ON CONGENITAL HIGH SCAPULA.

A Consideration of Four Cases, in One of which were Absence and Defect of Ribs and a Lumbosacral Hypertrichosis.

By DAVID M. GREIG, C.M., F.R.C.S., Surgeon, Dundee Royal Infirmary; Lecturer on Clinical Surgery and Surgical Diseases of Children, St. Andrews University, &c., &c.

Congenital high scapula, sometimes erroneously referred to as congenital high shoulder, otherwise known as scapula alta congenita, Sprengel's deformity, is altogether a rare abnormality. The first term is the most correct, and preferable as it conveys to the mind with accuracy the condition it describes. The term "Sprengel's deformity" is objectionable, because meaningless to the uninitiated, and requiring an effort of memory for its recollection, and as shedding on Sprengel a lustre to which he is scarcely entitled, for though Sprengel described the condition from his own observation in 1891, it had previously, though briefly, been described by M'Burney in 1888, while some hold that Willett and Walsham's was the pioneer case in 1883.

The association of congenital high scapula with other deformities is a recognised fact, but the association with such an abnormality as is indicated by the title of this paper is uncommon. A priori one would not be surprised to find congenital displacement of the scapula have, in principal or subsidiary relation, some defect of the shoulder girdle or of the ribs, but such indeed is not the case, and in the majority the scapular is the only defect. To illustrate the condition of congenital high scapula I give the following four cases which have been under my observation for various periods:

Case I.—A female child, aged 9 months, presented a deformity which at the first glance appeared to be merely an increased deposition of fat passing from the nape of the neck towards the left. On closer examination this proved to be the spine of the scapula, its undue prominence being accounted for by the fact that the entire bone was placed higher on the left side than on the right. The left scapula was smaller and angled, so that the supraspinous fossa looked more directly upwards than normal, and was placed in the neck. There were no cervical ribs. A marked
Fig. 1.—Congenital high right scapula. Female, aged 4 years (Case II).

Fig. 2.—Congenital high right scapula. Male, aged 7 years (Case III.).
dimple* was present in the skin at the vertebral border of the scapula, midway between the root of the spine and the inferior angle. The birth of this child had been in every respect natural.

Case II.—In a girl of 4 years (Fig. 1) the deformity was accidentally noticed only two months previously while she was being bathed. The right scapula was smaller than the left, raised towards the neck, with a slightly oblique inclination, and the subscapular angle was increased. Movements were full and perfect, and the child had no other deformities. She was an only child of healthy parents. As no inconvenience is caused by the deformity, it is not to be wondered at that early recognition of its existence seldom occurs.

Case III.—In a boy whose birth was a “cross-birth” no deformity was noted, and he was 2 years and 5 months old when the existence of congenital high scapula was pointed out by a nurse, whose presumably trained powers of observation enabled her to notice the inequality of the shoulders. In this child (Fig. 2) there was fulness in the right side of the neck, the right scapula was higher than the left by three-quarters of an inch, and slightly smaller. All movements were full in extent and free, and there was no other abnormality present.

In what literature of the subject I have examined—and the literature of this deformity is now fairly extensive—there is no evidence that any accident at birth or abnormal presentation has causal relation to congenital high scapula. With very young children, accuracy of measurement, thoroughness of examination, and leisurely comparison of the two shoulders is fraught with difficulty, and it is from the examination of older children or adults that one has to gather the anatomical characteristics.

The following case, shorn of its concomitant anomalies, illustrates well in detail the abnormalities of position and configuration which characterise congenital high scapula.

Case IV.—A female, aged 12 years, a healthy and intelligent child, at present employed as a “shifter” in a jute mill, was referred to me on account of asymmetry of the shoulders. She was of good family history, her parents being well. She is the seventh of ten, of whom two are dead—one of measles and one still-born. The

* Dimpling of the skin seems to be in frequent association with congenital deformity of bones. I have seen it in several cases in various parts of the body.
others are well and strong. Her birth was normal and her mother received no professional assistance. During infancy she had three attacks of "inflammation" of the lungs or bowels. She walked at sixteen months, and talked as early as the other children of the family.

