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THE NATURE AND ETIOLOGY OF BONE DISEASE
IN KASHMIR.

THE CONSERVATIVE SURGERY OF LONG BONES.
NECROSIS OF THE LOWER JAW.

(Reprinted from the "Indian Medical Journal.")

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REPORT OF THE COMMISSIONERS OF THE LAND OFFICE

THE NATURE AND ETIOLOGY OF BONE DISEASE IN KASHMIR.

BY ERNEST F. NEVE, M.D., F.R.C.S., E.,

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Rickets.—It is a curious circumstance that rickets is exceedingly rare in Kashmir. During more than a year, out of 13,000 patients, many of whom were seen in the very heart of the city, I have only seen two cases; one of these was not well marked, the other was quite typical. It was a young child about two years old. The rest of the family were unaffected. Its parents had never been out of Kashmir. This infant was suffering from diarrhoea, was anæmic, but fairly well nourished. The ribs at the junctions with the costal cartilages were beaded, the skull did not appear to be affected, the lower extremities of the radius and ulna of both sides were enlarged. Other bones were similarly affected, the tibia, in addition, being markedly curved, with the convexity forward. There was no room for doubt as to the nature of the disease. In the other example the signs were similar, but much less distinct.

The discovery, however, of one or two cases, only accentuates the fact of the rarity of the disease, which was, I believe, until a year or two ago, thought not to exist in the valley. Yet the conditions of life here are such as would lead us, according to prevalent ideas of its etiology, to expect it to exist to an unusual extent.

The principal views of the causation of rickets are* that it is either connected with improper nourishment and bad hygienic surroundings, or that it is a *discrasia*, possibly *sui generis*; but possibly resulting from syphilis or other constitutional defects in the parents. Well, with regard to food, the infants here, almost as a rule, are suckled for more than a year. Indeed very frequently

* Cf. McDonald Brown, Edr., Med. Chir. Socy. Trans., Vol. IV, 1884, p. 205.

when two years old, they still partake of that form of nourishment, and sometimes when even older. In the city, cow's milk is apt to be of very inferior quality. Extras in the way of food are not more curtailed than in Europe. From a very early age the infant may indulge freely in rice, native bread, vegetables and even tea, and as one would expect, diarrhœa is common. Again, Srinagar, the capital of Kashmir, is notorious for its smells. Its dark, crowded, badly-ventilated houses and narrow streets and lanes, exist over a wider area than the slums of most English cities, in which rickets is common. As for the poverty of many of the inhabitants of Srinagar, it is extreme ; their clothing is very defective.

With regard to the existence of a distinct diathesis, there appears to be no shadow of evidence that syphilis has any causal relation to rickets. If it had, rickets would be a common disease in Kashmir.

The whole surroundings of the particular children to whose cases I have referred, together with their histories, pointed to the disease being probably sporadic, and doubtless, the causes which would eventually create a diathesis to be perpetuated by heredity, must have a time when they first begin to act as factors of definite disease.

It appears to me evident that, if there were anything like a real diathesis existing in the valley, then, in the presence of such potent exciting causes, (or causes which we are apt to regard as such) rickets must be common, even if only of mild type ; but no cases of even modified rickets have been discovered by me, with the above exceptions.

It is clear that the absence of rickets in apparently such favourable soil for its manifestation is a fact which it is difficult to account for. Why is it prevalent in England, and absent or very rare in Kashmir and India, generally ? But why, strangest of all, should we meet with isolated cases ? As far, at any rate, as predisposition is concerned, debility of the mother has, I believe, a considerable causal relation. For three years, during which I acted as House Surgeon to the Cowgate Dispensary, Edinburgh,

a district where I had very large opportunity of studying rickets in its clinical aspects, the most marked family of rickety children that I ever observed was that of a woman far advanced in consumption, and it was the later children, (those born since the debility had set in) who were most profoundly affected.

In Kashmir, even in the city, the women of the lower classes lead a more active, or at the least a less confined, life than those in England.

The sum total of sunshine is much greater than in England. But in Kashmir again, in the winter, often for two or three months, there may be but little sunshine. The height of the valley (5,000 feet) above the sea-level must not be forgotten.

It seems, however, to me almost more than within the bounds of possibility, that rickets may have an exciting cause in a specific micro-organism, occupying somewhat similar relations to a constitutional predisposition as the tubercle organism does to the strumous diathesis. The two diseases are commonly found in the same locality. They are both rare in India. In Kashmir tuberculosis is almost as rare as rickets.

Tubercular disease of bone.—I have been able to recognise but very few examples of this disease.

Rheumatic affections.—Acute rheumatism, as far as I know, does not occur in Kashmir. Chronic muscular rheumatism is not rare, but I have not met with any instance of rheumatic osteitis or of osteoarthritis.

Fragilitas ossium.—We have recently met with two examples of this curious and rare condition. In one case it was very well marked.

The following is a brief abstract:—

Case 1.—S.—Male, aet 13, no history of syphilis or rickets, parents healthy. Has two healthy brothers, aged 18 and 14, and one sister, aged 4, also quite strong. His infant brother K—is affected. The mother was not well during the pregnancy both of S—and K—. S—has had small-pox and measles. At different times he has fractured his right clavicle, left humerus, left clavicle, right humerus, both femurs and

the left tibia. The first fracture occurred when he was 20 days old. The right humerus, has been twice broken, and the right femur twice, *viz.*, in the upper and lower one-third. Since three years ago when his right femur last broke he has been crippled, union usually occurs in about a fortnight. The boy is intelligent looking and not very strong, cannot walk or stand unaided, and has slight pain when moved, the bones are distinctly thin except where they have been broken, where they are apt to be thickened and distorted. For instance, the right clavicle is deformed. The right humerus is thickened. The right femur has two elbows, one, 4 in. below the trochanter, with convexity outwards. Another, 3 in. lower down, backwards and inwards, the bone is thickened and nodulated; the left femur is curved forwards and thickened at two points.

*Case 2—K—*aet 14 months; the brother of S— At four months his right arm was broken, at six months the right femur, at 11 months the left femur and the spine (by a child falling on it). The infant is rather irritable but well nourished. It takes its mother's milk supplemented with goat's. Its head is well developed. The anterior fontanelle open. Right arm tender, thick and bent. Left arm similar. Both femurs are thickened, and in places curved and tender.

Simple tumours of bone, with the exception perhaps of enchondroma, are not of frequent occurrence in Kashmir.

Malignant tumours are not rare. Sarcoma is certainly the most common of these.

During the past year we have met with two cases of osteosarcoma of the femur. In one, the tumour was of immense size, as large as the head of an infant. The patient declined operative interference. In the second, a lad of 19, the femur was enlarged and painful. The swelling being of a doubtful nature it was trephined. The extracted disc of bone was examined microscopically and proved the boy to be suffering from myeloid sarcoma. There also, unfortunately, permission to amputate was refused. One case of myeloid sarcoma, one of epithelioma, and one of malignant epulis, each of the upper jaw, com-

pletes the list of tumours of bone for last year. These were successfully excised. It would be outside the scope of the present paper to enter into further details with regard to these cases.

Simple hypertrophy of bone.—We have met with no cases of simple hypertrophy. But the following case is interesting as showing an occasional indirect sequel of osteitis.

Case 3—K—æet 14, was treated in 1886 by Mr. Arthur Neve for syphilitic caries of the left tibia. The bone was gouged and the condition cured. In February 1888 the leg was found to be curved owing to hypertrophic elongation of the left tibia. The measurements were as follows. Left tibia $34\frac{1}{2}$ millimetres, right tibia 31 millimetres. Left fibula 33 millimetres, right fibula $32\frac{1}{2}$ millimetres.

Increase in the circumference of a bone is very common. But in most cases it is too directly the result of osteitis to be regarded as in any sense a real hypertrophy.

Inflammatory diseases of bone are common enough. It is by no means easy to assign each, etiologically, to its proper place. In attempting to do so, one has, of course, to endeavour to distinguish between predisposing and exciting causes. With regard to the former, I have already pointed out that the scrofulous or tubercular constitution is rare, and that rheumatism does not play an important part in the production of bone disease. It is, however, not so with syphilis. Syphilis is rampant in Kashmir. Some idea of its prevalence may be formed from the following :—The population of the valley is between 3 and 400,000. Of this number we saw, last year, 13,000 as out-patients, *i.e.*, speaking roughly, about $\frac{1}{30}$ th of the population. Now of this $\frac{1}{30}$ th, probably about one in every ten was suffering from affections of a syphilitic nature, *i.e.*, either acquired or hereditary syphilis. Now it is evident that in a population as much tainted with recognizable syphilis as this indicates, there must be a very large amount of indistinct hereditary syphilis. As time passes on, there is an admixture, by marriage, in the different generations of a family, of taints of disease of varying strength, with occasionally a healthy parent introduced, and with, in many stocks, a progressive

tendency to shake off the peculiarity and revert to the normal. In this way a large number of the inhabitants, especially of the city, must be syphilized to a greater or less extent. This constitutional taint, I believe, whether evident or not, and it is seldom demonstrable, lies at the foundation of a large number of our cases, as a predisposing cause. That other conditions may exist, apart from syphilis, which have a similar tendency to produce bone disease, I do not for a moment deny. In the villages and side valleys of Kashmir, syphilis, as we should expect, is much less common than in the city. Yet from the country we get many of our worst cases of bone disease. Again, many of those who suffer, not only do not show signs of hereditary syphilis, but actually present rather a high type of development, being intelligent, with well formed features and figure. This is especially the case in young people. There can be little doubt that the process of development, with its active changes in the way of growth, going on at the epiphyses, is in some cases, of itself a sufficient predisposing cause to bone disease. We must not forget, too, how there is in all the peculiarities of disease in one country as compared with another, the tendency for different types to occur. These may be associated partly with locality, climate and other influences which it would take some time and patient investigation to discover.

As temporary predisposing causes may be mentioned any conditions which lower the powers of resistance, as for example, improper food, starvation, fatigue or debility from overwork or disease.

