

this the figures showed the variations usually met with in healthy persons. The normal totals are generally considered as ranging between 50 and 500 per cubic millimetre. In this patient the minimum (after the first three days) was 67 and the maximum 668; this was the only occasion on which the number 500 was exceeded, except in October, 1905, two years after the operation, when 555 were met with. We may fairly consider the counts as being quite normal in this respect and the absence of the eosinophiles during the first three days is, as has been pointed out above, not peculiar to cases of splenectomy.

The mononuclear cells.—We had hopes that a careful analysis of the mononuclear leucocytes, in the early period especially, might throw some light on the relations of these cells to one another and to this end we prepared a careful list of all the varieties of lymphocytes, hyaline cells, transitional cells, &c., met with. These were arranged under ten headings, the grouping being facilitated by careful micro-metric measurements where necessary. The labour expended in the preparation of this table was very great and an inspection of our results led us to the opinion that no valid conclusion could be drawn from it, so that we have stated our results on ordinary lines and have not given this extended table. We found that there was no sort of sequence in the results which we obtained in this way, a form of leucocyte which occurred in large numbers in one day being entirely absent on the next.

An inspection of Tables II. and III. will show that the lowness of the total numbers of the lymphocytes which occurred immediately after the operation was due mainly to the scarceness of the small forms, of which there were less than 900 present, whereas the large lymphocytes and hyaline cells were in normal amount. For the next four days the small lymphocytes increased, reaching 3805, four times their initial number, whereas the large lymphocytes fell to 40 and the hyalines to 70. Then the reverse process occurred and the small lymphocytes showed a general downward tendency, though usually remaining within normal limits, whilst the larger forms, the large lymphocytes and the hyalines, showed a very decided rise. For example, on Dec. 3rd the small lymphocytes were 1200, a little above the normal minimum of 1000, whilst the large lymphocytes were 4100, about five times their normal maximum, and the hyalines 1700, their normal maximum being about 400. The predominance of large forms was a marked feature of this period, a period which, we may note, though without attempting to draw any inferences therefrom, roughly coincided with that showing signs of great stimulation of the bone marrow.

We noticed one cell which is rarely, if ever, seen in normal blood in films taken about this period. This was a very large cell, attaining nearly $20\ \mu$, which in general appearance and staining reactions resembled large hyaline cells, but which had nuclei as contorted as those of polynuclear leucocytes. They occurred scantily and were counted as hyaline cells. They were entirely devoid of granules.

The last stage shows merely an increase of the small forms, the large lymphocytes and hyaline cells being normal (October, 1905, and December, 1906).

In our opinion it would be idle to attempt to draw any conclusions as to the site of origin of the mononuclear cells from these figures. We may, however, draw attention to the fact that in the first two counts after the injury the lymphocytes were decidedly low, though not below the lower normal limit (see Chart III.). At this period they commenced to rise and this rise was fairly parallel to the enlargement of the lymphatic glands, which was first noticed on Nov. 27th and had disappeared entirely by Dec. 7th. It is possible that this early rise is due to these glands taking on unusual activity and increasing their output of lymphocytes, the number of which is reduced owing to the absence of the spleen. It seems clear that this early rise (from 1570 on Nov. 27th to 3890 on Dec. 29th) is not due to any increased output from the bone marrow, since at this time the number of polynuclears was decreasing, suggesting that the stimulation of the tissue was diminishing. At the same time, we have seen reason to believe that what I have called the "secondary rise" in which the lymphocytes took part (from Dec. 1st to Dec. 11th, or thereabouts) was due to increased activity of the bone marrow. If any importance is to be attached to these observations they would go to prove the usually accepted view that the

lymphocytes arise from all three structures—bone marrow, lymph glands, and spleen.

[In addition to the references given throughout this article see Simpson, Transactions of the Clinical Society of London, vol. xxxix., 1906, and Harrison and Eve, Brit. Med. Jour., vol. i., 1906, p. 320.]

A CONSIDERATION OF SOME SYMPTOMS WHICH MAY BE PRODUCED BY SEVENTH CERVICAL RIBS.

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AN accessory rib, or pair of ribs, springing from the seventh cervical vertebra, are developmental anomalies with which all are familiar, but I venture to think that the characteristic symptoms to which they sometimes give rise are by no means so widely recognised. In these circumstances it seems worth while recording 16 cases which I have been able to collect and which illustrate the condition. Though cervical ribs produce definite vascular symptoms I wish chiefly to draw attention to the result of pressure, by these accessory ribs, on the brachial plexus. The class of cases to which I am about to refer has been described before on several occasions. Lewis Jones,¹ so long ago as 1893 in a paper published in the St. Bartholomew's Hospital Reports of that year, recorded several instances of symmetrical atrophies affecting the hands and occurring in young people. He gave a full clinical account of these cases, and they correspond closely with my series. At that time he ascribed them to the result of a neuritis, and did not suspect a seventh cervical rib as a possible exciting cause. It was Thorburn² who really first brought prominently forward the association of hand atrophy, resulting from pressure on the brachial plexus, with a seventh cervical rib in a communication to the Royal Medical and Chirurgical Society, published in the Transactions for 1905. In his paper he gives a description of four cases which had been under his observation and treatment, in two of which subjective sensory symptoms predominated; in the other two muscular wasting and sensory loss were the chief features. More recently still Lewis Jones,³ writing in the September number, 1906, of *Medical Electrolgy and Radiology*, refers again to his cases. He has been able to trace 14 of his original series of cases and has demonstrated the presence of seventh cervical ribs in ten of these.

