick or irregular movement of flexion. The bandages soon become deranged, and it is necessary that they should be reapplied, whenever they are found relaxed. At every reapplication a new effort should be made to reduce the foot to its natural shape. It generally requires six weeks for the complete consolidation of the new tendinous tissue, and for the foot to become divested of the habit of inclining in an improper direction. But it frequently requires no more than eight or ten days, and even a shorter time in some cases, for its complete reduction. When the consolidation of the tendon is completed, half boots should be made with very thick stiffnings, and two long leather straps on the inside, for the purpose of lacing over the instep, and keeping the heel firmly applied against the sole. The patient should endeavour gradually to re-establish the functions of the leg, but never fatigue himself.

Those authors, who have preceded me, have given but incomplete directions with regard to their operative process, and such as are wholly insufficient to guide the surgeon in an operation for the division of the tendo Achillis.

Delpech, to whom, I take pleasure in repeating, we are indebted for our first exact notions with regard to the operation under review, has laid down the following rules:

1st. The tendon to be divided ought never to be laid bare,—it should be cut in a slanting manner, and not by an incision parallel with the skin, for in that case it would probably exfoliate.

2d. Immediately after the tendon shall have been divided, the two ends should be approximated and maintained in contact by means of a suitable apparatus, until they are reunited.

3d. This reunion having taken place by means of the interposition of a new formation of fibrous matter, it is necessary before that substance has become completely solidified, to elongate it by means of extension gradually increased.

4th. When a sufficient lengthening has been obtained, the parts should be immediately fixed in their proper position, until the intermediate substance shall have acquired all the firmness of which it is susceptible.

Operative process of Delpech.—In the case recorded in the *clinique chirurgicale* of Montpellier, Delpech divided the tendo Achillis of a young man nineteen years of age, in the following manner. The patient having been placed on his abdomen, he thrust a bistoury, which was held flat, behind the tendon in such a manner as to occasion on each side of it an opening of about an inch in length; he then withdrew the instrument, and introduced into the wound a convex knife, the cutting edge of which was turned towards the tendon, which was then divided transversely without implicating the skin situated above. But by this operation it was impossible to prevent the exfoliation of the tendon; the sup-

puration was very abundant, and extension could not be used until the twenty-sixth day, and the sides of the tendon had become adhered to the cicatrices which formed but slowly on account of the suppuration. At first, the movements of extending and flexing the foot occasioned a puckering of the skin, but this inconvenience disappeared in the course of time.

Process of Stromeyer.—The Hanoverian surgeon, from the time of his first operation on the 28th of February, 1831, modified the process of Delpech in the following manner. The patient being seated on a table in front of the operator, with the left side towards him, one assistant held the knee down firmly, and another seized the foot, and bent it, so as to stretch the tendon forcibly,—a pointed bistoury, very narrow and bent so as to make the cutting edge convex, was thrust two inches above the insertion of the tendon, between it and the tibia; the back of the instrument being turned towards the bone, and the cutting edge towards the tendon; this latter was divided by the mere introduction of the instrument; the section was accompanied with noise. The indication of making the external wounds as small as possible, in order to avoid the entrance of the air, the exfoliation of the tendon, and suppuration, was, the author says[1] perfectly fulfilled, for the point of the bistoury only passed through the opposite side, without making a bleeding wound, and the entering wound was only of the size of the blade of the instrument. In his second operation, performed on the 12th of June, 1834, the author used the same process, with the exception, however, that the tendon was divided in this case at the distance of three inches above the heel.

Although this operation is nearly analogous to that of Delpech, it nevertheless differs from it; in that the author took great care to make the incisions as small as possible, which was an important step towards improvement, and his success is owing to this circumstance. We congratulate M. Stromeyer on it, but at the same time we do not hesitate to state that there are inconveniences attending the double wound, and danger in dividing the tendon as high up as three inches above its insertion into the calcaneum.

Process of M. Bouvier.—The patient being placed on his abdomen, a small opening was made with the point of a lancet parallel to the axis of the leg, only a few lines from the tendon, and opposite to that point where it was found to be smallest and most prominent. This opening permitted the introduction under the skin of a small, straight probe-pointed knife, scarcely larger than a cystitome This ténotome was passed between the skin and the tendon, which latter was then easily cut from without inwards, without wounding the integuments on the opposite side. The foot was then placed in an apparatus constructed so as to maintain it flexed on the leg, and thus keep the ends of the tendon separated.[2]

[1] Archives générales, vol. iv. p. 103.
[2] Bulletin of the Academy, Dec. 1836, p. 200.

