REFRESHER COURSE FOR GENERAL PRACTITIONERS

INTERNAL DERANGEMENTS OF THE KNEE-JOINT

BY

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The knee is the largest and also the most vulnerable joint in the body. In general, it is hinge-like in character, depending for stability primarily on the active control of the powerful quadriceps group of muscles, and secondarily on the passive control of the ligaments. The latter structures determine the direction in which muscle action is transmitted to the moving surfaces and achieve through their sensory nerve fibres the co-operation essential to protection from injury. The arrangement of the muscles about the joint is such, however, that when the knee is extended, or almost extended, the leverage exerted is relatively small and the protective power limited; nor is there any position within the range of motion in which muscle action has any considerable control over lateral bending or rotation.

That the knee can attain any degree of stability in extension, and indeed is not even more vulnerable, is due to the all-important quadriceps and to the complex action which differentiates the joint from a simple hinge—namely, the “screw-home” movement. This is the mechanism whereby, at the completion of extension, the tibia rotates laterally by the indirect action of the quadriceps, guided in its course by the anterior cruciate ligament and the form of the articular surfaces. The screw-home movement is an important feature of the knee-joint mechanism not only because it determines the stability of the joint in extension but because disorders of its complex action are responsible for most of the common internal derangements of the knee.

Importance of the Quadriceps and Ability to Attain Complete Extension

There are two related factors which, above all others, influence the rapidity of recovery of function following disease or injury. Neither appears to be completely understood; both are still neglected in treatment.

Volume and Tone of the Quadriceps.—When the knee-joint is affected by disease, accident, or operation reflex inhibition of the quadriceps takes place. Muscle wasting is extremely rapid, and the volume is reduced at a much greater rate than it can ever be regained by the most conscientious exercise. Active treatment is therefore a matter of urgency if the period of disability is to be reduced to a minimum. Treatment consists in non-weight-bearing exercises such as straight leg raising and quadriceps drill (quadriceps-setting) which do not entail movement of the joint and cannot therefore produce aggravation of the disease or injury. There are few exceptions to the rule that five minutes of exercise in every hour throughout the waking day should be observed throughout the period of recumbency and thereafter until the muscle bears comparison with the normal side. No passive therapeutic measure has been discovered which is a substitute for active exercise. The patient, the physiotherapist, and the practitioner should not be under any illusion that the time-honoured use of heat and massage does anything more than stimulate intramuscular circulation before treatment: treatment consists in exercise.

Ability to Attain Complete Extension.—The vastus medialis (vastus internus) component of the quadriceps is selective in action and comes into force in producing the final 10 to 15 degrees of extension, although it is used throughout the whole range in overcoming marked resistance. In spite of the apparent insignificance of such an operational range, the vastus medialis is by far the most important component of the quadriceps apparatus. These final few degrees of extension, including as they do the screw-home movement, are the most vital in the whole range. Witness the marked selective wasting which is present when for one reason or another full extension is permanently lost. Those elusive final 10 degrees are always something to strive for in the recovering joint, for without them redevelopment of the medialis component is impossible and perfection of function unattainable. In this respect the acutely swollen knee should not be “made comfortable” flexed over a pillow. If an effusion is so great as to demand the flexed position, it is great enough to demand aspiration.

Diagnosis

The term “internal derangement of the knee-joint” is commonly applied to those intra- and extra-articular affections, most often of traumatic origin, which are the result of lesions of the menisci (semilunar cartilages)—rupture of the cruciate, medial, and lateral ligaments, recurrent subluxation of the patella, loose bodies, etc. The term is thus no more than a statement that there is something wrong with the joint. It is not without significance that the abbreviation “I.D.K.,” which so often adorns case records, also stands for “I don’t know.”