The frequency with which cervical ribs occur is difficult to estimate but they are by no means uncommon; four or five cases have occurred within recent years in the dissecting-rooms of St. Bartholomew's Hospital. In the majority of cases (about 70 per cent.) there are bilateral ribs, though they are not as a rule equally developed on the two sides. Llewellyn Phillips,⁴ late demonstrator of anatomy at St. Bartholomew's Hospital, in the Proceedings of the Anatomical Society for 1900, described two cases which he had fully dissected. In the first case, that of a man, besides the cervical ribs there were various slight developmental anomalies present in the bony skeleton. The cervical ribs were bilateral but not symmetrical; that on the right side was fully developed, resembling closely the first dorsal rib, and consisted of head, neck, tubercle, and body; it articulated posteriorly with the sixth and seventh cervical vertebrae and intervertebral disc, and anteriorly with a cartilage which was ossified, and which in turn articulated with a cartilage joining the manubrium sterni. The rib on the left side was shorter and narrower and reached neither the sternum nor the first dorsal rib. The upper surface of each rib was grooved by the lowest trunk of the brachial plexus, which passed over it. Both ribs were moveable within narrow limits.

The second case was that of a woman, but the ribs, though similar, were not so fully developed, that on the left side being quite rudimentary. It was only about one inch in length, yet its upper surface was also grooved by a root of the plexus; it was firmly fixed, thus differing from the other

¹ St. Bartholomew's Hospital Reports, 1893.

² Transactions of the Royal Medical and Chirurgical Society, 1905.

³ Medical Electrolgy and Radiology.

⁴ Proceedings of the Anatomical Society of Great Britain and Ireland, 1900.

three. The ribs received considerable muscular attachments from an extra intercostal muscle and from the scaleni. Perhaps the most important point in connexion with these cases is that they illustrate the relationship which may exist between the brachial plexus and even a rudimentary cervical rib. In these circumstances an imperfectly developed rib, which can hardly extend beyond the transverse process of the first dorsal vertebra, may yet cause pressure effects on the brachial plexus. The relation of the plexus to these ribs has been further disclosed by findings at operations for their removal. In one of my cases in which the rib was removed by Mr. W. D. Harmer, the rib, a large one, was found to push the lower part of the plexus forward in front of it, but, without an undue amount of dissection, it was not possible to determine accurately what root or cord of the plexus was most involved. In another instance, however, Mr. L. B. Rawling⁵ at operation found the cervical rib lying between, and exerting pressure on, the eighth cervical and first dorsal root, which united a short distance beyond the rib. At first sight it appears difficult to see how a first dorsal root can come into intimate relation with a seventh cervical rib, but the direction of the first dorsal root on its way to enter into the formation of the plexus must be remembered. It passes almost directly upwards over the neck of the first dorsal rib and so might come without any difficulty into direct relationship with a seventh cervical rib which was growing somewhat downwards and forwards. That this is probable is shown by examining the appearances seen in skiagrams and comparing them with the clinical findings; as a rule, those ribs which appear to grow directly outwards from the spine do not cause pressure symptoms so often as those which seem to grow downwards and with a slightly forward tendency. Further, it is noteworthy that the longer ribs seem to produce symptoms less often than the shorter, stumpy ones. It is possible that the first dorsal root may be damaged by a seventh cervical rib without actually lying constantly in relation to that rib. The first dorsal root lies on the superior aspect of the neck and body of the first rib and may be compressed in this position between this rib and a seventh cervical one, more especially during lateral movements of the head and neck. The shortness of the ribs which produce symptoms, and the fact that improvement has followed removal of the first dorsal rib both point to this as a possible explanation in some cases.

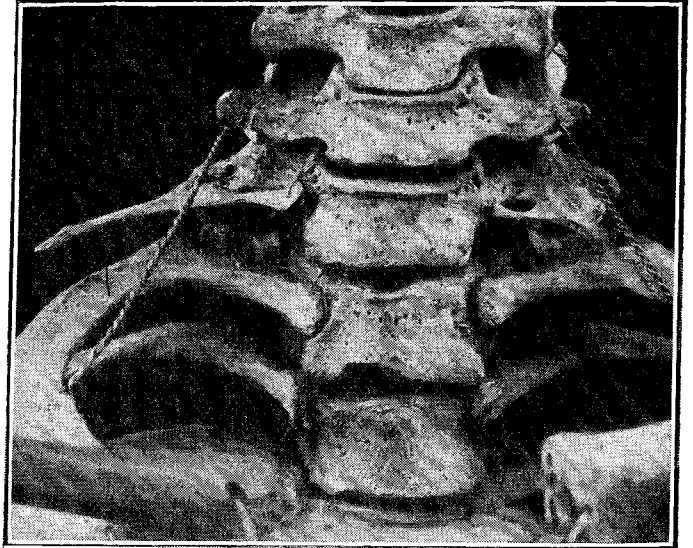
Gruber⁶ classifies cervical ribs under four heads: (1) smallest type—rib does not project beyond transverse process, resembles articular end of a thoracic rib with head, neck, and tubercle, articulating with body and anterior aspect of transverse process of seventh cervical vertebra; (2) larger rib reaches a varying distance beyond transverse process, terminating in a free end or articulating with the osseous part of the first dorsal rib; (3) the rib may reach the first costal cartilage which it joins either by ligament or by direct contact; and (4) the rib is in all respects like a first dorsal rib articulating with the manubrium sterni.

I propose now to give a short description of my series of cases and subsequently to discuss certain points which arise in connexion with them.