When 3 years old she was knocked down by a cab but scarcely hurt. She was not laid up nor confined to bed, and the police surgeon stated that the injuries were trivial and that no bones were broken. It appears, however, that the critical parental examination at this time first disclosed the deformity, which was consequently ascribed to the accident.

On examination she was observed to have a slightly Mongolian cast of countenance, and to be undersized. There were evidences of approaching puberty. Stripped, she presented three developmental defects (Fig. 3):—(1) Congenital high left scapula; (2) defective upper left ribs; (3) hair-field over sacrum.

To take these in detail. 1. Congenitally high left scapula was obvious at a glance (Fig. 4), on account of the very striking asymmetry of the shoulders, the left being much the more elevated. Both scapulae were well defined, and the right normal in size, shape, and position. The inferior angle of the left scapula stood out more distinctly than the right, and when the arms were held straight forward the whole vertebral border was thrown into relief as in the so-called "dislocation of latissimus dorsi." Not only was the scapula raised in the neck, but it was tilted, so that the superior internal angle approached the clavicle and the inferior angle was thrown backwards, and this was again accentuated by the increase of the subscapular angle. The scapula was rotated on its sagittal axis so that its lower extremity came nearer the spine. The clavicles were equal and normal, but the entire left scapula was dwarfed. Its vertebral border measured 5 inches as compared with 6½ on the right, and the other dimensions appeared to be proportionally diminished. The inferior limit of the left scapula in rest lay at the angle of the fourth rib. Raising the extended arms above the head she did so equally as far as the level of the shoulders, but on continuation of the movement she had difficulty in quite raising the left, and tried to counteract the deficiency by voluntarily producing a marked lordosis. Nor could she bring the raised left upper extremity so near the mesial plane, nor draw it quite so far back. This defect in movement may perhaps be more clearly expressed thus: standing erect, without any exertion, she could raise the extended right arm till it touched
Congenital high left scapula. Female, aged 12 years (Case IV.), General view and showing lumbosacral hypertrichosis.

Fig. 3.—Congenital high left scapula. Female, aged 12 years (Case IV.), General view and showing lumbosacral hypertrichosis.

Case IV., showing relative positions of the scapulas and the obliquity and dwarfing of the abnormal one.

Fig. 4.—Case IV., showing relative positions of the scapulae and the obliquity and dwarfing of the abnormal one.
Radiogram of Case IV showing defect in ribs. The relative position of the scapula is observable.

Radiogram of Case IV showing defect in ribs. The relative position of the scapula is observable.

Lumbosacral hypertrichosis in Case IV, showing the extent and quality of the hair.
the pinna, but on the left side the arm could not be brought within a couple of inches of the pinna, nor backward beyond the level of the eye.

2. Defective development of the upper ribs was found on the left side of the chest during the examination of the scapula. The presence of this abnormality was evidenced by a marked hollow of the chest wall in the axilla, and the radiogram (Fig. 5) showed that this was due to complete absence of the third rib, that the fourth rib was represented by a mere shred of bone passing from the neighbourhood of the third dorsal intervertebral disc to fuse with the fifth rib in front of the angle, and that the fifth and sixth ribs were continuous at their angles. There was practically an absence of two ribs, represented by a retrogression of the thoracic wall of the axilla, but that part had due resistance, and there was no tendency to hernia of the lung. The defective ribs were probably adequately represented by fibrous tissue. Apparently in consequence of this costal deformity there is slight scoliosis with a little rotation.

3. There was also present in the patient a well-marked hair-field (Fig. 6), somewhat triangular in shape, with the apex pointed downwards, and situated at the posterior commencement of the cleft of the nates. It was 5 inches broad at its base, which lay over the last lumbar vertebra. The area was covered, but not thickly, with soft silky hairs, the longest of which measured quite 5 inches. There was no bony defect to be made out underlying this hair-field.

Six years have elapsed since the above notes, with the accompanying photographs, were taken, and the deformities remain *in statu quo*. The girl is bright, active, and healthy, and the abnormalities do not interfere with her work, but her diminutive stature seems to be more accentuated as her age increases.