In diagnosing an internal derangement of the knee-joint it may be necessary to listen to the patient’s story for only a few moments to appreciate, for example, that he is suffering from a complete longitudinal (bucket-handle) tear of the medial meniscus. On the other hand, a large proportion of cases present a complicated problem solved only by balancing every shred of evidence available. In this respect it is hardly possible to overstress the importance of the history. In many cases of long standing there may be no definite physical sign on which a diagnosis can be based.

The approach to the problem can usefully be illustrated by considering some common features in relation to diagnosis.

Mechanism of Injury.—The menisci are torn in a rotation mechanism when the productive force is seldom more than the patient’s superimposed body weight. The common sprains of the upper femoral attachment of the medial ligament are similarly produced. Major lesions of the ligaments, involving complete solution of continuity, usually occur as a result of external violence, as for example in a motor-cycle accident or from a fellow football-player falling against the lateral side of the extended knee.

Immediate Incapacity.—It is seldom possible for a player to complete a game of football with a torn meniscus, even if reduction has been achieved by one of his colleagues; he usually tries, but he generally fails. In contradistinction,

a footballer sustaining an injury such as a direct contusion or a sprain of the upper femoral attachment of the medial ligament, although he may suffer severe pain at the time, usually manages to complete the game.

Locking.—The patient's statement that the knee "locked" should never be accepted until he has explained what he means by locking and demonstrated the position in which the knee was fixed. The locking produced by a bucket-handle tear of a meniscus usually takes place at a point 10 to 40 degrees short of full extension. It is sudden and definite in character and the unlocking equally sudden and even more dramatic. When true locking is associated with a history otherwise suggestive, it is almost pathognomonic of a torn meniscus and must be regarded as one of the most important of the diagnostic points available; but it must be emphasized that not more than half of the cases in which the meniscus is proved at operation to be damaged exhibit this particular symptom. The locking of a meniscus, at least on the first occasion, occurs while doing something abnormally active like coal-mining or playing football; the locking of a loose body or habitual subluxation of the patella is transitory and occurs during an everyday action like walking down stairs.

Giving-way.—While there are several causes for the complaint that the joint "gives-way" or "lets me down," such as an old rupture of the anterior cruciate ligament, quadriceps insufficiency, or a permanently displaced meniscus producing loss of full extension and consequently of the screw-home movement, by far the most common underlying lesion is a longitudinal tear of the posterior segment of a meniscus. If such a tear is confined to the posterior segment, insecurity may be the only serious symptom present. Some idea of the nature of the underlying lesion may be deduced from the patient's account of the incidents. Giving-way due to an old rupture of the anterior cruciate ligament, quadriceps insufficiency, or loss of full extension occurs on descending stairs or jumping from a height. That due to a torn meniscus takes place as a result of a rotatory movement such as turning round suddenly, stepping on a small stone, or walking on uneven ground, and is accompanied by the sensation of something loose in the joint.

Effusion.—The reaction of the synovial membrane to irritation is effusion, whether the irritation takes the form of direct contusion, minor sprain, or the stretching of the peripheral synovial attachment of a meniscus as occurs in a bucket-handle tear. The presence of effusion alone is, of course, no indication that a meniscus has been injured, but it is of assistance to remember that a meniscus is seldom, if ever, torn in the absence of effusion at the original accident. It is important to differentiate a simple traumatic synovitis from a traumatic haemarthrosis, not only because of the desirability of aspiration in haemarthrosis but because of the existence of concomitant lesions, in the form of serious ligamentous injury, which haemorrhage into the joint implies. In this matter the history may be of assistance: in acute traumatic synovitis there is usually an interval of about six hours between the injury and the appearance of swelling, whereas in traumatic haemarthrosis the swelling occurs within half an hour.

Pain and Tenderness.—If the patient can locate accurately the site of the pain it is undoubtedly of assistance in deciding upon the source of the lesion. The most constant and reliable region of localized tenderness in injuries of the medial meniscus is the collateral ligament at the level of the joint line. This clinical finding is not well known; in fact its presence is sometimes given as a reason for eliminating the possibility of a meniscus lesion in favour of a diagnosis of sprain of the ligament. The tenderness which is found in the common sprain of the medial ligament, existing as an isolated lesion, is localized in the great majority of cases to the upper femoral attachment.