The discovery of gross exciting causes is not so difficult. The majority of inhabitants go about with the legs below the knee bare. The cold in the winter is very intense. For several weeks the daily average is for a considerable portion of the 24 hours below freezing point, and the snow is often abundant. Cold is undoubtedly a potent exciting cause, and each spring we have a fresh influx of patients suffering from bone disease, apparently due to the effect of a severe winter. That injury in the shape of blows, kicks, &c., may produce grave results of a similar nature,

there is of course abundant evidence. Again, disease of contiguous soft parts may attack the bone. In one case of noma, for instance, which was attending the hospital, the lower jaw was deeply ulcerated. Gummata and syphilitic and other ulcers may produce similar effects.

I cannot pass from this subject without making a passing reference to the subject of the relation of certain specific diseases, *viz.*, measles, small-pox and typhoid fever, to bone disease. The subject is a wide one, and affords room for careful investigation. Apart from the general predisposition which the consequent debility would involve, the question of pathogenic organisms comes to the front. The three fevers which I have mentioned are of all the exanthemata, those most apt to be followed by bone disease. To these causes must be added pyæmia and infective osteomyelitis. And in all these conditions, micro-organisms no doubt play an important part. In *typhoid fever*, very probably, there may be a lesion in the bone of a similar nature to that found in other organs, notably the intestine and mesenteric glands, the liver and the spleen. Some investigations which I once commenced, but was unable to complete, tended to show a participation of the lungs, and perhaps the bronchial tubes in the same lesion, and there was a strong suspicion that this condition was associated with micro-organisms. Typhoid is, however, not endemic in Kashmir.

Clinically the multiple bone and joint lesions of *small-pox* are hardly distinguishable from those of pyæmia.

Acute osteomyelitis has for some time been definitely associated with different forms of micrococcus.*

In some of the acute forms of suppurative periostitis, inflammation of the bone substance and medullary cavity, these are all important and the condition is doubtless infective. The relation of these organisms to more chronic cases and indeed even to some cases of acute suppurative periostitis is by no means clear.

* Jones, *Disease of the Bones* 1887, p. 87. *Bibliography*, &c., Woodhead and Hare, *Pathological Mycology*, vol. I. p.p. 83, 86, 138, 152 and *Bibliography* McGill and Littlewood. *British Medical Journal*, vol. 1, 1887, p. 459.

M. E. Kirmisson* mentions cases in which even chronic inflammatory lesions of bony tissue were believed to be due to these organisms. In one instance, M. Jaboulay† recorded three cases of chronic osteomyelitis in which he found the staphylococcus, cultivated it and reproduced experimentally in animals a disease analogous to the acute osteomyelitis of man. And M. Verneuil in connection with what he terms the latent parasitism (*le parasitisme microbique latent*), described in February 1886 the case of a young man, æt 24, who when twelve years old, had an infectious osteomyelitis for which his leg was amputated. Four years subsequently, he came under M. Verneuil's charge suffering from osteomyelitis of the upper extremity of the humerus and in 1886 he was affected with osteomyelitis of the opposite humerus. In the pus of the abscess, which was opened with rigorous antiseptic precautions, the staphylococcus albus was found.

These cases may be suggestive, but they are hardly complete enough to prove their point, clinically. I think that one is bound to believe that there is an acute osteomyelitis of an *infectious* nature, distinct from ordinary suppurative periostitis or osteitis.

There is room for further investigation in the matter,—to determine the presence or absence of the distinctive staphylococci in inflammatory bone diseases, their specific characters (as compared with the micrococci of boils, whitlows and other purulent collections), their relations to pyæmia and to acute and chronic suppurative affections of bone.

* *Dictionnaire Encyclop, des Sciences Medicales Art. Periostite* p. 219.

† *Dictionnaire Encyclop, des Sciences Medicales Loc. Cit.*

THE CONSERVATIVE SURGERY OF LONG BONES.

BY ERNEST F. NEVE, M.D., F.R.C.S.E.

In Kashmir, there is every inducement to practise conservative surgery. In whatever light amputations may be popularly regarded in Europe, here at any rate they are firmly believed by the people to be "the opprobrium of surgery." Unfortunately, not a year passes in which lives are not lost, especially in the case of malignant disease, from the senseless refusal to permit removal of a diseased member. From this refusal, however, as can be at once recognized, great advantages may accrue to the surgeon and sometimes even to the patient. It is an instructive thing to see a patient, whose limb you had condemned, recover with a useful member. And yet, if amputation is permitted, there are not a few cases in which the surgeon, while fully recognizing the *possibility* of recovery without dismemberment, nevertheless knows that the risk to life in the attempt is such that he is not prepared to take the responsibility of perhaps causing (indirectly) his patient's death by omitting to operate. For, often, as far as experience and the application of general principles are concerned, the odds are heavily against recovery, if amputation be not performed. In this country, however, all the responsibility in the matter of refusal is borne by the patient. The surgeon's part is to watch and see what efforts unaided nature will make. And from these often a valuable lesson may be learnt. But he will also feel impelled to study earnestly those operations which afford a chance of recovery without mutilation. In other words, he is obliged, by the process of exclusion to practice conservative surgery.

Nowhere is the result of conservative surgery more satisfactory with regard to the past, and more promising with respect to the future than in its relation to disease of bone, especially of

the long bones. And this form of treatment is capable of great extension and of wide application.

Let us glance for a moment at some of its historical aspects. In 1865 Holmes * removed, sub-periosteally the whole shaft of a tibia ($7\frac{1}{2}$ in. long) in a child 10 years old. This was done one month after the commencement of acute periostitis. The result was very successful. There was $1\frac{1}{2}$ in. of shortening. This was not the last time that Mr. Holmes performed similar operations. Other surgeons were working on the same lines. Some months subsequently Mr. Joseph Bell recorded a resection of a large portion of the femur.† In his work on Surgery,‡ the late Professor Spence deals in a very clear and able manner with the question of resection, and expresses his belief that in one class of cases of necrosis, sub-periosteal surgery seemed likely to achieve some brilliant successes. In 1875 cases were published by Duplay § (*osteoperiostite phlegmoneuse du tibia chez un homme de seize ans; résection de 29 c.m. de cet os reproduction; guérison*) and Giraudeau. || (*Résect. précoce dans la périostite phlegmoneuse diffuse.*) In his paper on the subject, M. Duplay referred to cases of Holmes, Letenneur and Macdougall, in all of which the operation was done in the acute state of the disease.¶ In 1876 Spence published two striking cases of resection respectively of the tibia and the tibia and fibula.** Since that time considerable advances have been made in this direction. Amongst others who have performed operations of this nature are Macnamara, Fayrer, Heath, Marsh, Vincent, Barwell, Pye, MacCormac, Bryant, and Pitts.

Nevertheless, considering the space of time since 1865, the frequency of bone disease and the few cases recorded, it is evident

* *Surgical Treatment of Children's Diseases*, 1868, page 391.

† *Holmes' System of Surgery*, Vol. III, page 778. *British Medical Journal*, 2nd May 1868.

‡ *Lectures on Surgery*. Spence, 1875, page 240.

§ *Gaz des Hop*, 123, 1875.

|| *Bullet de l'acad de med.* 2, 1875.

¶ For extensive bibliography on this subject, vide *Dict. Encyclopéd, d. Sciences Med. Art. Periostite*, page 229.

** *Lancet*, 11th March 1876

that this operation has been performed very sparingly and has been chiefly limited to those cases of total necrosis of a bone in which there has been more or less loosening of the diaphysis from its epiphyseal attachments (for the operation has been performed usually on young people). And I may observe here that when the diaphysis is quite loose, the operation for the removal of the sequestrum can hardly be termed a resection.

Macnamara has been bolder. He has left the beaten track and has extended the operation, in one case at any rate, to the removal of sclerosed bone, which was not dead. The result was most satisfactory. (For particulars of the operation which was done on account of pain and disablement, see Macnamara's *Diseases of Bones and Joints*, 1887, pages 54, 76.)

Now between the application of the operation of resection to a condition of this nature and its adoption for complete necrosis with almost entire separation of a diaphysis, there lies a wide field of bone disease in which more or less extensive sub-periosteal resection will, I am persuaded, be found very useful; a field in which there is, and will be, a wide scope for conservative surgery.

The minute and scrupulous cleanliness inculcated by Lister (Koch and others) and its associated study of the nature and prevalence of micro-organisms and the relative value of anti-septic substances have had practical results, which place us in a much safer position in carrying on an experimental clinical investigation of this kind.

What then are the indications for sub-periosteal resection of a bone? The class of cases in which it is most imperatively required is that indicated by the late Professor Spence * viz., "cases of acute form, in which inflammation of the dense shaft of a long bone has been so rapid, general and violent, that nutritive changes seems arrested; and the bone separated, or nearly separated,

* *Lectures on Surgery*, 1875, page 240.

from the investing periosteum, is exposed with its surface bare, smooth and white, as if dead." In such cases as this, you have choice of three methods of treatment, *viz.*, expectant, amputation or resection. If the patient's health is in a low state, expectant treatment may be attended by the gravest risks, not only of extension to neighbouring joints but worse still, of the patient sinking from the hectic of chronic suppuration with septic absorption. And even in acute necrosis separation seldom occurs under six weeks or two months. While in the meantime the periosteum may be irreparably injured, and its capacity for the reformation of bone may be destroyed. Whether this happen or not it is no exaggeration to say that the Medical Journals abound in cases in which early resection would have saved months of tedious, painful waiting, and in some instances even amputation might have been averted, yes, and death! For in some such cases even amputation, as Spence has pointed out, has been attended with so little success that it is scarcely warrantable.

It is by the third method, *viz.*, resection, the mean between extremes, that, the source of evil having been removed, exceedingly good results have been obtained. For by it, the patient is saved both *prolonged* suppuration from a large area with the consequent drain on the whole system and the risks mentioned above of eventual deficient bone formation. He keeps his limb and a new bone is formed. Finally, he may derive immediate benefit from the stimulus of the operation, and in the vast majority of cases he is at once put on a straight road to recovery.

How does the adoption of the system of antiseptic surgery, associated with the name of Lister, affect this question? In two ways, I think. *Firstly*, cases of what are called acute suppurative necrosis if incised early with Listerian precautions before the purulent collection has had access to the outer air are, I am convinced, apt to run a modified course. In fact, there is good ground for believing that exfoliation or even complete necrosis may be averted by preventing the entrance of external

morbific influences. Lister himself reported a case* of two or three weeks duration, in which the bone was bare, and there were no granulations on its surface. The abscess was opened antiseptically and the wound healed without formation of any sequestrum. I quote this case as an illustration of a class which is not unfamiliar to surgeons who practice Listerism. (As far, however, as this particular instance is concerned, it is, as I shall show afterwards, quite possible that under any circumstances necrosis might not have occurred).