There is abundant proof that the deformity does not interfere with ordinary avocations, though it relieves from military service on the Continent. Vorobyeff\(^2\) publishes two cases from the Military Hospital of Kiew, where the subjects were exempted service though each was quite able for ordinary work, one being an agricultural labourer, the other's employment not specified.

The etiology of congenital high scapula is by no means obvious. Different theories have been advocated by different writers, but none has been generally accepted. "Hereditary tendencies" is not an explanation—indeed it is the case that such are rarely found. The family history in each of my cases, for example, was particu-
larly good—not even a suspicion of neurosis. Abnormal position of the arm during parturition might lead to injury, but not to the defect under consideration. To ascribe the condition to foetal rickets when there is no other evidence of rickets, and where, if there were, the same condition would apply to both scapulae, is but an incompetent suggestion.

Ballantyne places the causal theories very succinctly. "Some authors," he writes, "have placed it in the same category with torticollis as a result of primary muscular defects; others looked for an intra-natal cause, such as traumatism during labour; others suspected a malformation of the scapula, a suspicion strengthened by one of Bar's specimens examined by Kirmisson; and yet others found it in deficient quantity of liquor amnii and dorsal displacement of the arm during foetal life." Ballantyne himself concludes that it is "sometimes, at least, of embryonic origin."

Kirmisson more recently admits that the causation is still doubtful. He acquiesces with Ballantyne apparently in admitting that it may be attributed to "a survival of the elevated position of the bone in the lower part of the neck during embryonal life; it is, in a word, an arrest of development."

There can never be a clear understanding as to the nature of the deformity until a distinction is made between high scapula and high shoulder. The scapula is not the shoulder, and only confusion can result if an abnormality of the bone be spoken of as an affection of a region. It is impossible to insist too strongly on this. In congenital high scapula obvious defects in the muscles are rare, but one must remember that the muscles, acting at a certain disadvantage on account of the scapula's position, may not be fully developed. High shoulder is a generic term, and would include high scapula. High shoulder may be congenital or acquired, and with it we have nothing to do; but in discussing the etiology of congenital high scapula there is no use in complicating the issue, as Bender has done, by dragging in the consideration of acquired high shoulder. It is recognised that such a deformity may follow tuberculous or other inflammatory conditions, and that some arrest of development may result, or atrophy of bone may follow from want of use, while the position of ankylosis in "caries sicca" might tilt the scapula and produce a high shoulder.

Congenital high shoulder may be due to the presence of cervical ribs or be a mere symptom of congenital scoliosis, a condition primarily due to defective or excessive development of the dorsal vertebrae. It is true that congenital high scapula is com-
Congenital High Scapula

Commonly associated with a slight scoliosis; that exists in about half of the published cases, but the scoliosis is incommensurate with the scapular displacement, and though it might exaggerate, could not cause it. Such scoliosis, whose convexity is almost invariably directed to the affected side, does not tend to increase as years go on. What appears to be a very marked "secondary kyphoscoliosis" is so radiographically figured by Müller that one doubts if the case were uncomplicated elevation of the scapula, and he makes no reference to it in his text.

Kayser, in recording a case which came under his observation, classified congenital high scapula into four groups:—

1. Where there is a bridge of bone between the vertebral border of the scapula and the spine;
2. Where there is complete absence of one or more muscles forming the shoulder girdle;
3. Where there is a long and everted supraspinous portion of the scapula;
4. Where there is no osseous bridge and the scapula is normal or smaller than usual, with short or otherwise defective muscles;

and states that "the great majority of recorded cases fall under the last group." It seems doubtful to me if these should be placed together, as in the first three classes the position of the scapula is secondary to some obvious primary defect, for congenital high scapula is a condition in which the scapular misplacement is the primary defect, and may be alone, but if in association, it cannot be accounted for by any of the other developmental defects which may be present. I would exclude cases of displaced scapula due to bony union between the vertebral border and the spine. Stiles records such a case, and the case is by no means unique; but here the developing scapula is retained in the neck by the abnormal process of bone which attaches it to the vertebra and prevents its descent, and the scapular displacement is secondary and easily explained, and not to my idea to be classed with true primary congenital high scapula. Marked torticollis produces a slight elevation of the shoulder, but it is merely secondary to the more important lesion. In Vorobyeff's second case the subject of the deformity had been in early life operated on by Billroth of Vienna for torticollis. The shoulder may have been lowered, but the high scapula remained the same.