CASE 1.—The patient, a female, aged 28 years, gave a history of pain affecting the radial border of the left wrist for the last two years. The hand was constantly cold and all symptoms were worse in cold weather. The left hand was weak and the patient constantly dropped anything she might be holding. She was in all respects normal except in the left forearm and hand. Flexion and extension of the wrist were weaker in the left than the right; flexion was most affected. The fingers were similarly weak. The grasp was weak, with some overaction of the extensors of the wrist and slight ulnar deviation. The muscles of the left hand were all much wasted, most markedly the thenar muscles and first and second interossei. As regards electrical reactions, in the extensors of the wrist and fingers there was some diminution to faradism; otherwise they were normal. The reaction of degeneration was present in the thenar, hypothenar, and first and second interossei, though there was no polar change; the third and fourth interossei appeared to be normal. Sensation: Subjective—as above. Objective—there was definite alteration in an area involving the ulnar border of the forearm corresponding to the first dorsal root

distribution. Anæsthesia was moderate in degree with perhaps pain more affected than tactile sensation. The pupils were equal and the pulses at the wrist were equal. Nothing abnormal was felt in the neck. A skiagram showed well-marked bilateral seventh cervical ribs.

FIG. 1.



Reproduction of photograph of the cervical region of a female skeleton in the Royal College of Surgeons' Museum and reproduced by kind permission of the Council. The illustration shows bilateral but asymmetrical cervical ribs, that on the right side resembling a first thoracic rib in miniature, that on the left side being quite rudimentary and ankylosed. The photograph illustrates well how high the neck of the first rib is above the clavicle.

CASE 2.—The patient was a female, aged 21 years. There had been a history of pain for the last two years, which had been felt at first all over the right arm from the hand to the shoulder, and which later had settled along the ulnar border of the right forearm. A gradual onset of muscular weakness was noticed first when the patient attempted to cut wire with pliers. The muscles of the right hand were much wasted. This was most marked in the first dorsal interosseus and thenar eminence, the abductor, flexor brevis, and opponens pollicis suffering more than the adductors. The flexors of the wrist and fingers were affected in a slight degree. Electrical reactions in the forearm were normal. In the interossei there was marked diminution to faradic excitability; fairly brisk to galvanism (partial reaction of degeneration). In the thenar muscles there was well-marked reaction of degeneration; in the hypothenar partial reaction of degeneration. There was well-marked first dorsal anæsthesia. The pupils were equal, as were also the radial pulses. A skiagram showed bilateral cervical ribs.

CASE 3.—The patient was a male, aged 37 years, with a history of gradual and progressive weakness of the left forearm and hand extending over five years. There was an obvious swelling in the left supraclavicular fossa, with visible pulsation. The left forearm was markedly smaller than the right, with much flattening of the inner border, more marked atrophy of the hand muscles, and main-en-griffe. The grasp was very weak, with extension of the wrist, the flexors of the fingers and wrist having very little voluntary power. The aspect of the left arm resembled that seen in syringomyelia. The extensors of the wrist and fingers were affected also to a small extent. There was partial reaction of degeneration in the flexors (most) and the extensors of the wrist and fingers. No response was obtained in the hand muscles. There was no subjective painful sensation at all. There was marked sensory loss in the first dorsal and eighth cervical distribution. The pulses were unequal at the wrist, the right radial being almost double the left. The skin of the left hand and forearm was much cyanosed and the extremity was always very cold. A skiagram showed bilateral cervical ribs.

An operation was performed by Mr. Harmer on June 12th, 1906. A well-formed cervical rib was removed, about one and a quarter inches long, which did not articulate with the sternum or the first dorsal rib. It was seen that the lower cords of the brachial plexus were pushed forwards in front

⁵ Medical Electrolgy and Radiology, September, 1906.

⁶ Gruber quoted by Fürnrohr, Die Röntgenstrahlen in Dienst der Neurologie, 1906.

of the rib, and were under considerable pressure. The radial pulse improved immediately after operation. On June 27th the wound had healed by first intention and sensation was returning. On July 16th the anæsthesia was almost gone. It was noticed that the serratus magnus was very weak on the left side and showed partial reaction of degeneration. In December, 1906, the muscular power was much improved and the wasted muscles showed slight signs of filling out, the serratus magnus was greatly improved, while the electrical reactions were normal in the extensors, much improved in the flexors, but still absent in the hand. Sensation in the first dorsal area was normal. There was slight loss of sensation on the palmar and dorsal aspect of the terminal phalanges of the third and fourth fingers (remains of anæsthesia of the eighth cervical root).

CASE 4.—The patient was a female, aged 42 years. The history of the case showed that the condition had commenced 20 years previously when very severe pains in the right elbow and the inner side of the right arm were experienced, so severe that she had to give up work, which always caused an exacerbation, as also did cold. Soon after the pain was first noticed the muscles of the hand began to waste. Flexion and extension of the wrist were weaker on the right than on the left. Flexor spasm was noticed in the second, third, and fourth fingers, and extension of the distal phalanges in these fingers could not be performed voluntarily. There was no power in the interossei, the thenar and hypothenar groups being much wasted and very weak. Electrical reactions appeared to be little affected in the extensors and flexors of the wrist and fingers. There was reaction of degeneration in the thenar and hypothenar muscles and there was no response at all in the interossei. There was anæsthesia in the first dorsal and eighth cervical distribution. The right radial pulse was less than the left. A skiagram revealed bilateral cervical ribs. The patient has thought lately that the left hand is getting weak, but there is no evidence of this.