Again, *secondly*, supposing that in a bad case, the surgeon should make up his mind to amputate, I think that in such a case, where the suppuration is apt to be excessive, and frequent dressing is especially bad, the patient will have a better chance if treated with strict Listerism.

In these remarks, I have quoted Listerism as the ideal antiseptic system, because it is compact and complete in itself. But the above observations apply also to recent modifications of antiseptic surgery† in so far as they achieve the same objects and are carried out by those who recognize the principles at stake and have as an ideal the complete exclusion or destruction of micro-organisms and their germs and the strengthening of "tissue defences." But to return from our digression; when is a bone in a condition of total necrosis? Unfortunately it is not always quite evident, this is indeed one of the main difficulties of surgeons in their treatment of bone disease. It is this which produces so strong a feeling in favor of expectant treatment. So difficult is it to know with certainty the condition of a bone which has been bared by suppurative processes that we find a surgeon of the standing of Bryant, cutting through a femur with chain saw, with the intention of resection and then finding the bone very vascular and adjusting the fragments without removal.‡ In this case only a small shell came away. Again, Lister, (*loc. cit*) speaks as if the fact of bone being bare and without granulations was something rather like proof that it was dead. And yet we

* *British Medical Journal*, Vol. II., 1865, page 101.

† The use of Mercuric Perchloride, Glycerine, Iodoform emulsion, &c., &c.

‡ *Lancet* 1877, Vol. I, page 574.

know how often bone is bare for quite a long time without expoliation ever occurring, and this even when the communicating wound is not aseptic. I have seen at least six instances in point. To enable us to recognize dead bone more distinctly it has been suggested* that the bared bone should be struck with a metal instrument, the dull note of the living bone as compared with the musical note of the dead, being distinctive. But this is really no more than the *tactus eruditus* of most surgeons detects with the ordinary probe! Moreover, it only gives definite information as to the superficial aspect of the part. An advance upon this, is M. Ol liers' advice to trephine the doubtful bones and see the extent of disease.† This appears to me the more satisfactory, that it may be at the same time a means of relief of tension; while there is but little fear that under proper precautions is likely to cause further necrosis. But here again, the nature of the information obtained is not extensive and may sometimes, from its extreme localization, be rather misleading. In deciding the vitality of a bone I think that by adopting the above methods and taking into consideration the history, the general and local condition of the patient, the latter with special reference to the presence or absence of sepsis, the patency of the nutrient artery and the condition of the periosteum, one will in most cases be able to form a fairly accurate diagnosis as to the completeness of the necrosis. At the same time, in adopting operative methods, we must be ready to alter our methods if occasion require.

If the bone is partially necrosed only, is resection ever indicated? I think so undoubtedly. For, let us consider the duration of many of these cases. Bryant has recorded‡ a case of disease of the tibia of *twenty-seven* years' standing in which latterly the joint became affected. Amputation was successfully performed! Spence mentions an instance in which a sequestrum took *seventeen* years in separating. Cases of such duration are it is true exceptional. Yet in the former

* Barwell, *Lancet* 1877, page 573.

† *Lancet*, 1886, Vol. I., p. 304.

‡ *Lancet*, 1879, Vol. I., p. 10.

portions of sequestra were from time to time forcibly removed. Still the rule is, for a sequestrum to take a long time to separate. And finally, in a large proportion of cases it will need to be removed by operation, when loose. We have mentioned that even in acute necrosis the bone may take six weeks to two months to become separate. In chronic necrosis, it is a case of months or even years and at the end of that time I repeat, the sequestrum may need to be removed by an operation of more or less severity and perhaps even then, as Spence points out, we find the exposed surface still continues to discharge and fresh portions become necrosed. And in many cases the cavity left after removal of the necrosed portion continues to furnish discharge so persistently as to exhaust the general health and necessitate amputation to save life, and yet in many of such cases the necrosis is only partial.

I think that we ought to admit that often early resection is indicated in such cases and that we must not hesitate to remove if necessary, living tissue with the dead if the line of demarcation is not defined.

If the necrosed bone is loose at both ends there can be little doubt about the advisability of its removal even if some portions might have recovered. If one end only is necrosed and loose, that end may often be resected with advantage. And sometimes even if a joint is involved, amputation may still be avoided as in a case recorded by Pitts* where the ankle was affected. Bockenheimer† has gone further. He resected the femur and the surface of the tibia, opening the hip and knee joints. Four months after the child showed shortening of rather less than two inches. In the same year (1878) Th. Anger resected the upper extremity of the tibia, penetrating the knee joint, in a boy 15 years old. The child recovered, and in 1884 walked easily with the aid of an elevated sole, to his boot, of $3\frac{1}{4}$ in. the limb of the opposite side, in which growth had taken place since the operation, being largely accountable for the disproportion

* *Lancet*, 1886, Vol. I., p. 303.

† *Deutsche med Wochenschrift*, 1878.

between the lower extremities. Cerné (of Rouen) described in 1885 at the first French Congress of Surgery the case of a boy aged 15 whose ankle joint was involved in an osteomyelitis of the tibia. After resection the child recovered with a total shortening of $2\frac{3}{4}$ in.* Owen also, has recorded two interesting cases of a similar nature.† In one, a boy aged 7, the upper epiphysis of the tibia was diseased and the knee joint became implicated. The seat of disease was gouged and the knee joint drained with recovery.

In the second case, a girl aged 9, there was acute periostitis of the diaphysis of the right tibia, with sub-periosteal abscesses in all directions. Nearly the whole of the diaphysis was necrosed. An incision was made, and five inches of necrosed diaphysis resected. At the end of a month the knee joint became affected and a sinus was discovered leading from it to the tibial cavity. The joint was scraped and drained. Convalescence was at once established. We also have treated similar cases to these, and as I shall show afterwards with satisfactory results. And we must bear in mind what an important illustration this is of the advance of conservative surgery, for under like conditions amputation has hitherto been usually adopted.

But sometimes the disease is in the course of the diaphysis. In these circumstances, it may or may not be complicated with disease of the medulla. If quite superficial and limited, there is no special advantage in interfering actively. You may do harm and remove too much. Often, however, there is profound disease of the shaft implicating the medullary cavity and causing enlargement of the bone. Cases are not uncommon in which you have a chronic suppurative osteitis with or without *scattered splintery* or *localized central sequestra*. Here, early trephining sequestrotomy, trenching and gouging of the medullary canal—all or any of these operations may come into competition with resection. And yet I venture to think that the latter will often be found to produce the most satisfactory results. There is

* *Dict. Encyclop. d. sc. med. Art. périostite*, p. 227.

† *Brit. Med. Journ.* 1887, Vol. II., p. 1385.

room for prolonged investigation and comparison of the relative value of the eviscerating operations and resection.

This paper is a contribution to the subject. But I must here point out, that resections may not only be partial as far as the *length* of the bone is concerned, but also with regard to the *circumference*. In one sense, trephining may be a very modified resection. Trenching, where sometimes a strip of bone 4 or 5 inches or more in length and $\frac{1}{2}$ to 1 inch in breadth is removed, is a distinct partial resection, and it is in the performance of these operations that one is gradually led on to remove more and more of the diseased area and sometimes indeed of healthy new bone in order to get the best results. For the size of the actual bone cavity left after evisceration exercises great influence over the rate and completeness of cure. Some of the most satisfactory cases are those in which just a strip of bone is left posteriorly for the whole length of the shaft, as a support.

The formation of new bone is a question of paramount importance in connection with resection. If the operation is done early and the periosteum treated gently, provided the patient is young, there appears not to be the slightest risk of failure in this respect. I have mentioned that the patient should be young. This is an important point. One may indeed lay down the rule that the younger the patient the more rapid and completely successful will the result be, while in patients of more than fifteen years of age one grows increasingly cautious in performing resection and reluctant to remove any but unmistakeably necrosed bone. It is right to mention that a case has been recorded in which false joint followed resection of a portion of the tibia.* In this instance the operation was done in 1876 for extensive death resulting from abscess, and probably the periosteum was partially destroyed. In 1885 the boy was able to walk fairly well, but there was fibrous union of the contiguous ends of the tibia.

Even with a great extension of the frequency of performance of resection there will still be a very large number of cases left

* Murray. *British Medical Journal*, 1885, Vol. I, page 793.

in which this operation would be quite out of the question. In their *early* stages, most bone diseases will require surgical treatment of a different kind. Some forms of this treatment we have already referred to—as, for instance, the “antiseptic” opening of sub-periosteal purulent collections trephining, gouging and trenching. We may in addition mention the great value of subcutaneous periostotomy and of linear osteotomy and drilling. These latter operations are especially useful in subacute and chronic periostitis and ostitis whether pus be present or not.

Nowhere can bone disease be more advantageously studied than in the tibia, for here it is so common. This frequency may be accounted for partly by the great superficiality of the bone and its consequent exposure to cold and the action of violence.

Given an individual with the poison of acquired or hereditary syphilis in his blood and tissues, or with some other predisposition; add to this imperfect nourishment and then even a slight exciting cause may bring on disease. Sometimes it is not easy to determine the nature of the exciting cause. For instance, a few days ago I examined a boy in our out-patient department, who presented rather profound hypertrophic ostitis of the left tibia and left humerus. These bones on the right side of the body having escaped implication. This boy dates his disease from the time of the famine, some eight years ago. On the same day, I saw another lad suffering also from hypertrophic ostitis, but here the tibia and ulna of each side were affected, and the fibula to a less extent. In this case in which superficial bones of the extremities were generally affected, it was more easy to account for the condition than in the former.

One of the earliest and most frequent forms of bone disease, especially in the tibia, is a degree of periostitis associated or not with evident ostitis. In many cases this is obviously syphilitic. The patient comes to the Surgeon with complaint of pain in the shin continuous and rather severe; worse at night; great tenderness on pressure. The slight œdema of the skin and fleshy feel of the subjacent periosteum is characteristic. Here, if the symptoms are not urgent, the application of red mercuric

iodide ointment is often beneficial. Should the symptoms be severe, subcutaneous section of the periosteum may be performed for about an inch and a half of its extent. In the cases which I have treated in this way, the symptoms have often been strikingly alleviated.