Cases of absence of the trapezius muscle have been recorded, and it is noticeable that in these circumstances the shoulder
deformity is a depression of the scapula, not an elevation. In like manner a traumatism to the brachial plexus, causing induration in the neck at the site of injury and paralysis of the arm, produced a displacement of the scapula downwards and away from the spine. Horwitz points out that the scapula in its development is a cervical and not a dorsal appendage. He agrees with Sprengel that excessive intra-uterine pressure, due to lack of amniotic fluid, is a primary factor in the causation. Could the observation be trusted, a case shown by Riolan would be unique as regards its origin. The deformity was present in a boy, aged 11 years, in whom “during an attack of whooping-cough when a year old the deformity suddenly appeared and has remained without change since.” Then follows a description of typical congenital high scapula. There was no paralysis in any of the muscles but a very slight degree of degeneration in the fibres of the trapezius. Riolan considered the deformity due to paralysis of the serratus magnus, permitting unrestricted contraction of the opposing group, viz. the rhomboids and levator scapulae, and that later a contraction of the trapezius took place. Professor Starr considered it due to primarily, haemorrhage; secondarily, sclerosis at the fourth and fifth cervical segments of the spinal cord. Considering how unobservant parents are of congenital defects, one hesitates to accept the sudden onset but not the sudden discovery of the condition.

One cannot pass over without consideration the explanation that congenital high scapula is due to an affection of the trapezius muscle, where the lower fibres are deficient in development or innervation, and the upper fibres are more or less in spasm or contraction. Both Brown-Séquard and Hughlings Jackson favour the theory of a paralysis of the lower fibres of the trapezius, but it must be granted that this is rarely obvious, and in the great majority of cases certainly non-existent. Pischinger found nothing abnormal in the muscles in three cases examined by him, nor in their electrical reactions. There is a sufficient difference of opinion about the importance of the muscular affection to make one sceptical of its value. There was no muscular defect in any of my cases.

In nearly all the cases there is recorded some alteration in the size and shape of the high scapula. It is rare to have co-existing abnormality in any of the other bones of the shoulder girdle. Virden notes that in a woman, 30 years of age, the clavicle on the affected side was “straighter and an inch shorter” than its
Congenital High Scapula

fellow, and a similar shortening, though less marked, was found in Travers Smith's case. M'Burney on the other hand, in a woman of 23, noted that the clavicle on the affected side was "at least one and a half inches longer," and there was no paralysis of the scapular muscles.

The existence of congenital inequality in the corresponding bones of the two sides of the skeleton is too well known to require more than mention, and in the living subject these inequalities are mostly exemplified by measurements of the limbs. It is not common to find, however, that there is a measurable discrepancy in the size of the two scapulae. Yet such occasionally occurs. For instance, I recently saw a young lady, 19 years of age, who, complaining of some vague and indefinite pains, was afraid of developing a scoliosis such as an elder sister had. Her fears, however, were perfectly groundless, and the discomfort she complained of was apparently due to anemia and some gastric disturbance. On examination the spine was found to be perfectly straight and of normal mobility. While the shoulders were of the same level, the inferior angle of the left scapula was an inch higher than that of the right, and this was accounted for by the vertebral border of the left being an inch smaller than that of the right. The superior internal angles of both scapulae were on the same level, and each bore normal relations to each other and the thorax. Curiously enough a similar inequality existed between the osa innominata, the left being less developed than the right and the left trochanter major consequently less prominent. This observation accentuates that variation in level of the two scapular angles is not necessarily indicative of high scapula.

An ill-developed scapula is one in which there is a want of depth at the deepest part of each fossa, that is, at the root of the spinous fossae on the dorsum and of the subscapular angle in the venter. Along with this, none of the three muscles is so well developed or so thick as it should be, and consequently acts less effectively on the head of the humerus than fully developed muscles would.