Quadriceps Wasting.—Perfect muscles seldom control imperfect joints. Some wasting of the quadriceps is the accompaniment of every internal derangement of the knee; but, because of the rapid loss of volume which may follow

even a short period of complete functional inactivity, the degree of wasting is not of necessity any indication of the gravity of the underlying lesion. The importance of the vastus medialis has been stressed. Thus it is that the earliest manifestations of wasting are seen in this component of the quadriceps apparatus. It is for the same reason that a better estimation of loss of volume and tone may be obtained by inspection and palpation than by the use of a tape measure. Many thighs are clothed with a thick layer of subcutaneous fat. A degree of flattening which cannot be measured can be appreciated by the eye.

Lesions of the Menisci

In Britain most meniscus injuries occur on the football field or in the coal-mine. On the football field the tibia is fixed by the studs of the boot, and thus the situation may arise in which forced extension may occur in the absence of lateral rotation of the tibia—the screw-home movement—or forced flexion in the absence of medial rotation of the tibia. In the cramped conditions of the narrow seams of a coal-mine rotation of the tibia is rigidly controlled by contact of the medial or lateral side of the foot with the floor. In such circumstances flexion and extension may not be accompanied by the appropriate rotatory movement of the tibia on the femur or of the femur on the tibia.

When the joint is suddenly extended, in the absence of synchronous lateral rotation of the tibia, the meniscus is caught in an abnormal position and is trapped against the head of the tibia, resulting in a longitudinal tear. If the tear involves only the posterior third the entire meniscus springs back into the normal position and the joint does not lock. If the tear extends forwards beyond the plane of the ligaments into the anterior segment the femoral condyle traps the meniscus against the tibia at the extreme anterior limit of the tear, the centrally displaced fragment cannot regain its normal position, and the joint locks.

The characteristic clinical feature of locking is the inability to extend the joint. What is less well recognized, but more important, is the block to lateral rotation of the tibia, and thus to the screw-home movement, which displacement of the medial meniscus entails. The significance of this statement in relation to the future function of the joint will be evident later.

The treatment of the torn meniscus is determined by two factors: (1) the meniscus is a structure devoid of blood supply—tears of the substance of the fibrocartilage cannot heal; and (2) weight-bearing activity in the presence of a permanently displaced bucket-handle tear, or a tear apt otherwise to produce locking or giving-way incidents, leads inevitably to rupture of the anterior cruciate ligament, deterioration of the joint, and eventually to osteoarthritis.

Injuries of the menisci are encountered in one of three forms:

- (1) *The joint is locked.* In these circumstances the diagnosis is seldom open to question whether the locking occurred at the original accident or at a subsequent incident. The locked joint should be reduced to eliminate pain and discomfort, to prevent further damage, and to enable arrangements to be made for the rational treatment of a lesion which does not heal—namely, excision of the entire fibrocartilage. The action to be taken after reduction or in the presence of other indisputable evidence of a torn meniscus is: (a) application of a compression bandage; (b) rest, preferably in bed—weight-bearing is undesirable; (c) the immediate institution of quadriceps exercises; (d) removal of the compression bandage several times daily

for knee-flexion exercises; and (e) operation as soon as the preparation of the skin, the availability of a hospital bed, and the personal views of the orthopaedic surgeon will permit.