Then, again, a certain number of patients with symptoms and signs of a similar condition will show, in addition, an increase in the size of the tibia,—usually most evident on its internal (subcutaneous) surface,—which tends to become markedly convex from above downwards. This is due to ostitis with formation of bone—hypertrophic ostitis it is usually called. Here in many cases, in which pain is a prominent symptom, linear osteotomy will be very valuable. The surface of the limb having been thoroughly cleansed with solution of mercuric *for* chloride, a firm incision is made down to and into the bone for a length of two and a half inches. Then,—the irrigator or spray being used meanwhile,—with the rounded end of a Hey's saw, incise the bone in the line and throughout the length of the first to a depth of $\frac{1}{4}$ to $\frac{1}{2}$ inch, and rapidly withdraw and stitch. In the majority of cases the wound heals by first intention, and great amelioration of the symptom results.

In both these classes of cases anti-syphilitic remedies are indicated.

Six cases of Ostitis treated with Linear Osteotomy.

Name.	Age.	Duration of disease.	Most prominent symptoms.	Progress.	Days in Hospital.	Result.
1. Sultana ...	22	3 years	Severe pain in tibia: no sleep at night.	Uninterrupted.	23	Cured.
2. Sadiqa ...	45	3 months	Swelling over lower half of tibia: great pain.	„	14	Considerable relief.
3. Asan Bhat	12	1 year	Considerable swelling on internal surface of tibia: great pain.	„	24	Cured completely.

Six cases of Ostitis treated with Linear Osteotomy.—concl'd.

Name.	Age.	Duration of disease.	Most prominent symptoms.	Progress.	Days in Hospital.	Result.
4. Kazima ...	30	3 years	Soft swelling, inner aspect of tibia.	Uninterrupted.	Not admitted	Cured.
5. Ramzana	22	1 year	Thickening and curving forwards of tibia, painful spots diffuse sclerosis and localized periostitis.	"	22	Improved.
6. Subhana...	40	...	A firm enlargement at lower end of humerus: painful.	"	21	Cured.

A much graver series of cases is that in which the patient suffers from severe ostitis resulting in necrosis of a portion or the whole of the bone. In some instances this commences in connection with the epiphysis, either at its surface or in its substance; in others it is diaphysial: and this latter form may be central, interstitial or superficial.

The *epiphysial* forms, as far as the tibia is concerned, occur with almost equal frequency at each end; perhaps they are found rather oftener at the upper end, in which the development is more rapid. The intensity of the process varies very much according to its duration.

1. There may be a mere local enlargement of the bone. In addition, congestion may be marked and pus formed* with softening of the epiphysial line, there may even be separation of the epiphysis from the diaphysis, the ends bathed freely in pus and with one or more external sinuses.

2. In some instances the epiphysis may be completely necrosed and found lying in an abscess cavity.† In such cases

* Case I, page 535. Case II, page 537.

† Case II. Case IX.

the contiguous end of the shaft of the bone is almost sure to be affected, and in many instances either a case of new bone or a barrier of embryonic tissue will have been thrown out around, and thus the neighbouring joint may have escaped disorganization.*

3. On the other hand, occasionally a localized abscess forms within an epiphysis. This may be pent up and eventually find its way to the surface (not unfrequently in a joint, especially in the young), or it may be opened by the Surgeon and a catastrophe be thus averted.

4. Caries in young people is sometimes set up at the epiphysial end of a bone as a process distinct from those already mentioned.

It must be borne in mind that epiphysial disease is seldom strictly localized. The medulla of a bone may be affected early. Inflammation may even be communicated from one epiphysis to the other through the medullary cavity.

In death of the *shaft* of a bone there are several forms which have to be dealt with.

1. There is that in which the diaphysis as a whole has become sequestered or nearly so.† FIG. 1. This results in most cases from a suppurative periostitis having cut off the blood supply. The bone may be enclosed by a case of new osseous material with discharging vents or cloacæ. In early stages of acute suppurative necrosis this case is absent or nearly so.

2. The *end* of a diaphysis may die. When this occurs death is often due to the contiguity of a diseased epiphysis. Indeed, sometimes a destructive process which originates at the epiphysial line may affect the diaphysis chiefly, the epiphysis escaping disorganization.

3. There is that form in which a *central portion* of the bone dies and becomes surrounded by expanded and porous or sclerotic and dense bony tissue preserving the general form

* Case IV.

Case V.

† Case V.

FIG. 1.—NECROSIS OF ULNA (reduced $\frac{1}{2}$) case (v.)

- a. b.* Sigmoid cavities.
- c.* Shaft, apparently unchanged.
- d.* Atrophied end, with gaps resulting from disintegration.
- e.* Flat olecranon end; the process has not yet been developed.

FIG. 2.—PORTION OF TIBIA (measuring $6\frac{3}{4}$ inches) resected, for suppurative osteitis, and showing fusiform expansion of medullary cavity.

A.—External aspect—

- a.* Upper end of abscess cavity.
- b.* Deposit of new bone, porous with innumerable new nutrient foramina or enlarged Haversian canals.
- c.* Chief sinus.
- d.* Ulcerated area, the floor of which is formed by old bone and the walls by new.
- e.* A second abscess cavity.

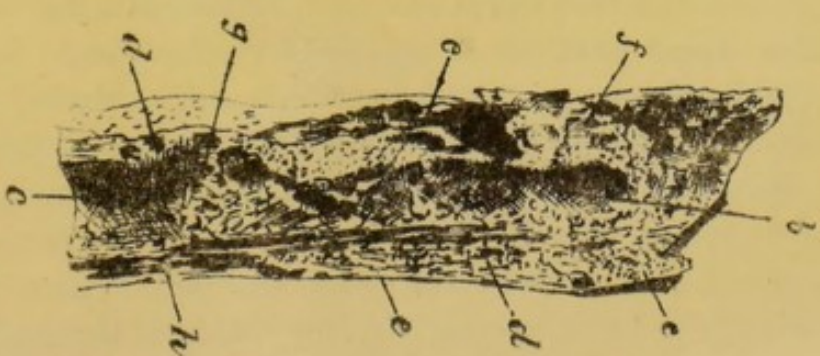
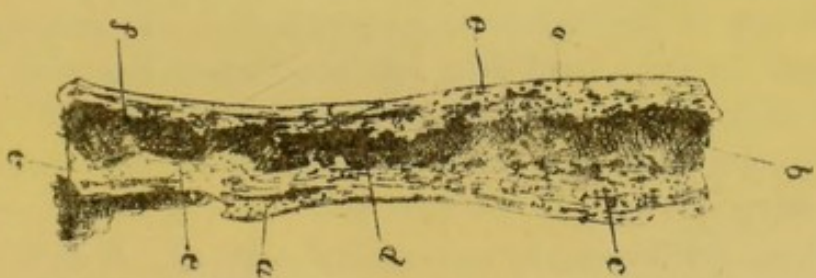
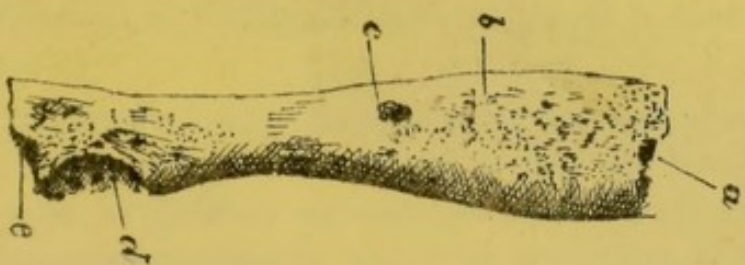
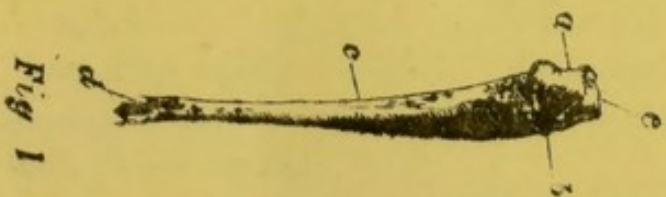
B.—Vertical section—

- b. f.* Abscess cavities, communicating with each other through the medullary canal.
- d.* Medullary cavity, strikingly devoid of cancellated tissue and with indurated walls.
- a.* Dense bone, the greater proportion of which is newly formed.
- c. e.* Porous bone, more or less stratified.

FIG. 3.—INTERSTITIAL SUPPURATIVE OSTITIS.

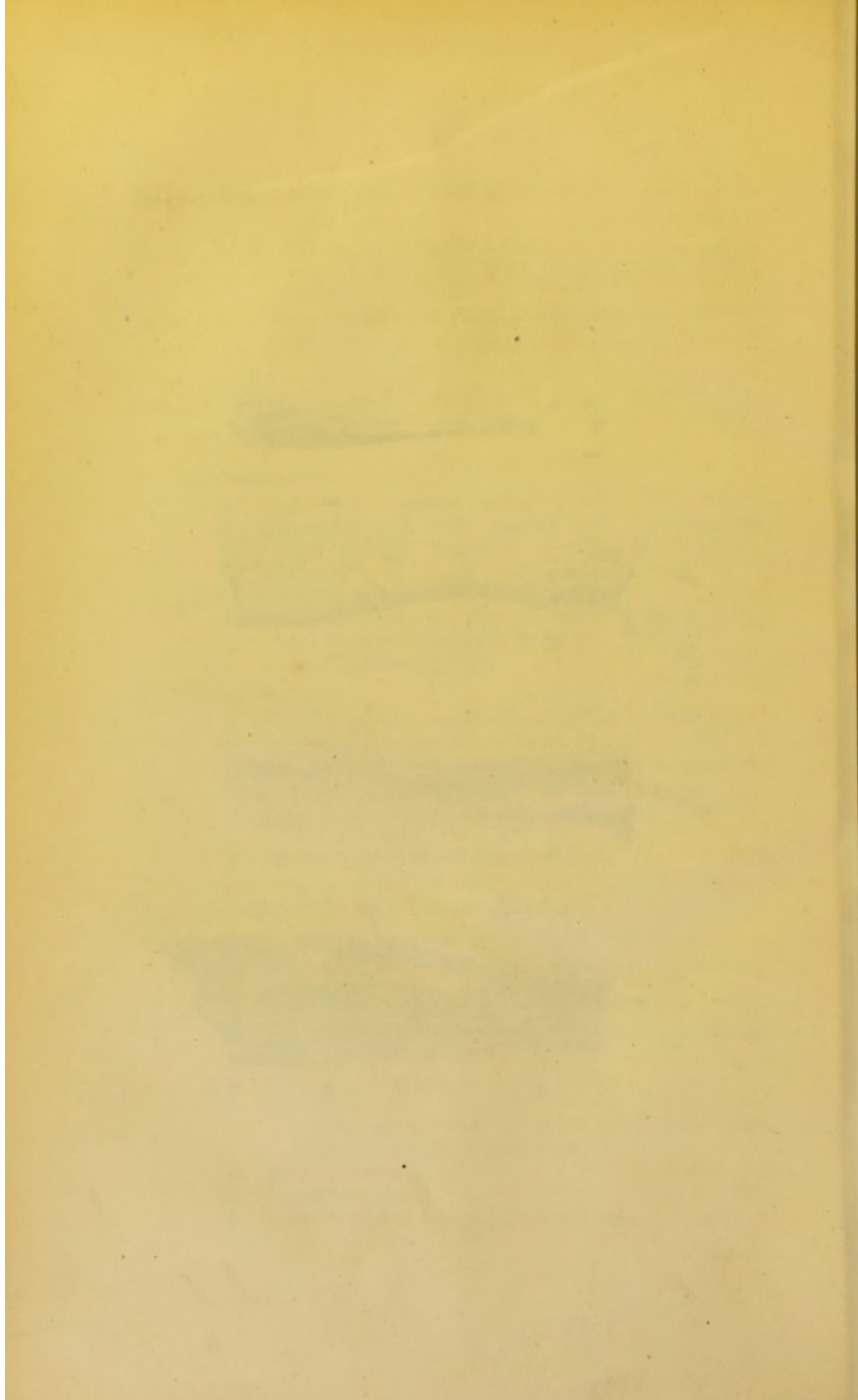
Resected portion of tibia (measuring $6\frac{1}{2}$ inches).