This process is attended with the serious inconvenience of having to cut from without inwards; the instrument—if the tendon should give way suddenly—might be carried downwards on those deep-seated parts which it is of the utmost importance not to injure. Here we also have the inconvenience of two instruments.

Process of M. Stœss. The object of this operator, as of MM. Bouvier and Duval, is to perforate the skin on one side only, and divide the tendon from as small an external wound as possible. For this purpose he introduces between the tendon and tibia, a double-edged bistoury with a very narrow blade, (it is only a line and a half broad,) held flat, with which he makes an incision two lines and a half long, taking care at the same time not to perforate the skin of the opposite side; it is then withdrawn and replaced by a probe-pointed bistoury, bent in a very obtuse angle, and having a very small convex cutting edge on the bent part. The straight part of the blade is placed in front of the heel, where the instrument is made dull to prevent its enlarging the external wound, at the moment when the bistoury being turned vertically, performs by a saw-like motion, the section of the tendon. The division being made, the instrument is immediately withdrawn, and the wound closed by the finger, to prevent the entrance of the air into the vacant space left by the retraction of the two ends.[1]

This process is likewise liable to the objection already made, of employing two instruments, when one only can be as advantageously used. This description, as well as the preceding ones—leaves something also to be desired as to the point to be selected for performing the operation, according to the age of the patient; and some directions should be given as to the precautions necessary to be taken, to avoid wounding the artery and veins.

Process of M. Duval. This expert orthopedist has not yet published an account of his process, or at least I have not met with it, although I have in one case seen him operate; in this instance he used but one instrument, of which mine is only an imitation; he took great care not to traverse the integuments on both sides, and divided the tendon with remarkable dexterity.[2]

Consecutive Treatment.—It is not enough to have overcome the principal obstacle to the reduction of the foot, the parts must be replaced in their normal position, and in order to obtain this result, it will be found indispensable that the following indications should be fulfilled:—viz. to overcome the inordinate contraction of the

[1] Held, Diss. cit. p. 53.

[2] [An account of M. Duval's method of operating, will be found in the Bulletin of the *Royal Academy of Medicine* of Paris, of the 15th March, 1837, and in his "Traité pratique du Pied-bot," Paris, 1839, in 8vo., page 117. It does not differ essentially from that of our author, and the instrument which he uses, is the acknowledged original of that of M. Scoutetten. M. Duval is, however, in the habit of employing occasionally in the cases of very young children, and under certain circumstances, straight probe-pointed scissors, with which he has in three instances operated successfully. *Transl.*]

muscles, and to restore the articular surfaces to their natural relative positions. These indications can only be accomplished by time and a suitably constructed apparatus. It can easily be conceived that a certain time is requisite for restoring to their normal position bones which have become separated, and there would be serious inconveniences attending its being greatly abridged, for this could not be done without violent pressure and traction, occasioning pain, a stretching of the ligaments, and a convulsive contraction of the muscles, which, giving rise to inflammation, might retard, and would probably hinder altogether the re-establishment of the union of the two divided ends of the tendon. Here it is that the wise precept of Hippocrates should be remembered—"*neque magnâ vi, sed leniter cogantur!*"

The reduction is nevertheless performed in some cases with wonderful promptitude; I have seen many feet strongly distorted, perfectly restored in six and eight days, and it rarely requires more than fifteen.

The reduction was obtained in the thirty cases reported by M. Duval to the Academy of Medicine,[1] in from ten to twenty-five days. Agreeably to my own observation, accidental club-feet are the most easily reduced.

But at what time should the apparatus be applied? Authors do not agree on this subject; according to some, the application ought to be made immediately after the operation,—whilst others are of opinion that a period varying from five to fifteen days should be allowed to intervene. In the cases of the two persons first operated on by M. Stromeyer, the apparatus was not used until the tenth day. M. Stœss has frequently applied it on the fourth and fifth day, and I have seen M. Duval arrange it immediately after the operation was over. My practice is always to leave my patients at liberty for four or five days; the object is to avoid extension, which, if combined with the irritation caused by the division of the tendon, might induce inflammation. At the expiration of four days, then, and when the wound is healed, I apply the machine. How ought the foot to rest in the apparatus? Should it be inclined, so as to favour as much as possible the approximation of the ends of the divided tendon—as advised by Delpech and the greater number of operators who have succeeded him? And should the elongation of the intermediate substance secreted by the ends of the tendon be gradual? These are important questions which appear to me not to have been duly considered. It is generally admitted as necessary, that the two ends of the tendon should be as nearly approximated as possible, and then to cause a progressive lengthening. The newly secreted substance appears to be viewed in the light of glass rendered soft by the application of heat, which may be extended at pleasure. We instantly reply to such an assertion, that if the elongation takes place as is supposed, it can only be by diminishing the