CASE 5.—The patient was a boy, aged 13 years. Six weeks previously, after swimming for too long a time, he had felt pain in the right wrist which was followed by weakness in that hand so that he dropped things. On examination no very marked wasting in the right forearm and hand was made out, but the hand was very slightly in main-en-griffe position, and there was marked weakness in the intrinsic hand muscles and very slight weakness in the flexors of the wrist and fingers. There was reaction of degeneration with polar change in the thenar group and in the first and second interossei, and reaction of degeneration with no polar change in the third and fourth interossei and hypothenar muscles. The forearm muscles were normal and the pulses were equal. There was slight diminution of sensation to light stimuli in the first dorsal area and there was more marked diminution to painful sensations. A skiagram showed bilateral cervical ribs.

CASE 6.—The patient, a woman, aged 43 years, had experienced the feeling of "pins and needles" in the right hand for 18 months. There had been pain for the last two months extending from the elbow to the little finger of the right arm of an aching character which was described as feeling "right in the bone." The pain was worse after exertion, and in cold weather, and at night. At the same time as the pain the patient first noticed that the right hand was weak, she could not wring clothes and when scrubbing could not get the floors clean, and she had difficulty in holding the needle when sewing, and in picking up pins, and so on. More recently she had had spasmodic contractions in the first and fourth fingers. The movements of the right arm all seemed slightly weaker than those of the left, though all could be well performed and with fair strength. Pronation and supination were slightly weaker in the right arm than in the left. Extension of the wrist was slightly weak; flexion was more affected and was definitely weak. There was less power in extending the fingers of the right hand than of the left and very much less power in flexing them. The thenar muscles were wasted, opposition and abduction being lost. In the interossei there was some wasting and they were definitely weak. The hypothenar muscles appeared to be practically unaffected. The grasp of the hand was poor. Sensation: subjective—as above; objective—slight tactile anæsthesia in the first dorsal distribution of the right side, analgesia was more marked, also slightly in the eighth cervical. There was typical reaction of regeneration with polar change in the thenar muscles and flexors of the fingers and partial reaction

of degeneration in the interossei. The hypothenar muscles were normal. A cervical rib was palpable in the neck on the right side. The pulses and pupils were equal. A skiagram showed bilateral cervical ribs.

This case was operated on by Mr. Rawling at St. Bartholomew's Hospital on Jan. 24th, 1906. The abnormal rib was removed as far back as the transverse process of the seventh cervical vertebra. The rib was crossed and grooved by two nerve roots, though it was impossible to define exactly which they were. The wound healed by first intention. After the operation for two days the patient had lost power in the deltoid, triceps, and biceps, but this has steadily improved and their power is now almost normal. There has been no further pain in the arm and on testing, the sensory loss has almost entirely disappeared. The patient states that the wasted muscles have filled out a little and this seems to be the case. The operation is too recent for anything like considerable improvement to have occurred.⁷

CASE 7.—The patient was a woman, aged 33 years, and the symptoms had commenced when she was 28 years of age, at which time she first noticed numbness, followed by pain, along the ulnar border of the right forearm. This was followed by gradually increasing weakness of the right forearm and hand. The symptoms were unilateral. There was slight wasting of the flexor group of muscles on the inner side of the forearm—the flexors of the wrist seemed normal but those of the fingers were weaker in the right than in the left hand. The thenar muscles, especially the abductor and flexor brevis pollicis, were much wasted, as was also the first dorsal interosseous muscle—the remaining interossei and the hypothenar muscles showed only slight change. The second, third, and fourth fingers were held slightly flexed. There was reaction of degeneration in the abductor and flexor brevis pollicis, with partial reaction of degeneration in the interossei and hypothenar group. The reactions in the flexors of the wrist and forearm were normal. There was slight analgesia in the first dorsal root distribution, where, however, a light touch was easily appreciated. The pupils were normal and the pulses were equal. A skiagram showed bilateral but asymmetrical ribs.

CASE 8.—The patient, a girl, aged 18 years, had experienced the first symptoms—"rheumatic pains" in the left arm when wearing a tight coat—ten years previously. Four years before coming for treatment the arm had been twisted in play, since which time she had always felt pain in it, which was very severe sometimes, burning in character, and causing her to drop anything she was holding. The pain was situated chiefly in the middle of the biceps and in the middle of the forearm. A year later the hand began to get weak and to waste. The symptoms were entirely unilateral. There was a tender spot in the left supra-clavicular fossa and a hard lump could be felt, and when this was pressed upon pain was felt in the places referred to. There was no objective sensory change. The movements of the upper left arm were good and the power was the same as in the right arm. There was some flattening along the ulnar border. The hand was slightly in main-en-griffe position and the third finger was markedly over-extended. Extension of the wrist and fingers was very slightly affected; flexion was markedly weak, the third finger being much weakest in flexion. The patient could not strike a note on a piano with this finger. There was wasting of the thenar eminence, with marked weakness in abduction and opposition of the thumb. Wasting was also marked in the interossei with guttering of the palm and dorsum of the hand. The hypothenar muscles also were wasted but not to the same extent. There was diminished response to the faradic current in the extensors of the wrist and fingers. The galvanic response remained brisk. Reaction of degeneration was present in the remainder of the muscles mentioned. Pulses: the left was much smaller than the right. A skiagram showed double cervical ribs, that on the right side being much longer than, and running in a different direction from, that on the left.

CASE 9.—The patient, a woman, aged 32 years, gave a history of pains on the outer side of the right arm extending over a period of 12 years. She thought the symptoms followed an attack of influenza. After this the hand began to waste. She had suffered from cramp in the fingers of the hand for several years when making any strain upon them and for the last few months had complained of involuntary twitchings of the third finger of the right hand. The forearm was not wasted, but the thenar group of muscles were

⁷ The patient has now almost entirely recovered.

much atrophied and movements were very weak. The interossei and hypothenar muscles seemed to have escaped. The electrical reactions were normal except in the thenar muscles, which did not respond at all. Sensation was normal and the pulses were equal at the wrist. A skiagram showed bilateral and very large cervical ribs, also considerable scoliosis in the cervical and upper dorsal region of the spinal column.