- a.* Deep trench like ulcerated surface on the anterior aspect.
- b.* Medullary cavity communicating with (*a*).
- c.* Another portion of medullary cavity communicating by sinuses with (*b*).
- d. d.* Small cavities, original purulent foci.
- e.* Thickened wall, the outer aspect dense; the middle porous and expanded; the inner consisting of laminated cancellous tissue.
- f.* Mass of porous bone.
- g.* Cancellous tissue.
- h.* Loosely packed laminae of porous bone.



A Fig. 2. B

Fig 3



of the bone and perforated by sinuses.* This variety, which is not common, is apt to be confounded with the first form, mentioned above, in which a new bony *case* contains an entire bone necrosed to a greater or less extent.†

In some cases porosity may be an early stage, and later on a bone thus affected may become dense. Porosity does, however, not unfrequently remain as a permanent condition; the bone, although bulky, remaining light in weight. Like sclerosis, this condition is by no means always associated with necrotic changes, but may result from simple osteitis.

4. Exfoliations of portions of the surface of a bone are not uncommon.

5. An important form of bone disease, a common result of osteitis to which hitherto due attention has not been accorded is spicular or *splintery necrosis*. In more severe forms of this affection, separate sinuses lead down to portions of dead bone in different parts of the diaphysis—none of the sequestra are of large size. In such cases, minute collections of pus will be found here and there, associated with local areas of death of bone.‡ The cancellous tissue of the medulla will often be found riddled with sinuses and abscesses, with walls sclerosed to a greater or less extent. The whole bone may be greatly enlarged. FIG. 3. In spicular necrosis the medullary cavity is apt to be early implicated. As the result partly of tension, localized and often fusiform swellings of the bone occur with discharging sinuses. FIG. 2. Some forms may consist chiefly in an inflammation of the medullary cavity with one or more areas of pent up pus which tend to bore their way to the surface. This process may occur without any death of bone, except such as the destruction of the medullary cancellated tissue and the sinuses boring imply, together with the original focus of spicular necrosis which started the disease.

* Cases VI and VII.

† Case IV.

‡ Cases VIII and IX.

6. Finally, in adults, after union of shaft and epiphysis we may meet with caries of the cancellated tissue of bone ends. Sometimes this arises from external processes as the extension of ulcers, gummata, etc. Amongst other varieties there is a special form of caries of a very indolent character arising in elderly people. But I do not purpose dealing with this subject in the present paper.

In the above remarks I have adopted classification to a certain extent with a view to facilitating description. But here, as in many diseases, the varieties are frequently more differences of degree than of kind. In speaking of cases of necrosis, for instance, the recognition that this state is only the final condition or one goal of inflammatory processes—that it is not so much the disease as the result of disease—must, where not expressed, be understood.

The following cases, selected from a much larger number, will illustrate some points in the pathology and treatment of bone disease:—

CASE I.—Ostitis (epiphysitis?) and carionecrosis of upper end of tibia: Trephining and gouging: Recovery. L., male, *æt* 7: admission September 24th 1887: complaining of discharge from a sinus at the upper anterior aspect of left leg—of some weeks duration. The opening was situated over the inner border of the tibia on a level with the tubercle, and the sinus led backwards and outwards for about 1 inch; no dead bone could be felt. There was considerable local enlargement.

antero September 26th.—A near ^{by} vertical incision about $2\frac{1}{2}$ inches long was made over the inner aspect of the tubercle of the tibia, down to the ~~cutis~~ internal surface. The periosteum was turned back and two holes made with a $\frac{1}{2}$ inch trephine. One hole was situated vertically under the other, and a bridge of bone $\frac{1}{4}$ inch wide left between. On removing the discs the cancellous tissue was found to present a dark red, engorged appearance. Towards the posterior aspect of the resulting cavities carious spicules were found with globules of purulent matter. There was a sinus passing from the posterior aspect of the bone

and becoming continuous with that which opened externally. There was no definite sequestrum.

The cavity was freely gouged and tunnelled until all the walls were composed of healthy tissue. Drainage tubes were inserted, and the wound sutured.

September 26th—30th.—Temperature varying from 99 to 101° F. Skin wound opened up.

October 12th, et seq.—Wound steadily contracting and depth diminishing. Tubes shortened at intervals.

October 28th.—Tubes removed : area of wound 1 inch \times $\frac{1}{2}$ inch.

November 7th.—Area of wound $\frac{1}{4}$ inch \times $\frac{3}{4}$ inch. Dismissed.

This was a case which well rewarded prompt interference. In six weeks the child was practically well. With expectant treatment, it would have been a long time before such deep-seated disease could have undergone resolution, whilst there would have been an ever present risk of extension and serious implication of the epiphysis and the diaphysial end.

CASE II.—Epiphysitis of tibia : drilling.

Persistent ostitis and caries : resection.

Epiphysitis of fibula implicating joint ; amputation : recovery.

M., *æt* 15, male, was admitted with epiphysitis of the head of the tibia, November 30th, 1887; under the care of Mr. A. Neve. There was a sinus with a moderate amount of discharge. Pain on pressure intense. Local enlargement of bone, great. On the same day the bone was drilled to a depth of $1\frac{1}{4}$ inches. This was followed by distinct improvement. However the discharge continued, and as the bone was judged to be profoundly diseased a portion of the upper end, 4 inches in length, was removed by resection on December 17th. The boy made very fair progress, although rather weak, and the wound appeared to be granulating in a healthy manner. On January 8th, 1888, the knee was observed to be swollen. By the 12th, there was no doubt that suppuration of the joint had occurred. As the boy was not strong, and the cause of the suppuration appeared to be in all probability connected with the wound, amputation was performed through

the condyles of the femur by Spence's method. Recovery was a steady but very slow process : in fact the boy did not leave the Hospital until the 13th of April 1888.

The portion of bone mentioned above as having been resected was in a condition of profound osteitis, within one place purulent infiltration of the medullary cavity. The cancellous tissue of the upper end was carious. About $\frac{1}{3}$ of the portion of shaft removed was undergoing necrosis, and there was a diagonal line of separation visible, but not very sharply defined, running from behind downwards and forwards; on the anterior aspect the bone for a length of 3 inches was eroded deeply, rough and soft.

After amputation, the head of the *fibula* was found to have an ulcerated articular surface, communicating with disease of the epiphysis. This was evidently the source of the joint disease, and was confined so closely to the articular surface that it would have been impossible to treat it except by opening the joint. It is possible that had the upper end of the *fibula* been excised, and the joint been thoroughly erased and drained, that the boy might have recovered with a useful limb. But the condition of his health would have rendered the experiment dangerous to a degree, and in this connection the period required for his complete recovery, even after amputation, should be noted. The portion of the tibia which was the seat of the previous resection was carefully examined, and its condition, both microscopic and macroscopic, was thoroughly investigated with results sufficiently important to warrant separate and full publication. I may here simply remark that signs of active bone regeneration were present, and that even in the short space of 26 days, which had elapsed between the resection and the amputation, so much had been accomplished in this direction that I entertain but little doubt as to the eventual completeness of repair, had it not been for the unfortunate intercurrent fibular and joint disease.

CASE III.—Acute necrosis of lower $\frac{2}{3}$ of shaft of femur fracture at epiphysial line; implication of the joint, resection of large portion of femur: drainage: recovery.

I quote this case in juxtaposition to the last, on account of the fact, that here also the joint was involved. But in this instance the limb was saved. It will be seen, however, that the etiology of the two cases was very different, and that the boy, whose history I am about to relate, had certain advantages on his side.

G., *et* 14, admitted under the care of Mr. A. Neve, on April 2nd, 1888. The history was, that the lower part of the thigh had become greatly swollen, and then 7 days previous to admission the bone broke and pus and blood escaped. When admitted 3 inches of femur projected from a wound on the inside of the thigh near the knee. The joint was involved. On account of the weakness of the boy, amputation was proposed; as the friends would not entertain the idea a portion of the necrosed femur, consisting of $\frac{3}{4}$ of its length, was resected down to the epiphysial line, and the joint thoroughly drained. For a few days the condition of the patient was critical. But then steady improvement set in and continued with but few interruptions until June 9th, when the limb was set up in plaster of Paris and the patient dismissed: at that time there had been great formation of bone throughout a length of 5 inches—in some places indeed this was excessive. There was an abnormal degree of movement $2\frac{1}{2}$ inches above the joint. The limb was between 3 and 4 inches shortened—this being largely due to a degree of distortion of the lower end of the new bone and displacement backwards of the condyles. The combating of this by weight and pulley extension and splints had been greatly interfered with by a recurring tendency to ulceration of the limb from the pressure of the necessary plaster and bandages. In fact, for a time, the double inclined plane was the only form of extension practicable. About the end of June, when the patient was again seen, much improvement had occurred. The new bone was firmer, and the area of preternatural mobility, above the knee joint, had almost disappeared.