(2) *It is an acute injury, presenting difficulties of diagnosis, in which a meniscus lesion is suspected but cannot be proved.* There are few more difficult problems than determining the exact nature of the lesion in the acute injury with no history of a previous accident. The difficulty arises in the case seen for the first time at any period varying from a few hours to two to three weeks after the accident and showing little more than effusion accompanied by vague tenderness localized to the joint line. In this common problem, where a clinical and a radiological examination show no lesion other than a potential but unproved meniscus injury, the attitude to be adopted is one of expectancy. The case should be regarded as a traumatic synovitis and treated with compression in the form of alternating layers of wool and domette bandage, together with quadriceps exercises. No attempt should be made to safeguard the reputation of the practitioner by forbidding the return to athletic activities. When the volume and tone of the quadriceps have recovered, the resumption of football should be encouraged rather than discouraged. It is only in this way that the joint can be proved to be sound or otherwise; but the patient must be warned that if he has any trouble—the exact nature of which need not be suggested—he should not accept as inevitable the termination of his athletic career but should return without delay for further examination with the prospect that it will show the cause of his disability to be a condition which can be completely cured by a minor operative procedure.

(3) *There is a history of recurrent incidents with conclusive evidence on clinical examination of the presence of a torn meniscus.* This is the form in which most internal derangements due to damaged menisci are encountered. In the absence of outstanding contraindication the treatment is excision of the torn structure.

Lateral Meniscus

While tears of the lateral meniscus are less common than those of the medial meniscus, cystic degeneration is much more frequent and congenital anomalies are almost confined to the lateral side. The ratio of the incidence of lesions, computed from my own 1,650 cases which covers all types necessitating operation, is one lateral to two medial cases.

The symptoms and signs of tears are similar to those encountered on the medial side but with the difference that they occur in less positive form. The original accident is less definite, locking is less common, and incidents, because of the lax synovial attachments of the meniscus, may not be followed by effusion. Advice may be sought for little more than "trouble on the outer side of the joint," with vague symptoms of pain and instability and possibly the complaint of something "loose" or "clicking" on the outer side of the knee.

Treatment, as on the medial side, consists in excision of the entire meniscus.

Cystic Degeneration

Cystic degeneration of the menisci occurs as a result of trauma in the form of direct violence or abduction strain. It accounts for one out of eleven cases which come to operation; it is six times more common on the lateral side.

The patient complains of a dull ache on the lateral aspect of the joint which is greatly accentuated by any increase in physical activity. If the cyst is large he will call the examiner's attention to the presence of a

swelling; if it is small, the size of a pea, he may be unaware of its existence. The characteristic feature of the swelling, which is usually situated immediately in front of the lateral ligament, is that it varies in size, depending on the position of the knee, reaching maximum dimensions in extension and decreasing in size on flexion.

Treatment, which consists in excision of the entire meniscus, results in complete relief of symptoms. Local excision, in the erroneous impression that the swelling is a ganglion, is followed by recurrence.

Anterior Cruciate Ligament

The anterior cruciate ligament is attached inferiorly to the anterior aspect of the tibial spine and inclines upwards, backwards, and laterally to be attached to the posterior part of the medial surface of the lateral condyle of the femur. Its function, as has already been mentioned, is the control of lateral rotation of the tibia in the terminal phase of extension.

In general the ligament may be injured: (1) *By abduction*—if the force is of sufficient magnitude to produce complete solution of continuity of the medial ligament, the anterior cruciate is invariably ruptured; in these circumstances the injury merges into insignificance in relation to the problem of repair of the much more important medial ligament (see below); and, more commonly, (2) *By derangement of the screw-home movement*—if the action of the ligament is to guide and control lateral rotation of the tibia in the last few degrees of extension, any attempt to extend the joint without lateral rotation of the tibia puts the ligament on the stretch. This is the reason for the close association between lesions of the medial meniscus and isolated ruptures of the ligament and the explanation of the finding that one in four cases from which a torn medial meniscus is excised shows a ruptured or attenuated anterior cruciate ligament.