According to Pischinger, in every one of 17 cases collated by him the raising of the arm above the horizontal plane was restricted, but to a marked degree in only two cases, and in none was there any record of anomaly either of structure or electrical reactions of muscle. It seems readily comprehensible that muscles acting at a disadvantage, on a misplaced and possibly malformed bone, will not produce their normal effect in fulness of movement
of the parts on which they act. The imperfect movement upwards in the horizontal plane is therefore not to be wondered at, and there is no need to look for inherent muscular defects to explain it.

Multiplicity of congenital defects is common, and there is nothing to be gained by tabulating the numerous congenital defects co-existing with high scapula. The deformities may be in no way related to each other but merely demonstrative of the intra-uterine "Belaustungs difformität."

Of the many and various abnormalities which accompany congenital high scapula, absence of ribs is certainly one of the rarest. There is, indeed, no causal relation between the two. Almost an exact counterpart of my fourth case has been published by Whipham,\(^1\) where in association with congenital high left scapula is a slight sinistro-convex dorsal scoliosis, and the third rib takes a sloping course downwards while the fourth and fifth are rudimentary. As in my case, too, there were other less usual abnormalities. The similarity between Whipham’s illustrations and Figs. 4 and 5 of this paper are most striking. There is not in either case any structural defect of the vertebrae. In Willett and Walsham’s\(^2\) “Congenital Malformation of the Spinal Column, Bony Thorax, and Left Scapular Arch,” the scapula was connected by bone to the sixth cervical vertebra, there was a cervical which fused with the first rib, and the fifth, sixth, eighth, and ninth dorsal vertebrae were absent with several ribs on both sides. Their observations made by dissection and on the macerated specimen are most interesting, and, of course, detailed to an extent that cannot be attained by examination of the living subject.

Absence of ribs associated with absence of vertebrae is mentioned also in a case reported by Porter.\(^3\) Absence of several ribs is recorded by Gage\(^4\) in a girl of 17, with consequent scoliosis but no elevation of the scapula. The sixth to the tenth ribs were wanting on the left side, and there was "a hernia of the stomach," especially on coughing. Perhaps this indicates some defective musculature of the abdominal wall, a condition which I have seen in an infant, and which allows of protrusion of the abdominal viscera on straining—a variety of gastroschisis less common than exomphalos. It is not unusual to find absence of ribs predisposing to hernia of the viscera, thoracic or other. In the discussion which followed Gage’s paper, Willard of Philadelphia stated that he had observed a girl of 13 with absence of the anterior portion of the upper six left ribs outside their costal cartilages. Partial seems more common than complete absence,
and the defect is commoner anteriorly than posteriorly. Radiographic examination is most necessary, for it is impossible to differentiate by digital sensation the rib ends from the membrane. In Förster’s *Missbildungen des Menschen*, quoted by Levy, occurs the following passage:—“Finally, clefts in the thorax may be sometimes caused by defects of the ribs, in that several ribs of the one side may be wanting from the mid-point onwards, and the gap thus formed being closed by a firm membrane. It is the anterior portions of the ribs that are wanting, together with the rib cartilages. Sometimes the rib ends are not quite absent, but the ribs, the posterior portions of which are perfect, are continued forward as riband-like bands.” It is these “bands” which prevent hernia. In Levy’s case the deficient development of the third and fourth ribs was associated with absence of the sternal portion of the pectoralis major. A similar case, but with complete absence of the pectoralis major, is recorded by Jefferiss. The absence of muscle does not necessitate absence of ribs, and the converse is equally true. By far the greater number of muscular defects occur in the breast muscles. John Thomson points out that of 89 recorded cases of absence or defect of thoracic muscles, in 24 the cartilages, ribs, or both were implicated. The defect in his case, like that in Carter’s, is of the slightest as regards the ribs, the third rib stopping short of its cartilage and leaving a small space unsupported by bone. Young reports a female, aged 21, with “weakness in the left side and scoliosis.” There was complete absence of the ninth left rib, with a slight lateral curvature, but a large hernial protrusion between the eighth and tenth ribs, especially posteriorly. She had a dense imperforate hymen and entire absence of uterine organs and vagina. Hernia is more apt to be found in association with defect of the lower than the upper ribs. Murray’s case illustrates this. A male, aged 5 years, had absence of the eighth, ninth, and tenth left ribs, deficiency of eleventh, but overgrowth of the twelfth rib. Through the two-and-a-half-inch space in the thoracic wall the spleen could be distinctly felt, and, was protruded into the aperture when the child coughed.