I have heard quite recently (December 20th) that G. can now walk for considerable distances, with the aid of a stick.

In this boy's case the joint was distinctly affected secondarily to the disease of the femur, and indeed probably to the fracture, which occurred at the epiphysial line. The patient was rather younger, the disease of shorter duration; there had not been the shock and constitutional tax of a previous operation, and only one bone was affected. But both cases belong undoubtedly to that border-land class in which the Surgeon is often exercised in his mind as to whether amputation should be performed or whether it is justifiable to attempt the preservation of the limb.

CASE IV.—Necrosis of epiphysis and diaphysis of tibia; new bony case; sequestrotomy resection of case. Cure.

K., *æt* 7, female. Ill three months. Three sinuses at front of tibia, each communicating with dead bone. Sequestrum not movable. Discharge considerable.

September 26th, 1887.—Operation. Curved incision, including sinuses. Cut down to bony case. Periosteum reflected. I removed the whole of the greatly enlarged bony case, except the posterior aspect, a strip of which was left for support. At the upper aspect, considerably above the highest sinus, there was an abscess cavity the size of a walnut, which contained the epiphysis, loose and lying in pus, a thin layer of new (?) bone being interposed between it and the joint. The diaphysis, almost down to the level of the lower epiphysis, was necrosed and removed as a ragged sequestrum.

A drainage tube was inserted throughout the length of the wound, and the latter was closely sutured. Subsequently there was some sloughing of the skin edges. But, thanks to the removal of the bony case, coaptation was easily secured by plaster. Ossification and healing went on rapidly, and by the 5th of November I find the following entry in the case book: "The new tibia already resembles the opposite one in size, etc. The child walks and stands without help. At the upper and lower corners of the incision there are minute sinuses."

November 10th.—Dismissed cured.

This was a case of profound disease, treated in a radical manner. We observe that recovery took six weeks, or the same

time as in case I., a child of the same age, and whose operation was much less severe. I am persuaded that the result was more satisfactory both as regards the form of the limb and the duration of recovery than if I had simply removed the sequestra.

CASE V.—Total necrosis of ulna, following small-pox; joint unaffected. Cure.

S, male, *æt* 1½ years, admitted May 18th, 1887; under the care of Mr. A. Neve. Duration of illness 6 weeks. A month ago an abscess formed and then a sinus below the elbow. On May 18th, just previous to admission, the child fell, and bare bone protruded. The arm was much swollen, and the articular end of the bone was projecting near the elbow.

The shaft was withdrawn, and a counter opening made, with through drainage. At the time of operation, bone was found to be already in process of formation.

May 22nd.—Drainage tube removed.

May 25th.—Wound closed. Free movement of limb; slight serous discharge. Dismissed.

This case was evidently very acute. And the necrosed ulna was practically unchanged in form, with the exception of a somewhat ragged lower extremity. The interest centres in the fact that the joint escaped implication, being apparently shut off by embryonic tissue from the abscess cavity.

The whole of the articular surface of the ulna was present. But on account of the age of the child there was no epiphysis yet developed, and the olecranon process was absent, the bone being curiously flattened at that point (Fig. 1). The case is a good illustration of the rapid way in which nature sometimes removes subperiosteally a diseased bone. It also presents some distinct points of resemblance to case IV, than which, however, it was much more acute.

CASE VI.—Hypertrophic ostitis of tibia, with central necrosis; resection. Cure.

F., female, *æt* 4, admitted, November 17th, under the care of Mr. A. Neve.—Leg swollen. Bone enlarged. Four sinuses, the

lowest 2 inches above the ankle. Skin tense and cicatricial. Dead bone can be felt with probe, but not movable. Four and a half inches of the bone were removed by resection on the day of admission. The wound edges were coapted by sutures and pressure applied to arrest hæmorrhage.

November 24th.—All stitches removed. Line of incision united well.

December 23rd.—Plaster of Paris splint applied.

January 15th, 1888.—Well-formed bone. Stands and walks. No deformity.

The portion of tibia removed was of considerable interest. It was curved, convex anteriorly, and of circular section. Its external appearance was that of well-formed bone, with nutrient foramina and haversian canals on vertical section. The following condition was observed: At the upper end the medullary canal was patent for $\frac{1}{2}$ inch containing inflamed medullary fat. Then there was an obliteration of the cavity by firm dense caseous tissue for about $\frac{1}{4}$ inch. Below this was a cavity 3 inches long containing a cylindrical hollow, sequestrum of the same length jagged with vertically ribbed striation. Its breadth was $\frac{1}{4}$ inch. The floor of the cavity in which it lay was lined with a shiny membrane, in some places quite smooth. In other places, abundant granulations were present. The walls of the canal were formed by thickened dense bony tissue $\frac{1}{4}$ inch thick, on the outer aspect of which soft new bone had been deposited by the periosteum. The bone was penetrated by three sinuses.

CASE VII.—Hypertrophic osteitis, upper third of humerus, central necrosis sequestrotomy.

This case is not dissimilar from the last. As, however, the patient was a lad aged 17, sequestrotomy was performed instead of resection. The position of the disease, moreover, and its close relation to the important bicipital groove were determining factors as to the operation which should be adopted. An incision 3 inches long was made, extending downwards from 1 inch above the deltoid insertion. The periosteum having been reflected, I removed an oblong portion of the bone $2\frac{1}{2}$ inches \times $\frac{3}{4}$ inch.

The thickness of bone which required to be penetrated before medullary cavity was reached was quite $\frac{3}{4}$ inch. The cavity was full of pus and a sequestrum, forming an almost complete hollow cylinder of 3 inches in length and $\frac{3}{4}$ to $\frac{1}{2}$ inch in breadth, was found. From its size, position, and relations, there was every reason to believe that it was a circular central necrosis of the wall of the medullary cavity at that situation.

CASE VIII.—General splintery necrosis of tibia; purulent foci; trenching and gouging. Cure.

A., male, *æt* 12, admitted April 23rd, 1887. Duration of illness one year. Tibia enormously enlarged and bowed forwards. Small ulcer over centre of anterior aspect, in the floor of which roughened bone can be felt. Another tiny sinus close to the former and leading $\frac{1}{2}$ inch into the bone.

April 23rd.—I chiselled a longitudinal strip $1\frac{1}{4}$ inches wide and 5 inches long out of the convex antero-internal aspect of the bone. The medullary cavity was thus opened. It was found to be much congested and infiltrated with pus. In its walls were several small spicules of dead bone, varying in length from $\frac{1}{4}$ to $2\frac{1}{2}$ inches; and both there and in the bony edges cut by the chisel there were soft fatty areas, with occasional small purulent foci. One such focus, about the size of a large pea, was found in an isolated position, and about 3 inches below the knee joint, in the midst of bone, in this place apparently otherwise healthy. The whole medullary canal and all diseased areas were gouged. The resulting cavity was drained from the lower end through a hole passing backwards, and bored for the purpose 2 inches above the internal malleolus.

April 23rd.—Oozing severe. Liq. Ferri Perchl., applied twice in the night.

May 4th.—Granulating well, but skin wound has opened up almost throughout.

May 13th.—Discharge diminishing, but still abundant.

June 7th.—Filled up wonderfully. Cicatrizing over.

July 18th.—Quite healed. Leg still bowed forwards. This case took nearly three months to get well. Resection would have been more thorough. I think the time required for recovery would have been less, and the slight deformity mentioned above would have been absent.

CASE IX.—Extensive spicular necrosis of tibia; sequestration of epiphysis; extensive trenching. Great improvement.

R., *æt* 13, male, was admitted on September 7th, 1887, with enormous enlargement of the right tibia. Two and a half inches below the knee joint there was a sinus in front, leading to bare bone.

There were two other sinuses, one, two inches above the ankle joint. All were discharging copiously.

On September 8th I made an incision throughout the greater part of the length of the tibia, interrupted at the centre.

The periosteum was reflected. At the head of the bone there was an abscess cavity in which lay the epiphysis, loose and necrosed. The joint was not implicated.

The diaphysis was affected throughout its length with spicular necrosis. Strips of bone were removed from the anterior aspect, and the spicular and softened diseased tissue gouged. The bone was, in fact, thoroughly eviscerated, leaving a profound gap. This was stuffed with oiled lint, skin wound brought together throughout, except at the old sinuses, at which points the drainage tubes had their exit.

September 10th.—Oiled lint removed.

September 11th.—Upper end of wound opening up.

September 25th.—Discharge considerable.

October 10th.—Steadily improving. Tendency to knock-knee.

October 18th.—Lower wound almost linear.

October 21st.—Granulations (tested with a needle) are $\frac{1}{4}$ inch deep, and then bone is felt. Lower wound linear and 2 inches long.

October 28th.—Lower wound dry. Limb straight when extended.

November 3rd.—Upper wound $1\frac{1}{4}$ inches long and $\frac{1}{8}$ inch across.

November 15th.—Progress rather lingering ; a sinus at lower end of upper incision which will not heal.

November 18th.—Dismissed greatly improved.

This being, as far as the diaphysis was concerned, a case of splintery necrosis, *i.e.*, much healthy bone being mixed up with the necrotic portions. I thought it hardly justifiable to excise the whole bone. I am rather disposed to regret not having done so. Recovery took nine weeks and more, and even then was not quite complete, so large was the gap which had to be repaired. In a patient three or four years older than this no doubt an eviscerating operation is the best. But in a boy of 13, reformation of the whole tibia would take place more quickly and leave less deformity than remains after evisceration.

CASE X.—Caries of external malleolus ; gouging ; inflammation of ankle joint ; osteitis of lower end of tibia ; trephining and linear osteotomy. Recovery.