Once the medial meniscus has been torn and has become liable to produce locking incidents, the anterior cruciate becomes vulnerable: if the footballer or athlete is in motion at the moment when the block to the screw-home movement takes place, the whole strain is thrown on the ligament and it ruptures. Furthermore, the commonest way in which the ligament is injured is when a bucket-handle tear has become displaced into the centre of the joint. Attempts to reduce the locking by forcible extension under anaesthesia take place at the expense of the ligament; and, in cases in which the displacement of the fragment into the centre of the joint becomes permanent, walking about, or otherwise attempting to produce complete extension of the joint, results in slow gradual attenuation and eventually to complete solution of continuity.

The symptoms of isolated rupture of the anterior cruciate ligament are giving-way or instability, especially at high levels of physical activity such as football, athletics, or modern military training. Undetected rupture of this ligament is the reason for any evil reputation meniscectomy may have attained amongst footballers and Service statisticians.

The classical physical sign of rupture is the ability to pull the tibia forward on the femur with the knee in semi-flexion.

A large number of ruptures of the anterior cruciate ligament can be prevented: once the medial meniscus

is torn and has produced locking, or is torn and is liable to produce locking, there exists a serious risk of rupture of the ligament, and the longer the torn meniscus remains in the joint, and the more violent the occupation responsible for the recurring incidents, the greater the risk.

A degree of instability which makes strenuous athletic pursuits impossible may produce little or no disability even in the occupations of heavy industry. If treatment is required it consists in the recognition that the quadriceps is a lateral rotator of the tibia in extension. If the amazing potential of the quadriceps for hypertrophy can be exploited it is possible to compensate to a very large extent for absence of the ligament.

Sprain of the Medial Ligament

Sprain or partial avulsion of the long anterior parallel fibres of the medial ligament at their attachment to the femur is one of the common injuries of the knee-joint. It possibly ranks third in frequency of occurrence to the minor injuries producing traumatic synovitis, the exact aetiology of which may be undefined, and the derangements due to damaged menisci. The significance of the injury lies not only in its frequency of occurrence but in the fact that it is so repeatedly misdiagnosed. If the recent injury goes unrecognized the common complication of the formation of heterotopic bone at the femoral attachment of the ligament, which gives rise to the "medial ligament syndrome" (frequently called Pelligrini-Stieda disease), is not anticipated, and the symptoms which follow are responsible for severe and prolonged disability.

The injury takes place as a result of a rotatory mechanism such as may occur in a minor skiing accident or on the football field. On examination pain, swelling, and tenderness are accurately located at the attachment of the medial ligament to the femur not far from the adductor tubercle. It is an extra-articular lesion, and unless the productive force has been violent there is no effusion. The injury is distinguishable from complete rupture by placing the ligament on the stretch by attempting to abduct the joint in extension: pain may be produced at the upper femoral attachment, but the stability of the joint is unimpaired.

Treatment consists in infiltration of the site of maximum tenderness with a few millilitres of local anaesthetic. Thereafter a 2-in. (5-cm.) square of sterile orthopaedic felt is placed over the area and a diverging spica of elastic adhesive bandage is applied to the joint with the object of promoting rapid absorption of the products of injury by elastic compression. This simple treatment may provide relief of pain and allow immediate resumption of weight-bearing and quadriceps exercises to be started.

Most sprains of the medial ligament present no difficulty and make a rapid and uneventful recovery. In a certain proportion of apparently simple cases, and especially those undiagnosed and untreated, the symptoms of pain and restriction of movement, instead of making the progress expected, become more accentuated with the passage of time; and, the more strenuous the physiotherapeutic efforts to accelerate recovery, the greater the pain, weakness, and loss of flexion. These patients are usually found to be suffering from ossification of the haematoma at the site of avulsion. The presence of this complication can be confirmed with

certainty by radiograph at the third or fourth week following injury. Once the diagnosis has been established it should be recognized that the lesion is to a large extent self-limiting, and that, provided the popular forms of aggravating the condition by massage, passive movement, or manipulation are avoided, recovery will slowly but surely take place. A small number of cases reach a final and completely quiescent state after a period of nine months with a disability due to loss of flexion. In such circumstances surgical intervention may be necessary to excise the bony mass which is interfering with the free movement of the ligament.