[1] Bulletin of the Academy, Jan. 1837, p. 304.

thickness and cohesive power of the newly formed tissue, and that this tissue would thus be exposed to the possibility of being broken by violent or too long continued extension. It should still further be recollected that nature is not too bountiful or extravagant in the use of her "*vis medicatrix!*" and thus when she has caused the re-union of divided parts, the secretion of the fluids, destined to become solidified, ceases. Notice the phenomena which occur in the case of a fractured bone,—if the fragments are closely approximated, the plastic juices are secreted in small quantity, whereas if they are widely separated, the secretion is very abundant, and the callus extends to some distance around the parts.

These facts would lead us to infer that it is wrong to attempt bringing together the divided ends of the tendon, and that it would be better, within certain limits, to pursue an opposite course. At all events up to the present time, I congratulate myself on having conformed to such precepts. I place the foot, then, in the machine in such a manner that it shall stand at a right angle with the leg, and keeping it in this position for ten or twelve days, I then gradually and progressively bring it up to an acute angle of 55° or 60°, and never to 70°, as has been proposed, for there are many serious objections to keeping it so very much flexed. We must afterwards rely on the efforts of nature to make the parts supple, and restore to them their natural motions.

When I think it proper to flex the foot, I always do so slowly; I hold it firmly with my right hand, whilst with the left I raise the clicks (*fourchettes*) which rest on the ratchet, one of the teeth of which indicates the extent of inclination that I make. As long as the foot is kept in the apparatus, the position of the heel must be carefully watched,—the final success of the operation depends on the attention that is paid to its being placed and maintained in a proper position. The heel, which has a natural and decided tendency to become elevated, is still further assisted by the motions of the child, and the relaxing of certain parts of the apparatus. When any such displacement is perceived, every thing should be instantly removed, and the parts replaced in a suitable position. It is but seldom, especially in the commencement, that three days elapse without the displaced parts of the machine requiring re-application.

Although the little wound may be completely healed, I take the precaution constantly to surround the foot with several soft compresses, which are kept in their places by means of a bandage. I even take the precaution to apply a very thick piece of linen over the parts on which much pressure is likely to be exerted; it is in this manner that I protect the skin which covers the astragalus and calcaneum from pressure which might bring on inflammation and gangrenous eschars—misfortunes which many operators have had to regret.

Accidents.—Many accidents may immediately follow the section of the tendo Achillis, the most serious of which would be the division of the posterior tibial artery; very fortunately an example of

the kind has as yet scarcely occurred,—at least we may infer from the silence of operators that it has never happened. It is to be feared, however, that at some future day it may occur, for the surgical anatomy has already shown us that such a thing is possible, especially when the operation is performed on young children. Under such disagreeable circumstances the first object of the operator should be to compress the femoral artery, and at the same time endeavour to arrest the hemorrhage by applying a dossil of lint over the wound, and supporting it with a tight bandage. A stop being thus put to the flow of blood, the surgeon will have to choose between tying the femoral artery at the middle of the thigh, the popliteal artery, or the vessel itself immediately above the wound. The last seems to be the most simple, but it is nevertheless by no means the easiest,—from the difficulty that would be occasioned by the extravasation of blood in the cellular tissue, and the inconvenience that would be experienced in arresting the flow of blood. Whenever it is practicable, however, this part should be chosen, as it will be found most advantageous to the patient. If the child is young, and abundantly supplied with cellular tissue—a circumstance by the way very rare in the limbs of club-footed persons, it would be more prudent and easier to tie the femoral artery at the middle of the thigh. The facility with which the anastomotic communications are made renders this operation much less dangerous in young children than adults.

In performing the section of the tendon, the little artery might also be divided, which goes from the posterior tibial to the external malleolar, and passes in front of the tendon. Such an accident would not probably be serious,—the only danger would be a small sanguineous effusion, which, by the coagulation of the liquid, would soon stop the hemorrhage.

The veins have been frequently wounded,—it has happened in my own practice in two instances.[1] The accident may be detected by the abundant flow, in a continued stream, of blood more decidedly red in proportion to the youth of the subject. This coloration of the blood may surprise and alarm the operator; he must quickly, however, regain his self-possession, in order that the assistants may not perceive the danger which he apprehends, and instead of being in a hurry to stop the blood, he should allow it to run for a short time, for the double purpose of assuring himself by the jet, of the nature of the vessel wounded, and of obtaining the disgorgement of the veins, so that the hemorrhage may be the less likely to recur.