R., male, *æt* 16, admitted April 9th, 1887, suffering from swelling of the ankle and a sinus over lower end of fibula with discharge. Duration of illness 6 months. Has not been able to walk for a month. Lower end of bone enlarged and carious, there being a deep ulcer in the external malleolus extending from two inches above the tip, downwards, and inwards towards the joint. On April 13th, I gouged the floor and walls of the carious ulcer until healthy bone was exposed, except at the inner aspect where, on account of the close proximity of the joint, great care had to be exercised. The cavity left was about the size of a walnut. The matter removed consisted of pulpy granulation tissue and portions of pyogenetic membrane, lining sinus together with spicules and granules of decayed and sclerosed cancellous tissue and a certain amount of healthy cancellated material.

April 15th.—Wound looks clean. Little pain.

April 20th.—During the last two or three days there has been synovitis of the ankle joint and some synovial fluid (?) appearing in the wound. Also fever and pain.

April 21st.—Slight improvement. Evening temperature 101.8° .

April 24th.—Pain now localized to lower part of tibia just above the ankle joint.

April 26th.—Temperature still rather elevated. General state bad, eats very little, and is weak.

May 2nd.—I trephined the tibia over the lower epiphysial line. The periosteum was rather soft and thick, and more fleshy and vascular than normal. The bone was congested.

A linear osteotomy was also done immediately above the trephine wound, on the inner surface of the tibia. The result of this was a marked improvement in all the symptoms. The joint did not suppurate but became firmly ankylosed. The boy was dismissed at the end of June.

In this case, the interest centres around the fact of the proximity of the disease to the ankle joint, and the part which the fibula and the tibia respectively played. With regard to the fibula there was, on the one hand, the risk of leaving the carious cavity alone, with the absolute certainty, judging from the course it pursued during the week it was under observation, that the joint would soon become affected. On the other hand, there was a certain risk in treating the ulcer by usual methods. Three days subsequent to the operation, inflammation of the ankle joint appeared, and there was every reason to believe that there was a communication between it and the fibular wound. But the distinct localization of pain to the tibia suggested a new line of treatment. This case undoubtedly points to the advisability, in joint disease, of early treatment of any suspected bone, and it is obvious that by such treatment as that adopted in this case tension may be relieved and a joint saved from the results of a dangerously approaching condition epiphysitis.

CASE XI.—Compound fracture of both bones of leg; necrosis of portion of tibia; resection; subsequent bone grafting. Recovery.

R. B., *æt* 30, admitted January 13th, 1888. Eight weeks ago his leg was broken by a mass of stone falling from a height. The wound had been greatly neglected, and at the time of his admission there was a large collection of retained pus. A portion of the bone projected from the wound, bare and white. There was no attempt at union. The tissues were undermined by burrowing pus. The man was in the last stage of exhaustion, from pain and discharge. On the day of admission I operated, resecting about $2\frac{1}{2}$ inches of necrosed tibia and freeing the fibula from vicious attachment to the tibia. On the table the patient's pulse failed, and altogether he looked so bad that I rather regretted, at the time, that I had not amputated the leg.

January 15th.—Temperature 98·4.

January 17th.—Very little discharge.

January 27th.—Length of wound about $1\frac{1}{2}$ inches; bone ends are in good position, but a gap of soft tissue $2\frac{1}{2}$ to 3 inches in width between them.

January 30th.—Six grafts applied in different parts of this gap, four periosteal and two of bone and periosteum (these were taken from a young puppy, killed at the time); the smallest graft was about a cubic line in size. The largest measured $\frac{1}{2}$ inch in length and about $1\frac{1}{2}$ lines in breadth.

January 31st.—Longest graft partially detached.

February 3rd.—Four of the grafts have evidently taken—the others cannot be seen. (Subsequently, one bone graft was discharged).

February 17th.—Grafts completely covered in with granulations. Wound superficial. Still a degree of movement between, the ends of the tibia.

Considerable ossification has taken place. And in all directions, even between the actual ends of the bone, cartilagenous-like tissue can be felt, with a pin, at a depth from the surface of $\frac{1}{4}$ inch.

March 2nd.—Plaster of Paris splint applied.

March 7th.—Cannot walk yet, as the other leg is weak.

March 20th.—New plaster case applied. Shortening of limb 3 inches.

March 25th.—now walks a little on crutches.

April 17th.—Dismissed cured.

This case illustrates the fact that, even in adult life and under the unfavourable circumstances above mentioned, good results may be obtained after resection of a portion of a long bone.

It will be seen that in none of the above cases was prolonged expectant treatment adopted. In some cases of bone disease, especially perhaps in affections of the femur, expectant treatment is desirable and necessary. But usually, I take it, it implies an incomplete diagnosis—a desire to avoid a formidable operation in the absence of exact knowledge of the situation and extent of the disease. Prompt operative treatment should, however, be the *rule*, and expectant treatment the exception. When the diagnosis is not easy, an exploratory operation will often furnish all necessary information, and will place the Surgeon in the best possible position for deciding whether to operate or to remain inactive. And in addition to this such an opportunity may be advantageously seized for the relief of tension and the arrangement of satisfactory drainage.

NECROSIS OF THE LOWER JAW.

BY ERNEST F. NEVE, M.D., F.R.C.S. Ed.

In places, and under circumstances in which bone disease is common, it is not surprising that the lower jaw should be sometimes at fault. Its position and consequent exposure to the effects of cold and injury; its important functions and dependent activity; its tendency, through carious teeth, to exposure, to septic and other pathogenic influences, and its less blood supply (in comparison with the upper jaw)—all combine to mark it out for disease. It is, in fact, strange that morbid changes are not more common.

The chief antecedents to necrosis of this bone may be regarded as phosphorus poisoning and eruptive fevers. Of these the former has a much greater tendency to produce complete destruction.

Amongst other causes which have been assigned, are syphilis, mercurialism, blows, ulcerations, other than caries of the teeth and glanders. Probably the tubercular constitution is a predisposing cause. And the so-called "idiopathic necrosis" in a certain number of instances has no doubt occurred in subjects of this diathesis.

Nevertheless, some cases remain, the etiology of which has not yet been discovered.

Some years ago Mr. Cripps* recorded an interesting case, in which nearly the whole of the lower jaw became necrosed. This took place very rapidly, and was associated with sloughing of soft tissues. With regard to the causation there appeared to be some connection (closer than that of mere coincidence) between this and the illness of a favourite cat in the patient's house. This animal was suffering from swelling of the mouth and nose, with discharge. Mr. Cripps, with regard to what he believes to be a special disease, points out that nearly a century ago Hamilton

* *Lancet*, I, 1880, p. 768.

described a similar condition, and that since then, on this subject, little, if anything, has been added to our knowledge.

We have mentioned syphilis. Now it is fully recognized that this disease is one of the causes, if not the commonest, of chronic periostitis and osteitis of the jaw. There is, however, a tendency to regard it as inclining rather to produce enlargement of the bone than death. But syphilis is also, undoubtedly, a very important factor in the production of necrosis. How far, sometimes, mercury is to blame, if that drug has been previously used to an injudicious extent, it is not easy to say. Insufficient nourishment, however, superadded to the syphilitic poison, must be a predisposing cause quite sufficiently potent!

The symptoms and signs of disease of the lower jaw are peculiarly distressing. The pain, owing to the abundant nerve supply of the face, the early swelling, and even paralysis,* the impaired functions of so important a part—all contribute to make the condition a trying one. And then, when suppuration commences, it is difficult to say where its limits may occur, or where the burrowing pus may find an outlet; while the patient's health is apt to be seriously impaired as a result of the swallowing of foetid pus. Again, the treatment is increased in difficulty by the relations of the bone and, on the one hand, the undesirability of making incisions in the side of the face, both from considerations of resulting disfigurement and of risk of injury to branches of the facial nerve. On the other hand, we have the often comparative inutility of free incision within the mouth. In addition to this, if the surgeon elect to await the separation of a sequestrum, *a period of grievous distress* may be inflicted upon the patient, during which comparatively little can be done, and during which many or all of the conditions already mentioned may be present and actually progressive.

It is true that in some cases we may be rewarded by early (*i.e.*, after a few weeks) and partial exfoliation. And in other instances, patients may not come to us until the whole bone, or part of it, is ready or nearly ready to be cast off or removed.

* F. T. Porter. *British Medical Journal*, Vol. II, 1878, p. 121.

But in many cases several weeks, or even months, may be consumed, and even then it may be necessary for the surgeon to step in and shorten the natural process.

Exfoliation of a portion of the bone is common enough.

Total necrosis is of much less frequent occurrence.

I remember seeing, in Edinburgh, an interesting case of complete death of the jaw in a young boy, under the care of Mr. Annandale. The curious thing here was that there was no distinct cause. First, there were carious lower teeth; then, a gumboil, at the same time a lower molar tooth was being cut. There was no special evidence of tubercular constitution. *Acute* suppurative necrosis set in; after a fortnight the whole jaw which was almost completely isolated, was separated and extracted from the mouth by Mr. Annandale. The little boy, however, died five days subsequently from some complication—probably meningitis.*

As a contrast to this, let me mention a case of *chronic* suppurative necrosis which occurred in connection with the practice of the Kashmir Hospital. It was in a man aged 30, an inhabitant of Ladak, of robust appearance. He had been suffering for two years. From his mouth there was a fetid discharge. The teeth of the lower jaw, six or eight in number, were loose, and pus oozed up from their sides. There was very little new formation of bone. That which existed was chiefly at the angle. On the left side of the face, under the horizontal ramus, there was a sinus. The patient was operated upon by Mr. Arthur Neve. All the teeth having been withdrawn; the holes were joined together by an incision along the upper edge of the alveolus. The periosteum, where not already detached, was separated with the finger, and the entire jaw, in two halves, was removed through the mouth. The patient convalesced in a few days, and was discharged.

My friend and predecessor, Dr. Edmund Downes, has recorded a similar case, in which the bone was removed by external

* Vide *Lancet*, Vol. II, 1878, p. 165.

incision,* with a very good result ; the subsequent deformity being slight.

Necrosis of *half* the lower jaw is, however, more frequent. Good examples of this condition have been recorded, amongst others by Garden † (in an old woman, *æt* 76, first one half necrosed, and subsequently the other portion), Henry Smith‡ and Downes.§ In Mr. Smith's patient, a boy, *æt* 7, the condition had resulted from measles. After waiting nearly three months, during which time there was fetid oral discharge, the half bone, which had separated, was removed through the mouth. Dr. Downes reported five cases. All of these were, in his opinion, the result of syphilis. In two, he removed the diseased half by external incision. In one of these a fistula afterwards formed, which gave trouble, but eventually healed. In both, great deformity resulted, the face being much drawn to the side from which the bone had been removed. In each of the three subsequent cases the affected half of the jaw was removed from the mouth subperiosteally. The resulting deformity was slight.