CASE 10.—The patient was a woman, aged 48 years, who gave a history of pains of long standing—she did not know exactly how long. She had had feelings of numbness and at times severe pain from the shoulder to the hand, both right and left, which were worse in winter and after exertion. The right thenar eminence alone was wasted and weak, all the other hand muscles seemed normal. There was reaction of degeneration in the wasted muscles, sensation was normal, and the pulses were equal at the wrist. A skiagram revealed bilateral cervical ribs.

CASE 11.—The patient, a woman, aged 54 years, gave a history of symptoms of long standing, the exact time being unknown. There had been tingling and numbness in the first and second fingers of the left hand, also slight flexor spasm in the third and fourth fingers, with abduction of the fourth finger. There was marked wasting of the interossei, but the thenar and hypothenar groups of muscles appeared to be normal. The muscular wasting was of recent origin, about one year. The was reaction of degeneration with polar change in the interossei and in the adductors of the thumb; all the other muscles reacted normally. There was slight diminution of sensation to light stimuli over the two outer fingers and thumb. The pulses were equal at the wrist. A skiagram showed bilateral cervical ribs.

CASE 12.—The patient was a girl, aged 11 years. The history of the case was that a year previously the patient had begun to complain of a dull aching pain, ill-defined in character and locality, in the left arm; shortly after this the thenar muscles of that hand began to waste and she had lost considerable power in the thumb. No other muscles were affected, but the thenar group showed marked wasting. There was reaction of degeneration in the affected muscles. Sensation was not abnormal and the pulses were equal. A skiagram showed bilateral cervical ribs, that on the left side being most prominent and the right rib being very rudimentary.

CASE 13.—The patient, a woman, aged 49 years, had had tingling sensations along the median nerve distribution in the right hand for two years. Loss of power in the thumb followed, associated with wasting of the abductor and flexor brevis pollicis and spasm in the adductors of the thumb. There was reaction of degeneration in the wasted muscles. The sensory changes were very slight diminution to tactile and painful stimuli in the distal phalanges of the thumb and the first and second fingers on the palmar and dorsal aspect. The pulses were equal at the wrist. A skiagram showed short bilateral cervical ribs.

On July 12th Mr. Sargent operated and removed the right cervical rib. It did not seem to be exerting any particular pressure on the cords of the plexus. No injury was done to the plexus at the time of the operation. On the 21st all movements in the arm were lost except slight flexion of the fingers. At the present time (January, 1907) the patient writes to say that the arm is still much weaker than before operation. She can almost get her arm straight above her head but she cannot get her hand behind her back. She can almost put her hand on the top and back of her head but she has very little power in it. The thumb has not got any stronger, but the wasting away seems to have stopped and the muscles have filled out, but only slightly.

CASE 14.—The patient, a woman, aged 29 years, gave a history of pain in the right thumb and radial border of the arm 18 months previously. The onset had been sudden. The pain was always made worse by exertion. Muscular wasting in the thenar group followed the pain, but no other hand muscles were affected. There was reaction of degeneration in the wasted muscles. The sensory changes were similar to those described in Case 13. A skiagram showed bilateral cervical ribs. The wasted muscles improved slightly after an operation in which the first dorsal rib was removed.

CASE 15.—The patient was a woman, aged 40 years, with a history of symptoms of six months' duration. There had been pain in the left shoulder and down the left arm, with "pins and needles" at times. It was worse when the arm hung down by the side or after exertion, especially after washing. A tender spot was felt in the supraclavicular

region on the left side. The hands were said to feel weak, but no muscular wasting was noted and the electrical reactions were normal. There were no sensory changes. A skiagram showed short bilateral cervical ribs.

CASE 16.—The patient, a female, aged 27 years, gave a history of pain on the dorsal aspect of the right hand and a "tired feeling" along the inner side of the right forearm which had lasted for ten months. There was no muscular wasting, the electrical reactions were normal, and there were no sensory changes. A skiagram revealed bilateral cervical ribs.

In none of the above cases was any further change discovered in the nervous system than that described in the text. In no case were any sympathetic symptoms noted.

It will be seen from the above series that individual cases might be selected which differ widely from each other, and this fact might be used as an argument against the cervical rib as the common causative factor in all. I must admit that to some extent this is true, but it is only in the last two cases, where subjective sensations alone existed, that the diagnosis is really in doubt; and Thorburn, in his paper already referred to, has described cases very similar where operative procedure and removal of the cervical rib conclusively established the diagnosis by removing the pain. In the remaining cases the difference is only one of degree; I regard the first eight cases as typical examples of the fully developed symptom complex caused by pressure on the brachial plexus by the seventh cervical rib.

Before proceeding to analyse these cases it is necessary to establish the accuracy of the diagnosis. The only possible conditions which could produce similar symptoms, or symptoms at all comparable to those quoted, would be syringomyelia, anterior poliomyelitis acuta or chronica, peripheral neuritis, and the class of cases described by Farquhar Buzzard⁸ as uniradicular palsies of the brachial plexus.