When the jet decreases, the vein should be compressed, and a small pledget covered with cerate applied, over which a thick compress ought to be placed, and the whole firmly secured by means of a bandage. In such cases, as under more favourable circumstances, I allow the dressing to remain four or five days without touching it.

[1] See cases 1 and 4.

If the nerve should be wounded, severe pain would result, which would at once evince the nature of the accident. I know of no example of the kind having ever occurred,—if it should happen, nothing could be done, but to apply topical emollients and narcotic ointments.

After the instrument has traversed the tissues, it may, instead of passing entirely around the tendon, penetrate through its fibres, and thus leave some of them untouched. Such an accident is indicated by the incomplete retraction of the tendon, and the resistance offered by its undivided fibres,—a resistance which the operator may easily detect by the touch. A case of the kind once occurred in my own practice, in the person of a young lady twenty-one years of age; it was easily remedied by re-introducing the point of the bistoury, and dividing the fibres which remained.

Inflammation, suppuration, and exfoliation of the tendon are of rare occurrence; they however supervened in the case of the patient operated on by Delpech, and the cure, although eventually completed, was retarded by them.

It may so happen, although there be a total absence of all inflammatory action, that the two ends of the tendon will never reunite. This is a serious accident, inasmuch as it precludes all hope of cure. M. Stromeyer had a case of this kind, in a boy seven years of age;[1] the foot retained its vicious conformation.

When the section of the tendon is cured, the foot may in some cases still present a decided deviation; this accident occurred in the case of a lady of thirty years of age, who was operated on by M. Duval, and it was occasioned by the contraction of the tibialis anticus muscle. The tendon of that muscle was divided, and the cure soon after completed. Gangrenous eschars may supervene, when the precautions, which I have indicated for preventing violent compression of the skin, are not used. In the case of the first patient operated on by M. Stœss, one eschar made its appearance on the heel, and another on the first metatarsal bone,—two month's treatment was required to cure them.[2] In a patient treated by M. Duval, the formation of an eschar prevented the application of the extending machine for more than six months.[3] If it should happen that the skin is traversed on both sides, or completely divided, the wound should be closed, and an endeavour made to obtain an immediate reunion.

[1] Nouvelles Observ. in Archives générales, vol. 5, p. 194—1834.
[2] Held, Dissert. cit. p. 69.
[3] Bulletin of the Academy, Jan. 1837, p. 307.

SEQUELÆ OF THE OPERATION—PROGRESS OF CURE—CHANGES IN THE LIMB OPERATED ON.

The section of the tendon is followed by an immediate and quick retraction, varying from a few lines to an inch and more. A hollow is felt under the skin, indicating the unoccupied space; if the blood has accumulated under the skin, which ought, if possible, to be prevented, and which is moreover very rare, a slight bluish coloration will appear. There generally forms during the first three or four days, a slight sub-cutaneous swelling, which is not, however, inflammatory; the cavity is then filled with a concretable fluid, out of which is formed the new tissue destined to replace the tendon. The small external wound heals between the second and fourth day.

About the tenth day the plastic lymph becomes thickened, and begins to harden; the tissues in the immediate vicinity of the wound are swollen, and present to the touch the sensation of an unequal surface. Between the fifteenth and twentieth day, the new tissue becomes isolated, begins to assume its form and to get round; sometimes a sort of thick ferrule may be distinctly felt at the point where it is in the act of uniting to the superior end of the tendon. At the expiration of a month, the consolidation has become completed, and no evidence remains, except perhaps the very small cicatrix, to show that any operation had been performed. In the cases of some individuals of a lymphatic temperament, the progress of cure may be less rapid, but two months will always prove sufficient for the indicated results to obtain.

Direct experiments have been made on animals, with the view of discovering the mechanism of the reproduction of the ligamentous cord which supplies the place of the divided tendon. M. Bouvier presented to the Academy of Medicine of Paris the tendons of the extensor muscles of the foot of a dog, which had been killed thirty days after they had been divided, and which were found to have been reunited by a solid substance. The two ends of the tendon were seen to be separated about the distance of an inch, and their continuity re-established by a new fibrous tissue, which had formed in the interval. This substance presented the same form and external appearance as the tendon itself, and, like it, adhered loosely to the cellular tissue which served as its sheath, so that as far as solidity and mobility were concerned, it fulfilled perfectly all the functions of a tendon. Nevertheless it has been found from this case, and many more similar experiments, that the new tendinous substance differs from the true tendon in being of a grayish colour, and in having a more condensed texture,—so that its formation bears about the same relation to the regeneration of tendinous tissue, as the production of cicatrices of the skin does to the integuments, the true structure of which is but imperfectly replaced by them.[1]

[1] Bulletin of the Academy, 15th Oct., 1836, p. 32.