Now there is, in this later class of cases, a stage (perhaps I should say, a variety) in which disease is of a chronic nature, and defies ordinary medical and surgical treatment, in which drainage and counter-drainage, together with incisions of the periosteum, do not produce much amelioration of symptoms, and in which any separation of dead bone seems deferred indefinitely. These cases are commonly unilateral and usually the result of syphilis. At least, the condition occurs in syphilitic subjects. It is not necessarily as a tertiary phenomenon of acquired syphilis : for I believe that it is not unfrequently present in the hereditary form of the disease, especially, perhaps, where the taint is strong, and where want of food and exposure to cold have been super-added.

Now, instead of waiting months, and even years, it is here that early and sometimes radical operative treatment is often followed by the best possible result.

* *Lancet*, II, 1881, p. 870.

† *British Medical Journal*, I, 1880, p. 169.

‡ *Lancet*, II, 1878, p. 806.

§ *Loc. Cit.*

The form which this treatment should take is, in the first place, excision of the condyle (often ankylosed) of the jaw of the affected side. If this be followed by marked improvement, we can better afford to await the further development of the case. Sometimes, I believe, if the bone is not actually necrosed, the condition may in this way be averted. If, however, extensive or total death of the bone has set in, and deformity is considerable, and the patient's suffering great—then, in the second place, excision of the affected side of the jaw should be performed subperiosteally and from within the mouth.

If excision of the condyle have been performed first, the operation is, of course, somewhat simplified. If, however, the case be severe, excision of the jaw should be practised at once, and thus there is the advantage of having no such external wound as would probably continue to exist after previous excision of the condyle.

The following four cases are fairly typical, and I give them somewhat in detail:—

CASE I.—CHRONIC NECROSIS OF LOWER JAW.

SUBPERIOSTEAL RESECTION. CURE.

F., female, *æt* 45, in February 1887, suffered from periostitis of the left half of the lower jaw. Suppuration had occurred, which was treated by incision from the mouth. Subsequently, the cheek became swollen, brawny and riddled by sinuses. This state continued for two months, during which time, in spite of careful treatment, there was not only no improvement but steady aggravation of symptoms. The patient was admitted to the hospital on April 27th, 1887, and on that date the diseased half jaw was resected. The jaws having been separated by a Lister's gag, and two or three teeth removed, I incised the alveolar margin of the jaw, and detached the periosteum with a raspatory up to the condyle and coronoid process, sawed and cut through the horizontal ramus behind the lower canine tooth, and, twisting out the fragment, severed the temporal attachment and lateral ligaments. The bleeding was not great; but

for greater safety the patient's head was allowed to hang well over the table.

The cavity of the periosteum was stuffed with lint. On the 28th, the face was still much swollen.

May 3rd.—Doing well, wound clean, no pus from sinuses.

May 5th.—Some local retention of pus and consequent swelling of cheek.

May 13th.—Having been steadily improving and the swelling diminishing she was dismissed distinctly improved.

November 1887.—Mouth opens freely; some formation of new bone, sinuses healed; new discharge.

January 1888.—Deformity very slight; new half of jaw reformed to a certain extent.

January 1889.—Free movement of jaw, can eat comfortably. The sound half has rotated round somewhat. The deformity is not at all pronounced. There is a distinct hollow corresponding to the absent portion. This is due to the fact that *all the new bone has been absorbed.*

The pathological condition of the jaw in this case was the following:—The inner surface of the periosteum was lined by a thick layer of soft velvety granulations—consequently, throughout the greater part of its extent, especially on the outer side, no force was needed for its separation. The portion of the jaw removed was covered with thin scales of soft pink bone, apparently a feeble attempt at a new case. This could be scraped off and left a white dense surface, not sequestered or altogether necrotic. On section, the marrow and central portions of the bone were very dark, and of a gelatinous appearance. The opinion we expressed at the time was that probably eventually the bone must have become a sequestrum.

CASE II.—CHRONIC NECROSIS OF LOWER JAW.

SUBPERIOSTEAL RESECTION. CURE.

L. B., male, *æt* 35. Duration of illness up to time of admission, three months. Entered Hospital April 29th, 1887. His condition then was the following:—

The whole of the left side of the face was swollen and hard. There was a sinus in the left cheek, another under the jaw; a discharging point in the external auditory canal; much thickening about the left tonsil and an abscess in that region.

On the day of admittance, the left half of the jaw was excised by Mr. A. Neve, and the abscess opened. For the first two or three days, pus discharged through the sinuses; these communicating freely with the mouth. For the following week there was steady improvement and diminution of pus. About May 23rd, there was an increase of discharge from the sinuses and suppuration from the neighbourhood of the tonsil. On the 27th of May the sinuses were enlarged. After this there was continuous improvement. But on June 7th an abscess was found to be forming in the temporal region. This opened into the mouth on the 12th. From this time the patient did well, and was discharged on the 25th of June—cured.

CASE III.—THREATENED NECROSIS OF LOWER JAW. EXCISION OF LEFT CONDYLE. CURE.

K. B., male, *æt* 50. Duration of illness one and a half months previous to admittance. Entered wards August 12th, 1887. He was then suffering from abscess at the side of the jaw, and pain along the alveolar margin. Twelve days previously the abscess had commenced to discharge a drop at a time. And a few days subsequently a spicule or two of bone came away. On examination, there was found to be a large abscess outside the jaw; and the temporo-maxillary joint was ankylosed. There was a sinus opening into the mouth. On 12th of August the abscess was opened and the contiguous carious portion of the jaw was gouged slightly. On the 17th the condyle was excised.

August 20th.—Mouth opens easily to $1\frac{1}{2}$ inches; discharge from mouth less—about a drachm of pus by the external incision.

26th.—Bone appears covered with granulations, except a small patch.

September 9th.—Mouth sinus closed. But as suppuration was continuing externally, a counter opening was made below the jaw and a drainage tube passed through.

13th.—Drainage good ; but hard swelling remains.

17th.—Hard swelling diminishing rapidly.

18th.—Discharged ; much improved.

In this case the jaw was bare for a considerable part of its extent : still it was vascular, and it was evidently desirable to save the bone. As a result of the operation, the symptoms were greatly ameliorated. The patient was greatly pleased, and when he left, steady improvement was going on : still I felt that it was quite possible that the disease might become again troublesome, and that possibly excision of the jaw might yet be required.

CASE IV.—NECROSIS LOWER JAW. EXCISION OF CONDYLE.

CURE.

K., *æt* 45, female, had been attending our out-patient department for two or three weeks. In spite of drainage, her condition was becoming worse, and she implored us to do something for her. She was admitted September 24th, 1887. The whole of the left side of her face was greatly swollen, red and of brawny hardness. There was copious purulent discharge from the ear ; a discharging sinus was present over the mastoid process ; another, one inch below this ; a third at the side of the jaw in front of the lobe of the ear ; and a fourth sinus under the chin. The hardness and swelling extending down to the level of the upper border of the Thyroid cartilage. The jaws were firmly and immovably closed.

On September 26th I excised the condyle and inch of the neck of the bone. The incision, which was about 2 inches long, was partly parallel to, and just over the auricular end of zygomatic process, and partly at right angles to the former and running down over the condyle. Directly the periosteum of the bone was incised, a considerable quantity of pus made its appearance. Good drainage with counter-drainage was arranged.

September 29th.—Doing well ; pain less ; mouth can be opened an inch.

October 9th.—Incision healed ; discharge from sinuses slight ; can open mouth freely ; swelling of jaw almost disappeared.

October 13th.—Doing very well: a little bare bone can still be felt at the upper anterior sinus. Dismissed.

In the middle of November, when seen, there was no discharge whatever.

In January 1888 she was quite well, and there was no deformity to be detected, except after careful examination.

Here the surface of the condyle was found to be somewhat eroded, and the bone was separated from the periosteum by pus. This, again, is a case in which it will be interesting to note whether any recrudescence of the disease occurs, and whether excision of the jaw will be required eventually. I think not.

Briefly stated, the advantages of excision of the condyle in such cases as the above are, that it taps the subperiosteal pus, it gives room for effectual drainage, it is an osteotomy and relieves bone tension. Where ankylosis is present, it is removed while the resulting disfigurement is inconsiderable, and the usefulness of the jaw practically unimpaired. In the more serious cases of threatening necrosis of the jaw, time is gained by a palliative operation, while only if persistence or return of symptoms occur, one is impelled to perform the graver operation of removing the jaw bone.

The reformation of bone after excision of ^{the} jaw is a point of importance. In Case I, it will be seen that, although a certain amount of new bone was thrown out, this was subsequently absorbed. This agrees with the experience of Christopher Heath,* who says: "It is certain, however, that in the course of years a great, if not complete, reabsorption of new bone, thus formed, takes place."

I think, however, that this statement requires qualifying. For the formation of permanent new bone depends, doubtless, upon two important points, viz., the age of the patient and the duration of the disease. As a matter of fact, the periosteum of the jaw is not nearly so forward to throw out new bone as that of the long bones for instance. Cases of necrosis of the lower jaw seldom present any great formation of bony case.

* Dictionary of Practical Surgery, Vol. I, p. 834.

Still, in children under ten years of age, or thereabouts, separative power is great, and bone formation is often very active.

Thus, Warren Tay has reported a case,* in which a large sequestrum, including the condyle of the lower jaw, was removed from a child aged four years. Ten years subsequently the child was found to have good formation of bone, half an inch deep.

In another instance, that of a patient from whom J. R. Wood† removed the entire jaw on account of phosphorus necrosis; three years subsequently, the jaw was found to have been reproduced. In symmetry and form it was wonderfully perfect. On other occasions Wood performed this operation with satisfactory results. Similar cases have been recorded by Savory and Bristowe and others.

If, however, a sequestrum of the jaw be left for an indefinite period in contact with the periosteum, there can be little hope of subsequent regeneration of permanent bone, and especially is this the case in adults.

Kashmir.

* *Lancet*, Vol. II, 1883, p. 817.

† *Lancet*, Vol. I, 1877, p. 813.