The interesting points brought out by a consideration of these and other cases are:—(1) There is no relationship between congenital high scapula and deficiency of ribs. (2) Deficiency of ribs in the upper part of the thorax is unassociated with hernial protrusion of viscera. (3) Deficiency of ribs in no way impairs vitality or ability.

The hypertrichosis, which is the third anomaly presented by the case specially under review, is a comparatively common con-
dition, and though found in any part of the body is frequent over the sacral or lumbosacral regions. It is not always so pronounced as in my case. Such hair-fields are characterised by the presence, over localised areas, of a profusion of hair. The hair is generally softer and silkier than natural, and is often deficient in pigment, as compared with the subject's natural hair. Lumbosacral hypertrichosis is of interest teratologically, because it is associated not infrequently with a spina bifida showing as a tumour, or with a spina bifida occulta evidenced by defect in the subjacent bones but without protrusion of the membranes of the cord. It is commonly associated, as in my case, with other developmental defects. As such, it may be looked upon as a stigma of degeneracy. It is curious to find it present in a case of a female cretin with myxœdema (Fusari, quoted by Portugaloff\textsuperscript{30}), a disease in which sparseness of hair is the rule. Any congenital tumour may be associated, especially at its base, with a condition of hypertrichosis. It is usual that a spina bifida tumour itself is hairless, and this doubtless explains the bald spot in the centre of a lumbar hypertrichosis associated with spina bifida occulta recorded by Voelcker\textsuperscript{32} while in Portugaloff's case\textsuperscript{30} the actual hair-field was surrounded by skin which was abnormally smooth and quite free from hair. These hair-fields are to be distinguished from hairy moles, in which there is much more pigmentation, and in relation to which various neoplasms, such as melanotic sarcoma, are liable to take origin. In relation to co-existing congenital defects one would exclude such as depend entirely on the involvement of the spinal cord. It is the case that serious spinal lesion may exist in a spina bifida occulta where there is no tumour and where the vertebral defect can only be made out by palpation (Hagenbach-Buchardt\textsuperscript{31}), and it is interesting to note that operation and the division of intra-spinal bands or removal of exostosis has been followed by encouraging improvement.