Remarkable changes are soon manifested in the member operated on; the muscles of the calf become developed, the cellular tissue is distended with fat, the sub-cutaneous veins are made apparent, the callosities become effaced, and if the deformity has not been highly aggravated, the leg gradually assumes the form and size of an originally well-shaped limb. There are, however, some persons, who are never wholly divested of all the effects arising from the deformity.

DIVISION OF THE TENDONS OF THE LATERAL PERONEI MUSCLES FOR THE CURE OF EVERTED CLUB-FOOT.

When the contraction of the lateral peronei muscles occasions *everted* club-foot, it becomes necessary, as in the case of the tendo Achillis, that they should be divided. This operation has been but seldom performed, as *everted* club-feet are of more rare occurrence, and generally not so highly aggravated as the *inverted* variety.

The rules to be observed in performing this operation are exceedingly simple; it is only necessary to refer to what has been already said with regard to the situation of these muscles, to comprehend the necessity of dividing their tendons at the distance of two or three lines above the malleolus externus; at this point they rest on the fibula, and are covered by the skin only.

Is it requisite that both tendons should be divided, or one only? It appears to me to be very doubtful whether the tendon of the peroneus *longus* can be easily cut without that of the *brevis* also. It could only be done in cases where the peroneus longus makes a very decided protuberance under the skin, and I have seen a case of this kind in a young lady of Alsace, who would not consent to have the operation performed. But even admitting the possibility of dividing one of the tendons alone, I do not think that it would be attended with success, for in almost all cases they both contribute to the developement of the disease.

The operation is reduced to merely introducing the ténotome under the skin, using it carefully on account of its great tenuity, and dividing the tendons of the lateral peronei muscles. We cannot admit the practicability of cutting them below the malleolus, as great difficulty would be experienced in dividing the fibrous tissues and ligaments which exist in that region.

DIVISION OF THE TENDON OF THE TIBIALIS ANTICUS FOR THE CURE OF CALCANIAN CLUB-FOOT.

The decided protuberance made under the skin by the tendon of the tibialis anticus in cases of calcanian club-foot renders this operation remarkably easy. No accident need be apprehended, if it were not for the possibility of dividing a venous branch which ramifies on the instep—and that would be of too little importance to cause a moment's uneasiness to the operator.

Is it necessary in cases of a simultaneous contraction of the extensor tendons of the big toe, and four last ones, to divide them successively? I have no hesitation in answering this question affirmatively, as it does not appear to me that nature would be more embarrassed in establishing this multiform reunion, than in the case of but one large tendon. I think, however, that it would be better not to divide all at the same height, in order to avoid weakening the skin too much at one point. I intend pursuing this course in the case of the patient whose feet are represented in the fifth plate.

INDIVIDUAL CASES.

Case 1.—Congenital inverted club-foot highly aggravated. Extreme youth of the child. Division of the tendo Achillis. Venous hemorrhage. Complete cure.[1]

Joséphine H——, of Plombières, was only eleven months old when I saw her. She was born with a club-foot of the right side; the misfortune occasioned in the parents great anxiety, and they most ardently desired that the deformity should be cured. I advised them to have the tendo Achillis divided. They acceded to the proposition, and the operation was performed on the 25th June, 1837. There was great deformity, the sole of the foot being very strongly inverted—the tendo Achillis hard, and retracted—opposed the restitution of the foot to its natural position. So very decided was the deviation, that I could expect to derive no benefit from the application of machines, or plaster and bandages. I concluded then to perform the operation, but it was impossible for me not to foresee difficulties, and even danger, in practising on so young a person. The imperfect developement of the parts, the position of the artery, which was felt distinctly beating against the tendon, and the size of the veins which surrounded it—were all very unfavour

[1] See plate I. fig. 1.

able circumstances: thinking, however, that I might by prudence avoid the dangers, I operated. The tendon was easily divided, but on withdrawing the instrument a stream of blood followed, which was red, and coagulated rapidly; in my emotion, I thought for an instant that I had cut the artery. The jet, however, was not intermittent, and was arrested by pressure made below the little wound. Being now satisfied as to the nature of the accident, I continued the pressure with my finger, and after expelling the blood contained in the wound, I applied a small pledget spread with cerate, and placing a long thick compress in the tibio-calcanian fossa, secured it with a bandage. I caused the child to be most carefully watched, and the first day passed without the occurrence of any accident. On the fourth day I removed the dressing, and found the little wound healed. The next morning the reducing apparatus was applied. It was only with the greatest difficulty, and minutest care that we were enabled to maintain the heel in a suitable position—this inconvenience, however, diminished in proportion as the foot became reduced. Ten days were found necessary to bring it back to its normal shape; on the thirtieth the child was completely cured. The apparatus was allowed to remain on during a longer time, however, in order to permit the foot to grow in a proper direction; it is impossible, at present, to detect by examination, which of the feet is the one that had been deformed.