Rupture of the Medial Ligament

Complete rupture of the medial ligament is the most potentially disabling of the common ligamentous lesions of the knee-joint. The gravity of the injury lies partly in the importance of the medial ligament as an accessory stabilizing structure and partly in the fact that complete solution rarely, if ever, exists as an isolated lesion but is associated with rupture of the anterior, and even of the posterior, cruciate ligament, loss of the peripheral attachments of the medial meniscus, and fracture of the lateral condyle of the tibia; all the associated injuries may coexist in the same joint.

The diagnosis may be suspected from the history, which, as has been indicated, involves considerable external violence. The injury is followed by severe, nauseating pain accompanied by the sensation of "something tearing" within the joint. The severity of the lesion usually compels the patient to cease work or leave the football field, but in this respect certain cases are misleading, as, in spite of the gross damage, the immediate disability may be less than that encountered in a torn meniscus.

If the capsule is ruptured, as it usually is, the effusion drains into the periarticular tissues. Therein lie a trap for the unwary and a common source of error; a serious injury is unsuspected in the absence of effusion or haemarthrosis.

The final diagnosis must not be assumed until the presence of abduction in extension has been demonstrated. If pain and muscle spasm prevent the forcible manual abduction which is necessary to demonstrate whether there is complete solution of continuity or merely "overstretching," and to establish the condition of the cruciate ligaments by the drawer signs, "forwards" or backwards," or both, the examination should be performed under thiopentone anaesthesia.

When examination, on the lines indicated, demonstrates beyond shadow of doubt the existence of complete solution of continuity, the treatment of choice is operation. In incomplete lesions, or in the presence of technical contraindications to operation, conservative treatment in the form of immobilization in a skin-tight walking plaster cast, of the type which permits foot and ankle movement, is indicated.

Recurrent Subluxation of the Patella

The stability of the patella depends on: (1) integrity of the vastus medialis; (2) absence of undue laxity of the capsular expansion on the medial side; and (3) height of the lateral femoral condyle.

In many knee-joints which fall within the limits of normality an increase of lateral mobility of the patella may exist as a result of minor abnormalities of these

stabilizing factors. In such joints, and especially in the presence of a minor degree of knock-knee, medial rotation of the femur on the fixed tibia, or lateral rotation of the tibia on the fixed femur, may cause the patella to slip over the margin of the lateral condyle of the femur. If complete dislocation occurs the diagnosis is never in doubt, but lesser degrees of subluxation, in which the patella slips momentarily over the edge of the lateral condyle, are often missed. The complaints of locking, giving-way, pain, and effusion, being the same as those associated with meniscus injuries, may easily lead to an error of diagnosis. It is not an exaggeration of the situation to suggest that every internal derangement of the knee-joint in a female patient should be suspected to be a recurrent subluxation of the patella until proved otherwise: tears of the menisci in women are relatively uncommon.

On examination the most notable feature is wasting of the vastus medialis to a degree disproportionate to the severity of symptoms. The patellar tendon and medial capsule are lax, and mobility of the patella in a lateral direction is increased. It is well to remember that patients suspected of having a subluxation often display marked apprehension when the patella is pushed laterally in testing for stability or increased mobility.

Treatment is directed, if possible, towards the cause. In young people a knock-knee deformity may require correction by conservative or operative means. In older women, minor degrees may be treated conservatively by redevelopment of the vastus medialis. In many cases there is no alternative to operation, which normally takes the form of straightening the line of pull of the quadriceps by transferring the tibial tubercle together with the attached patellar tendon to the medial aspect of the tibial head.