From syringomyelia the diagnosis is almost self evident. Ocular changes, common in this condition, are almost unknown in connexion with cervical ribs, nor are the reflexes in the latter condition abnormal. Sensory changes in the cervical rib cases are confined to the first dorsal or eighth cervical root distribution, though within these areas dissociative changes are to a certain extent met with. Scoliosis in the cervical region is occasionally met with but not to any great extent. Any sensory changes when present at once exclude either an infantile paralysis or progressive muscular atrophy. Further, the onset in infantile paralysis is usually distinctive, and, moreover, it is rare to find the hand muscles alone affected in this disease. From progressive muscular atrophy the diagnosis in the absence of sensory changes may be more difficult but the progress of the two cases is quite dissimilar. In progressive muscular atrophy both hands are affected sooner or later, whilst many of the rib cases remain strictly unilateral; nor are the reflexes ever increased in the latter condition. Further, the electrical reactions differ; whereas in progressive muscular atrophy the rule is for a simple diminution to the faradic and galvanic currents to exist, in the cervical rib cases one meets with reaction of degeneration in its most typical form. This only occurs in the former case when the disease is running a very rapid course, in which case the diagnosis could not long remain in doubt.

From peripheral neuritis, the root distribution of the muscular wasting and the sensory loss (when such is present) make diagnosis easy. With regard to Buzzard's cases of uniradicular palsies of the lower roots of the brachial plexus the diagnosis without an x ray examination is well-nigh impossible. The clinical picture in both cases closely corresponds, for both are due to a lesion which chiefly affects the first dorsal root. Of the two conditions I think that caused by a cervical rib is by far the commoner, for of the eight cases in which the muscular wasting and sensory loss corresponded to some of the cases described by Buzzard the skiagram showed the presence in all of definite cervical ribs. In two of these cases the ribs have been removed, with marked improvement resulting. This result of operative interference is, of course, the strongest link in the chain of evidence pointing to cervical ribs as the cause of the symptoms described. All operations have not been equally successful, it is true, but I think sufficient have been so to prove the point conclusively. Besides the two cases of my series which have been operated on with marked benefit and

a third (Case 14) where improvement has been slight, the following successful cases have been recorded: Thorburn⁹ two, Weber¹⁰ two, and Seiffer¹¹ and Déjerine¹² one each.

I think it is fair to conclude from the above evidence that a seventh cervical rib does give rise at times to certain well-defined symptoms from pressure on the roots of the brachial plexus, that in fully developed cases the diagnosis is easy and that a skiagram should, of course, be taken to confirm the diagnosis; lastly, that a number of cases also occur in which minor degrees of muscular wasting and sensory changes exist. Analysis of the cases collected brings out several interesting points.

Sex.—14 out of the 16 cases were in women and the reason for this is by no means obvious; there is nothing to show that a cervical rib is commoner in woman than in man, nor can laborious occupation be an exciting factor, or we should have expected to find the preponderance of cases in men. Possibly certain arm movements may bring the plexus more into direct relation with the rib, as, for instance, scrubbing floors, but the women in whom the condition has occurred are not all charwomen. Possibly the more thoracic type of respiration in women may exert some influence, but such influence must be slight indeed.

Age.—10 out of the 16 cases occurred in persons under the age of 30 years, the explanation of this no doubt being that this period corresponds to the more active growth and ossification of the ribs. In the cases occurring at a later age it is possible that the increasing rigidity of the accessory rib, perhaps going on to firm ankylosis, may be responsible for the production of symptoms, which the rib in a more movable condition had failed to produce.

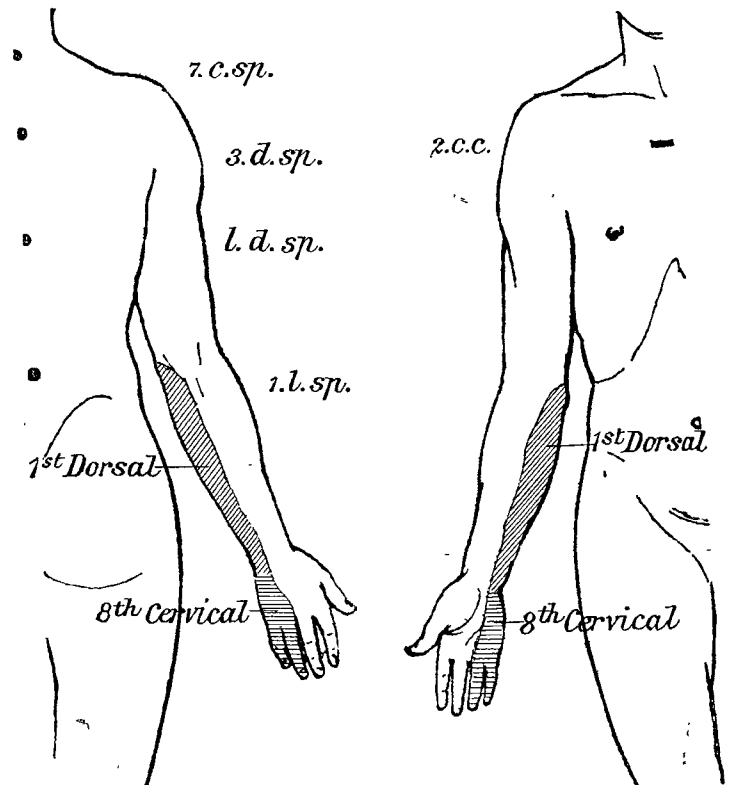
Sensory changes.—Both subjective and objective sensory disturbances are met with, the former being almost invariably present, while the latter were noted in nine of the cases. Pain is the predominant feature of the subjective changes and is specially influenced by exertion, in which the arms are involved, and by cold. The patients always complain more in winter than in summer. The pain may be severe—in one case it was so pronounced that the patient had to give up work; it is variously described as "sharp rheumatic pain," a "dull aching in the bone," "burning pain," and so on. Numbness and tingling were pronounced in two cases. The situation to which the pain is referred has varied, but is usually stated to extend from the shoulder to the hand on the affected side, being specially noticeable at the elbow and along the ulnar side of the forearm.