This case presents as yet the only known example of the section of the tendo Achillis having been performed at so tender an age. The difficulties encountered, and the risks run, lead me to ask if it would not be more advantageous, and certainly more safe, to postpone the operation to a period when the organs shall have become more isolated and distinct? I do not hesitate to reply in the affirmative; but are there not other inconveniences attendant on delay? The aggravation of the accident with age, the difficulty and sometimes impossibility of walking, the wasting away and deformity of the leg, and, finally, the distress of the parents, are motives which ought to induce us to attempt the cure at as early an age as possible. In order to meet all these indications, I think it best to wait until the child has acquired the age of two years at least. I have followed this rule in my own practice, and think that I may congratulate myself on having done so.

Case 2.—Little girl, aged two years and a half. Inverted club-foot, with retraction of the toes on the sole, reduced in fifteen days. Cure completed in six weeks.[1]

Ida Auvert, aged two years and a half, was born with a club-foot of the right side, and no attempt was made by the relatives to lessen the deformity. When the child was presented to me, the following was her condition: Locomotion impossible, the foot strongly contorted inwards, the malleolus externus almost in contact with the

[1] See plate I. fig. 2.

ground, scarcely any heel, the calcaneum, in consequence of being drawn upwards and backwards, formed an acute angle with the tibia, the sole of the foot was very concave, the toes were bent, and could only be very slightly extended by the strongest effort.

On the 25th June, 1838, I prepared for the operation; the child, placed on its abdomen, was held on the knees of one of my assistants. I assured myself of the situation of the artery; it ran along the inner edge of the tibia, and seemed to be in contact with it—an unfortunate, and yet almost constant condition in young children. In order to avoid wounding the arterial vessel, I caused an assistant to hold the point of the foot firmly, whilst with the left hand I pushed the tendon off towards the fibula, by placing my thumb on its inner, and the index finger on its outer edge; with this last finger I also stretched the skin near the point where my instrument was to penetrate. All these precautions being taken, my *ténotome*, although introduced slowly and cautiously, divided the fibres of the tendon so rapidly that I could scarcely distinguish the projection and the noise which always accompanies the division of the last fibres. The child did not utter a single cry, and only a few drops of blood escaped.

Notwithstanding the section of the tendon, the foot remained deformed, and I was unable to reduce it entirely to a normal direction. Fearing that I might not have divided with my instrument all the tendinous fibres, I introduced a stylet into the wound, and discovered that some remained in fact untouched; they were promptly divided, and, what is very remarkable, the gastrocnemius muscle scarcely contracted at all, the result of which was that the interval between the ends of the tendon was very short. The little wound being covered with a pledget spread with cerate, a compress and bandage completed the dressing. The bandage was wound from without inwards, in order that the folds surrounding the foot might assist in bringing it back to a natural direction.

The following morning I saw with pleasure that the deformity had diminished; the child did not suffer at all. On the fourth day the extending apparatus was applied, and on raising the dressing on the sixth, I found the wound completely healed—the heel was gradually descending, and the toes becoming elongated. On the tenth day the interval between the ends of the tendon was filled up with a soft, elastic substance. By the twentieth day the foot had assumed a natural shape, and the newly made tendon was gaining its form, and becoming detached from the surrounding cellular tissue. By the thirtieth day the operation was completed, and the foot which had been progressively flexed on the leg, was removed from the apparatus on the 3d of August, the thirty-ninth day after the operation. For the purpose of completing the cure, I caused a half boot to be made with very stout stiffenings, to press and maintain the foot in a suitable position.

Case 3.—A youth of ten years. Convulsions when in fourth year. Semi-paralysis of the left arm. Retraction of the gastrocnemius muscle of the same side. Inverted club-foot very decided. Reduced in eight days. Cure completed in one month.[1]

François Leturc was a strong and healthy child; when, at the age of six years, he was attacked with acute encephalitis, complicated with violent convulsions, and the child was thought to be in a desperate state. Contrary to every expectation, however, he survived, but his left arm remained partially paralysed, and there was a very evident wasting away of the muscles; the pelvic extremity of the same side was also weakened, and the gastrocnemius muscle became considerably retracted, which occasioned the developement of a most highly aggravated case of club-foot. The malleolus externus rested on the ground, and the principal weight of the body was borne by the back of the foot, whilst the sole was directed inwards and upwards, and the toes turned backwards. It was most distressing to see this child walk, and it could scarcely be conceived why so unnatural a distention of the ligaments did not give rise to such severe pain as altogether to prevent locomotion. The calf of the leg was very thin, when compared with that of the other side, and the heel was drawn up more than two inches from the ground.