Loose Bodies : Osteochondritis Dissecans

Loose bodies occurring in knee joints which are otherwise apparently normal are derived from either the articular surfaces or the menisci. For practical purposes, only those arising from the articular surfaces are of importance; these are fragments from the margin of a condyle displaced into the joint immediately following a direct injury, or displaced into the joint after an interval of months or years, the condition known as osteochondritis dissecans. The aetiology of the latter entity has long been a matter of controversy and remains unsettled. My own view is that the lesion arises in joints of a particular anatomical type in which impingement of the tibial spine against the lateral aspect of the medial femoral condyle is possible, especially when forced extension occurs in the absence of synchronous lateral rotation of the tibia.

In the early stages, before the loose body has separated, the symptomatology is indefinite. There is often a complaint of vague pain, made worse by exercise, and an ache in the joint when at rest. There are recurrent effusions brought on by exercise but which rapidly subside with rest. When the loose body has separated, to these vague symptoms is added locking, which may be described as of a type which occurs "out of the blue."

The diagnosis can only be suspected on clinical examination. It is determined by radiography. Indeed, it is probably true to say that the radiographs which form part of the pre-operative investigation of every internal

derangement due to a damaged meniscus, and which would ordinarily be expected to be negative, are taken largely with the purpose of eliminating osteochondritis dissecans.

In young people, in whom the condition is detected before the loose body has separated, there are prospects of securing healing by immobilizing the knee in a plaster cast for a period of three months. In adults, and in those patients in whom the fragment has separated, there is no alternative to operative removal of the loose body. The long-term prognosis depends on the length of the history and on the size and site of the defect in the femoral condyle. If the defect is large and encroaches on a weight-bearing area, osteoarthritis may be expected to develop with the passage of time. The rate of degeneration and the degree of arthritis are directly related to the demands made upon the joint.

TENTH INTERNATIONAL CONGRESS ON INDUSTRIAL MEDICINE

The tenth International Congress on Industrial Medicine was held in Lisbon from September 9 to 17. This was the second such conference to be held since the war, the last being in London in 1948. Some 750 doctors and 50 nurses from 27 countries attended, and over 250 papers were presented. The work of the congress was divided into five sections, but the wide range of the papers submitted made it difficult always to trace the connexion between the subjects discussed at particular sessions.

Broadly, the papers fell into two groups: those confined to the narrow field of industrial accidents and occupational diseases, and those dealing with social, organizational, administrative, and educational problems.

Nickel and Cadmium Poisoning

In the former group there were a few communications which were of considerable, if limited, interest. Professor S. FORSSMAN (Sweden) gave an interesting account of an outbreak of nickel fume poisoning, in which the haemorrhagic oedema encountered was indistinguishable from the clinical condition seen in nickel carbonyl poisoning. He had confirmed these observations in animal experiments.

Professor E. W. BAADER (Germany) read an interesting paper on chronic cadmium poisoning. He pointed out that the use of this metal was increasing considerably, and it was to be found in the manufacture of alloys, in electroplating, and in the manufacture of alkaline electric accumulators. The symptoms of acute poisoning had long been recognized. Chronic cadmium poisoning, however, presented an entirely different picture, characterized by loss of smell, cough, and dyspnoea, with loss of weight; examination showed golden yellow staining of the teeth, raised E.S.R., and the presence of an unusual protein in the urine, first described by Friberg. Post-mortem examination of a patient aged 39 who died of the disease showed a severe dilatation of the stomach, and several areas of segmental cylindrical distension and elongation, 8-12 cm. long, in the jejunum. Histological examination disclosed nuclear changes in the ganglion cells of the plexus of Auerbach and in the plexus of Meissner; similar nuclear changes were found in the ganglion cells of the bronchial and tracheal walls. No changes were found in any other nerve cells. Professor Baader postulated a "neurogenic lung emphysema," and called for further observation in other countries. Dr. LARS FRIBERG (Sweden) confirmed the finding of emphysema in patients with chronic cadmium poisoning. He spoke also of the proteinuria found in these cases. He described some recent investigations that await publication, which strongly support the idea that the cadmium excreted in the urine is