Objective changes.—The typical thing is undoubtedly loss in the distribution of the eighth cervical and first dorsal root (*vide* diagram), the latter being the most affected, and sometimes existing alone; I have never found a case where the eighth cervical loss was present alone; as a rule one finds slight dissociation phenomena, the tactile loss being less pronounced than the analgesia. This was also a feature of Buzzard's cases and indicates a root lesion, as Sherrington first pointed out. Déjerine¹³ has recorded a case in which a cervical rib was accompanied by paræsthesia and definite sensory loss in the fifth and sixth cervical distribution. The rib was removed and the sensory disturbances cleared up subsequently to the operation. In three cases there was very slight tactile diminution found over the thumb and first and second fingers, the change being most marked, but never profound, over the dorsal and palmar aspect of the distal phalanges. In two cases the changes were purely subjective and unaccompanied by any muscular weakness or wasting, and the electrical reactions of the hand muscles were normal.

Motor system.—Muscular wasting and weakness are in most of the cases chiefly noticeable in the intrinsic hand muscles, but in the more severe cases the flexors of the wrist and fingers may be considerably affected—the fingers, as a rule, more severely than the wrist muscles. The grasp is weak with extension of the wrist and the hand at rest in the pronounced cases assumes the main-en-griffe position. Wasting and muscular disability are usually most marked in the thenar muscles, and of these the abductor and flexor brevis seem to suffer most; in some cases these are the only muscles affected to any considerable extent. The interossei and hypothenar muscles suffer to a less extent. There may be some degree of spasm in the flexors of the third and

fourth fingers in cases where the muscular paralysis is not far advanced. Thorburn noted this point in his cases. There is sometimes abduction of the little finger. Even in cases of long standing the electrical testing of the affected muscles showed the presence of reaction of degeneration in its typical form, though where the muscular wasting was excessive the electrical response to galvanism, as well as faradism, could not be obtained. In all the recent cases reaction of degeneration was present. The motor and sensory changes thus point to a lesion which, in the majority

FIG. 2.



The shaded areas represent the distribution of the sensory loss met with in complete cases of cervical ribs. Analgesia is as a rule more pronounced than tactile anæsthesia in these areas.

of cases, involves chiefly the first dorsal root, with less interference with the eighth cervical root, which indeed may entirely escape.

Other phenomena which have been attributed to cervical ribs.—Sympathetic nerve: In none of the cases here recorded was there any affection whatever of the cervical sympathetic, but Fürnrohr¹⁴ records an instance of sympathetic eye symptoms associated with a cervical rib. The patient, a young girl, had complained for about six months of widening of the palpebral fissure and proptosis of the right eye; the right pupil was noticed to be wider than the left, the thyroid gland was slightly enlarged, and the right carotid pulsated more violently than the left. A radiogram showed a rib growing from the sixth cervical vertebra. It is not stated whether the rib was removed, with the subsequent cure of the symptoms.

Scoliosis.—According to Fürnrohr,¹⁵ Garré¹⁶ first drew attention to this symptom as a possible complication of cervical ribs. There is, he says, a displacement of the scapula on the same side as the cervical rib upwards and outwards and a deviation of the vertebral column, with the convex curve towards the accessory rib, in the cervical region, whilst a compensatory curve in the opposite direction is met with in the lower dorsal vertebræ. This scoliosis is by no means a constant feature and by many is regarded as accidental so far as the rib is concerned. Though only markedly present in one of my cases (Case 9) it occurred to a less extent in two others (Cases 1 and 4).

Syringomyelia.—This has been described by Oppenheim and others as occurring in cases where the radiogram has shown the presence of cervical ribs (the ribs being regarded as part of a widespread developmental anomaly). I do not know if any evidence exists to show that cervical ribs are more common in patients with syringomyelia than in others.

⁹ Transactions of the Royal Medical and Chirurgical Society, 1905.

¹⁰ Münchener Medizinische Wochenschrift, 1905, No. 33.

¹¹ Monatschrift für Psychiatrie und Neurologie, 1904, Heft 4.

¹² Neurologisches Centralblatt, 1903, No.

¹³ Ibid.

¹⁴ Die Röntgenstrahlen in Dienst der Neurologie.

¹⁵ Ibid.

¹⁶ Zeitschrift für Orthopädische Chirurgie, Band ii., No. 1.

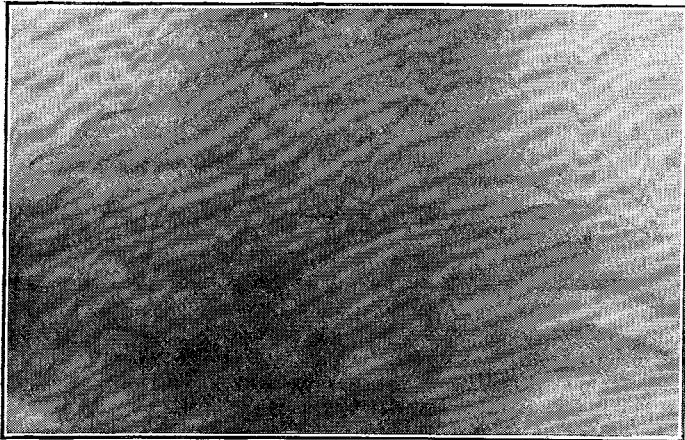
It is quite possible that the simultaneous occurrence of the two conditions may have been simply accidental.