On the 20th July, 1838, every preparation having been made, the child was laid on its abdomen, and supported on the knees of its mother; an assistant seized the end of the foot, and endeavoured to flex it on the leg—the tendon was thus made exceedingly tense, and the operation was over in a few seconds. The division of the last fibres was accompanied by a very decided noise. Scarcely as many as five or six drops of blood escaped, and the child did not utter a single cry. The tendon retracted with great force, and left a subcutaneous vacuity of at least fifteen lines in length. After carefully expelling the blood, which seemed to have a tendency to accumulate between the two extremities of the tendon, I brought the edges of the wound together, and applied a pledget covered with cerate, which was supported by a compress and bandage. Notwithstanding the wide separation of the ends of the tendon, the foot was but imperfectly reduced; I was desirous of applying the extending apparatus immediately, but the pain which it occasioned forced me to remove it. These circumstances caused me some apprehension as to the success of the operation, but what was my surprise on seeing, the next morning, that the foot had been almost entirely reduced by the unaided efforts of the extensor muscles? This being the case, the reducing apparatus was now applied without difficulty. The bandage which surrounded the foot having become displaced on the fourth day, I was enabled to see that the little wound was completely healed, and the cicatrix scarcely perceptible. The place which had been left hollow by the retraction

[1] See plate II.

of the tendon, was hard and slightly swollen, and the child experienced no pain. On the eighth day the foot was completely reduced, and no trace could be detected of the previously existing deformity, except a hard callosity just over the os cuboides. On the fifteenth day a very decided protuberance was felt about the superior extremity of the tendon, and the cure was completed on the twenty-fifth day after the operation.

The spontaneous reduction of the foot in this case, caused by the retraction of the extensor muscles, is a remarkable circumstance. It was to me a useful lesson, and since that time I have been very guarded in the application of the extending machine immediately after the operation. I learned the important fact, that nature, on being relieved of the obstacles which opposed the normal developement of the foot, would endeavour instantly to restore to the parts their proper position, and that she would attain this end gradually, and without any violent exertion: the deformed parts, also, not being compressed, would be less exposed to violent inflammation, which might occasion deplorable consequences.

This case serves still further to show the facility with which accidental club-feet may be restored; so decided a case of the congenital form, as that of young Leturc, would have required months of treatment, and it is even doubtful whether it could ever have been completely cured.

Case 4.—Double congenital club-foot. Child five years of age. Operation. Opening of a vein. Reduction of the feet in fifteen days. Cure completed in a month.[1]

Charles de L——, aged five years, was born with both feet highly deformed; the mother affirmed that she had experienced no extraordinary pain, or noticed any particular sign during the period that she was pregnant with this child, but that she had, on the contrary, suffered much more during two consecutive pregnancies, both of which terminated in the birth of daughters.

When Charles de L—— was brought to me, I was surprised to see the extreme deformity of the members—the feet overlapped, and their external edges rested on the ground, while the heels were forcibly everted—the tibiæ were bent, and one of the patellæ thrown on the inside, and the other on the outside of the articulation of the knee. The right foot was more deformed than the left; the malleolus internus did not protrude at all, and the astragalus seemed to have entirely abandoned the tibio-fibular cavity. Hard and painful callosities existed on both feet; locomotion was accomplished with great difficulty, and falls were of very frequent occurrence. I did not hesitate, notwithstanding these unfavourable circumstances, to operate on the child, and the section of the tendo Achillis was made on the 5th of August, 1838. The child was

[1] See plate III.

laid on the lap of an assistant, and the right foot was extended and held firmly by a second assistant, whilst I divided the tendon from the outer side. The operation was over in a few seconds, but on withdrawing my instrument, it was immediately followed by an abundant stream of red blood, eight or nine ounces of which escaped instantly. I was soon satisfied, from the character of the jet, that the accident would not prove serious, but I determined never again to perform the section of the tendon from the *outer side;* indeed this is now one of my principal rules in performing the operation.

The jet of blood was stopped by pressure made with the thumb above the wound. The skin having been cleansed, I applied my little pledget and compress, then a second long compress doubled into folds, and placed in the calcaneo-fibular fossa; a bandage secured the whole.