It is usual for a practical surgeon to bring any communication to a close by a reference to treatment. In pure congenital high scapula there is no treatment to be adopted, for no treatment can be efficacious. The deformity interferes little with appearance, and practically not at all with usefulness and ability, and indeed the question of treatment would never obtrude itself were it not that the condition is so frequently confused with deformities brought about by inflammation or disease, and with other congenital anomalies which, as I have endeavoured to point out in my paper, ought to be and must be distinguished from true congenital high scapula.
References.—1 Bender, O., “Zur Aetiologie des Schulterblatt höchstandes,” Münch. med. Wochenschr., 17th February 1903. 2 Vorobyeff, A. A., “High Scapula,” Russk. Viach St. Peterburg., vol. iii. p. 1179, St. Petersburg, 1904. 3 Kayser, C. R., “Congenital Elevation of the Scapula,” Clin. Soc. Trans., London, vol. xxxviii. 4 Horwitz, A. E., “Sprengel’s Deformity,” Amer. Journ. of Orthop. Surg., November 1908. 5 Riolan, J., New York Med. Rec., 13th September 1890. 6 Jackson, Hughlings, Trans. Med. Soc., London, 17th December 1888 (reported Lancet, London, 22nd December 1888). 7 Virden, J. E., “A Case of Congenital Displacement of the Scapula,” Pediatrics, vol. vii. p. 351, 1899. 8 Smith, Travers, An Atlas of Illustrations of Clinical Medicine, Surgery, and Pathology, New Sydenham Soc., f. 20, London. 9 McBurney (New York Surg. Soc., 25th April 1888), New York Med. Journ., vol. xlvi. p. 582, 1888. 10 Pischinger, Münch. med. Wochenschr., vol. xlv. p. 1471, 1897. 11 Warren, R., Rep. Soc. Study of Dis. in Children, vol. viii. p. 56, London, 1908. 12 Robinson, H. B., Rep. Soc. Study of Dis. in Children, vol. ii. p. 238, London, 1902. 13 Whipham, T. R., “A Case of Congenital Deformities,” Rep. Soc. Study of Dis. in Children, vol. vii. p. 5, London, 1907. 14 Ballantyne, J. W., Manual of Antenatal Pathology and Hygiene, p. 469, Edinburgh, 1904. 15 Schlange, Deutsch. med. Wochenschr., vol. xvii. p. 1383, 1891. 16 Kirmisson, E., Traité des maladies chirurgicales d’origine congénitale, p. 490, 1898. 17 Sprengel, “Die angeborene Verschiebung des Schulterblattes nach oben,” Arch. f. klin. Chir., vol. xili. p. 545, Berlin, 1891. 18 Kirmisson, E., A Handbook of the Surgery of Children (trans. J. K. Murphy), p. 219, London, 1910. 19 Greig, D. M., “A Case of Congenital Scoliosis Due to the Interposition of Half an Extra Vertebra associated with a Thirteenth Rib,” Edin. Med. Journ., September 1910. 20 Willett, A., and Walsham, W. J., “Congenital Malformation of the Spinal Column, Bony Thorax, and Left Scapular Arch,” Trans. Med. Chir. Soc., vol. lxiv. London, 1883. 21 Gage, H., “Congenital Absence of Five Ribs with Resulting Deformities,” Trans. Amer. Arthrop. Assoc., vol. ii. p. 233, Philadelphia, 1889. 22 Levy, A. G., “A Case of Arrested Development of the Third and Fourth Ribs,” Brit. Med. Journ., 1883, vol. i. p. 1150. 23 Jefferiss, F. B., “A Case of Incomplete Development of the Third and Fourth Ribs,” Lancet, London, 1900, vol. i. p. 1437. 24 Thomson, J., “Ona Form of Congenital Thoracic Deformity,” Teratologia: A Quarterly Journal of Antenatal Pathology, Edinburgh, January 1895. 25 Carter, D. B., “Rib Defect in a Fetus,” Lancet, London, 1884, vol. ii. p. 306. 26 Young, J., Trans. Edin. Obstet. Soc., vol. xii. Edinburgh, 1887. 27 Murray, J., “A Case of Deficiency of Ribs,” Clin. Soc. Trans., London, vol. xxix. p. 252. 28 Kalischer, S., “Ueber angeborene Muskeldfeekte,” Neurolog. Centralb., No. 15, p. 655, August 1896. 29 Porter, J. L., “Congenital Absence of Ribs,” Arch. of Pediat., p. 454, 1908. 30 Portugaloof, N. Y., “Lumbosacral Hypertrichosis,” Obcrz. psychiat. neurol., etc., St. Petersburg, No. 8, p. 598, St. Petersburg, 1903. 31 Hagenbach-Buchardt, “Spina Bifida Occulta,” Correspondenz-blatt f. schweizer Aerzte, No. 16, p. 541, 1904. 32 Voecker, Fr., “Spina Bifida Occulta,” Naturhistorisch-Medizinischer Verein, Heidelberg, 30th June 1903; Münch. med. Wochenschr., 13th October 1903. 33 Müller, G., Die Orthopädie des praktischen Arztes, p. 147, Berlin, 1910. 34 Stiles, H. J., “Congenital Elevation of the Scapula,” Trans. Med. Chir. Soc. Edin., vol. xxii. p. 204, Edinburgh, 1904. 35 Drew, D., “Injury to Brachial Plexus,” Proc. Roy. Soc. Med. (Sect. Study Dis. in Children), vol. iv. No. 1, p. 8, London, November 1910.