A word as to radiograms and their interpretation in cases where a rib is suspected. The photograph is best taken with the patient in the dorsal decubitus and the plate behind the neck. With a "low" osmium tube of about 5-inch spark gap and a 10-inch coil I think an exposure of from one and a half to two minutes has given the best results. It is sometimes difficult to say whether a definite cervical rib or a rather abnormally developed transverse process of the seventh cervical vertebra is present. I have photographed a skeleton where these transverse processes are particularly well developed, but in the radiogram they do not nearly reach in lateral extent the extremity of the transverse process of the first dorsal vertebra. I think that a transverse process or rudimentary rib, which extends beyond the first dorsal transverse process, should be regarded as a potential factor for the production of pressure symptoms. Phillips's dissection, already quoted, supports this view.

As a result of a number of radiograms of the neck taken at the National Hospital one has noted that in the first place cervical ribs may be present and produce no symptoms, and secondly, that though nearly all the cases of cervical ribs are bilateral—in the greater number the symptoms are unilateral. The explanation of this, I feel sure, entirely depends on the direction of growth taken by the rib. Those ribs which grow straight out from the spinal column or incline a little backwards (and therefore show most conspicuously in radiograms) are little liable to produce pressure symptoms. Whilst the rib which seems to grow forwards, or forwards and downwards, is almost invariably associated with some injury of the plexus.

The treatment of the various conditions produced by cervical ribs may be divided broadly into (1) palliative and (2) radical.

FIG. 3.



Bilateral and symmetrical cervical ribs (Case 4).

Palliative treatment.—This consists in rest to the arm as much as possible, the use of blisters as counter-irritants if subjective sensory phenomena are conspicuous, or the use of the constant current over the painful areas. The anode should be used as the active electrode and a current of 8 to 10 milliampères employed. In some cases this will suffice to remove the greater part of the pain, aided perhaps by the use of a liniment composed of mesotan and olive oil, in equal proportions, care being necessary to prevent irritation of the skin by this method. For the muscular condition much can be done in the slight cases by massage and the use of electricity, using a combined faradic and galvanic current sufficiently strong to produce a medium contraction in the affected muscles. Under this treatment some of the cases will show a decided improvement, but more probably will not. In some cases the painful sensations cease of themselves and the muscular wasting becomes arrested, leaving a hand that is still useful though not normal, the thumb movements being most restricted.

Radical treatment.—The question of operative interference is raised when the pain is extremely severe or when muscular wasting has advanced to such an extent as to interfere considerably with the utility of the hand, but in my opinion palliative treatment should always first be given a trial. In the slighter cases I do not think that operative interference is to be recommended as it is not attended by universally

satisfactory results. When undertaken it is most important that it should be complete, by which I mean that the periosteum should be removed with the rib. The necessity for this is shown by a case which Weber has recorded, where a subperiosteal excision was first performed with temporary relief of pain, but new bone was formed and the symptoms recurred to be ultimately cured by a complete removal. Unsatisfactory results sometimes occur. I have seen two cases, and another is recorded by Fürnrohr,¹⁷ where a more or less complete paralysis of the whole arm (especially affecting the deltoid) occurred after the operation, and this, too, without any obvious injury being done to the plexus at the time. One of these cases proved most intractable, but the other two cleared up almost completely within two months. The brachial plexus seems to resent any such handling or stretching, as is almost unavoidable during the operation. In another case a paralysis with reaction of degeneration resulted in the serratus magnus and though this ultimately improved very much the muscle has not yet, seven months after the operation, completely recovered. When one remembers the course of the posterior thoracic nerve it is not difficult to realise how easily it might be injured in the manipulations necessary for the removal of a seventh cervical rib. An important point for the surgeon to bear in mind is that the cervical rib lies much higher in the neck than is usually expected. The first dorsal rib has in several instances been mistaken for a seventh cervical rib and at times has been removed in error—a mistake which may be easily made when one recollects that the latter may articulate with the sternum, has muscular attachments from the scalene and intercostal muscles, and in some cases is crossed by an abnormally high subclavian artery.

Mr. Rawling, who very kindly operated on one of my cases, has expressed himself to me on the subject as follows. He bases his remarks on two cases on which he has operated himself and on two others which were operated on at St. Bartholomew's Hospital. 1. The ribs in all these cases have been short, projecting only from 1 to 2 inches beyond the tip of the transverse process. The ribs were directed outwards for a short distance and there turned markedly downwards and forwards. 2. The upper aspect of the rib is definitely grooved by a nerve trunk, though it is not always possible without testing electrically to identify which trunk is present. 3. Complete removal is usually a matter of very great difficulty, due to the small area of operative field and the numerous muscular attachments which the rib receives. In removing these many small, but troublesome, vessels are divided. 4. The rib is by no means easy to find. It seems to lie in such a manner that its tip is embedded in the substance of the scalenus medius and posticus muscles. It also lies at a very much higher plane than is usually anticipated, the very great obliquity of the first rib being forgotten.

In conclusion I wish to express my best thanks to those members of the staff of the National Hospital who have most kindly allowed me to make use of their cases.

Queen Anne-street, W.

A CASE OF ACUTE LEUKÆMIA (LYMPHOCYTHÆMIA).

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With Pathological Notes by F. G. BUSHNELL, M.D. Lond.,
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THE patient, a man, aged 20½ years, an Englishman, though resident in Morocco for a good part of his life, was first seen on Jan. 2nd of this year. He complained of a swelling on his leg of three days' duration. There was a large hæmatoma of the size of an egg, fluctuating in the centre, and situated over the internal saphenous vein of the right leg; the inguinal glands were enlarged and tender, and the temperature was 101° F.; there was no thrombosis in the vein above or below. There was no history of local trauma, the lump having appeared spontaneously, but three weeks or