No peculiarity was presented by the other foot, and scarcely as many as five or six drops of blood escaped.

This double operation was attended with no accident; during the first day there was some slight agitation—this, however, was soon calmed by a long and refreshing sleep.

On the fifth day after the operation, I applied the reducing machine. The greatest difficulty was experienced in reducing even slightly the anormal direction of the feet; the bones, more especially those of the right foot, had deviated so much, and the tibio-fibular articulation was so narrow, that doubts might justly have been entertained of complete success.

Nevertheless, after eight days of anxious vigilance, and efforts made to oppose the elevation of the heel, the conformation of the feet was found to have undergone considerable amelioration. The reduction was complete on the fifteenth day, except on the right side, where the astragalus still protruded slightly. The cure was terminated at the fifth week. The child did not experience the slightest inconvenience during the whole course of treatment.

CASE 5.—Accidental phalangian club-foot. A little girl nine years of age. Division of the tendo Achillis. Reduced in six days. Cured in one month.[1]

Ann Marie J—— was born, perfectly well formed, on the 2d of July, 1828; when one year old she upset a kettle full of hot milk, which occasioned a burn involving the lower extremities in nearly their whole extent. A violent fever, and other serious consequences, endangered for a time the life of the child. An evident amelioration, however, was manifested; when she commenced cutting four large teeth, a renewal of the fever was occasioned, and convulsions supervened. The child endured these accumulated evils, and after many vicissitudes during convalescence, got well. The relatives

[1] See plate IV.

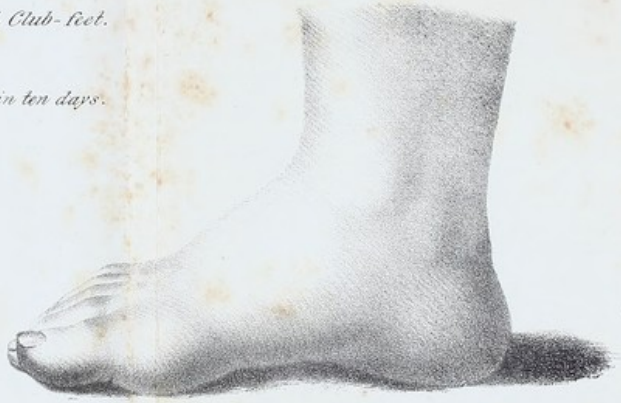
were not long in perceiving that the right leg was shorter than the other; the heel was drawn up, and the foot rested on the ground only by the toes—locomotion was very difficult, and was accomplished only by decided limping. At this time I saw the child; its health was good, and I had no hesitation in proposing the operation. It was performed on the 5th of March, 1837; no accident happened, and the foot was reduced with incredible rapidity—by the sixth day after the operation it had resumed its regular form. The machine was allowed to remain applied for a month, after which time the cure was fully accomplished. Time has not weakened this prompt and remarkable success.

CONTENTS.

Inverted Club-feet.

Fig. 1st

Reduced in ten days.



Reduced in fifteen days.

Fig. 2nd

Inverted Club-foot.

Reduced in fifteen days.

On Stone by A. Hervieu.

P. S. Duval, Lith. Phila.

Double inverted Club-feet.

Reduced in Fifteen days.

Phalangian Club-foot.

Reduced in six days.

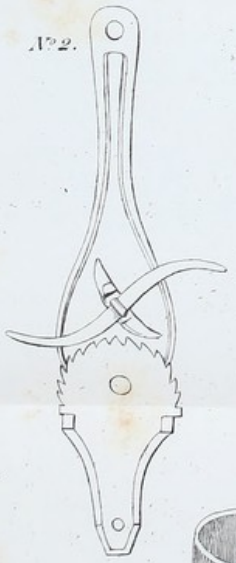
P.S. Duval, Lith. Philad.ª

Calcanian Club-Feet.

Models of Ratchets.

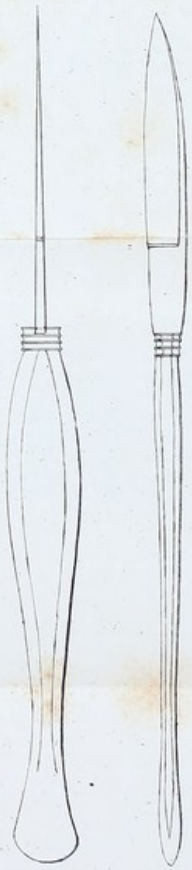
Nº 1.

Nº 2.



Reducing Apparatus.

Tenotome.



P.S. Duval, Lith. Phila.