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Ménière's Disease

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SUMMARY

FROM the results of a clinical and statistical study of 350 cases of Ménière's disease the following conclusions may be drawn. Acute disease or surgical operation, particularly dental extractions, seem sometimes to be related to the onset of the complaint. Allergy and true migraine do not frequently coexist. Allergy in general is not an important factor. Long duration of the complaint does not seem to be an adverse factor in prognosis but advanced age does. The surgical treatment of infection in nose, mouth or throat does as a whole improve the prognosis as compared with cases not so treated.

Of such surgical treatment dental extractions are found to produce the most favourable results with tonsillectomy a good second; operations on the nasal sinuses, however, do not seem to improve the prognosis but this may be accounted for by their failure adequately to influence the relevant infection.

During the period of fifteen years or so in which I have been interested in Ménière's disease I have accumulated clinical records and carried out a follow-up of some 350 private cases.

This paper gives the results of an analysis of this material in certain particular directions which would seem likely to help in the solution of the problem of the causation of the disease.

The cases studied had been followed up for periods varying from one to ten years with an average of about three years. The investigation has been particularly designed towards arriving at an answer to certain defined questions which might be expected to provide some evidence as to ætiology.

(1) *The reason given by the patient for the onset of the complaint.*—In the very great majority of cases the patient is as mystified as the doctor as to why this distressing disease should have come upon him. Of the 350 cases dealt with, in only 30 was any cause suggested. Of these 30, however, I was surprised to discover that in 15, i.e. no less than half, a recent extraction of teeth was blamed for the onset of the complaint.

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Causes	Number of cases	Causes	Number of cases
Extraction of teeth	15	Influenza	3
Trauma : Blast of motor horn	1	Hysterectomy	1
Head injury ..	2	Removal of tonsils	1
Syringing ear ..	1	Severe epistaxis	1
Acute tonsilitis	1	Childbirth	1
Pneumonia	1	Childbirth with eclampsia ..	2

I feel that this curiously high occurrence of dental extraction as an alleged cause can hardly be regarded as coincidental.

(2) *The co-existence of allergic manifestations.*—In the present analysis only 20 cases (6 per cent.) gave history suggestive of allergy: Asthma, 3; nasal allergy, 10; skin lesions, 5; angioneurotic œdema, 2.

While I have no control figures as to the occurrence of allergy in the general population the figure of 6 per cent. would not seem to be high enough to suggest an ætiological factor of importance.

(3) *Migraine.*—Care is needed in dealing with case-histories since the vertiginous attacks of Ménière's disease are quite frequently diagnosed as migraine both by the medical attendant and the patient. From the present series of 350 cases in only 8 (2 per cent.) was there a history of attacks of a classical migrainous type. In a number of others migraine was mentioned but on investigation it became obvious that the attacks so named had been, in fact, vertiginous and associated with a labyrinthine lesion.

The figure of 2 per cent. for the co-existence of migraine and Ménière's disease in the same individual would not seem to me to suggest any close relationship between the two complaints.

(4) *The duration of the disease or age of the patient as factors in prognosis.*—Length of duration of the disease does not appear to be an adverse factor in prognosis. Thus, while the average duration of the complaint when first seen in the cases later shown as cured or improved was five to six years, in the group of those in which no improvement took place the relative figure was five years. It would seem, therefore, that the duration of the disease is not an important factor in prognosis.

Age of the patient.—Some support would seem to be given from an analysis of this material to the view that the age of the patient is an adverse factor. Thus of the cases aged 50 years or less 65 per cent. were shown as cured or improved while the comparative figure for those over 50 years of age was 45 per cent.

(5) *The importance, or otherwise, of a focus of infection in the ætiology.*—In 1940[1] I presented to this Section a contribution on this question based on a series of cases in which surgical treatment had been carried out for the removal of such a focus from nose, mouth or throat. The results then given seemed to indicate that such treatment favourably influenced the course of the complaint. On the other hand, the period which had elapsed from the time of operation was relatively short and no control figures were then available.

[1] Wright, A. J. (1940) *Proc. R. Soc. Med.*, xxxiii, 459.

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In my present contribution cases have been followed up, in some cases for as long a period as ten years and in these have been included both those treated on the infective basis and those untreated, so that some comparative figures are available. Cases are grouped in accordance with the surgical treatment adopted and the results are recorded in regard to the symptom of vertigo. In the table " cured " means complete freedom from vertigo, and " improved " means an absence of attacks but with some remaining general unsteadiness.

RESULTS OF SURGICAL TREATMENT OF INFECTION

Form of treatment	Number	Average period of follow up	Cured	Improved	Unaltered	Worse	Cured or improved %
Tonsillectomy	32	3·50 yr.	20	1	8	3	66
Dental extraction ..	22	3·00 yr.	16	2	3	1	82
Nasal sinus operation ..	12	2·25 yr.	2	—	7	3	17
Combined operations (more than one of above)	16	3·00 yr.	9	4	2	1	81
Total	82	3·00 yr.	47	7	20	8	66
Untreated cases ..	30	3·00 yr.	2	4	17	7	20

It will be seen that of the 22 cases of dental extractions 16 were cured as far as vertigo is concerned. Of the 32 cases of tonsillectomy, 20 lost their vertigo, but of the 12 cases in which surgical treatment for nasal sinusitis was employed only 2 lost their vertigo. Thus removal of teeth produced the most favourable results, tonsillectomy came next, with nasal sinusitis little better than an also-ran. Figures for those cases in which more than one operative procedure was employed gave results which compared favourably with those of the nasal sinusitis group, but were not as good as the cases of dental extraction and tonsillectomy.

From consideration of the table it would appear that the disease in untreated cases with few exceptions tends to progress, thus of the 30 such cases in only 2 did the vertigo entirely clear up.

A comparison of all cases treated surgically to eradicate infection in mouth, nose or throat with untreated cases as a control shows a figure of 66 per cent. cured or improved in the treated group as compared with 20 per cent. in the untreated.

MR. TERENCE CAWTHORNE said that while focal sepsis might possibly play a part in the causation of certain forms of vertigo he did not think that such cases were frequent. One of the aspects of Mr. Wright's paper that he would like to emphasize was the pathology of this condition. It was well known, thanks to the work of Cairns and Hallpike, that the disorder which they now called Ménière's disease, and which used to be grouped under the umbrella-like term of " Ménière's syndrome " or aural vertigo, had a definitely pathological basis. For this Lindsay and others had suggested the title " hydrops of the labyrinth ", as being pathologically descriptive. But there were other forms

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of aural vertigo which were not infrequently confused with Ménière's disease. Since the original observations of Cairns and Hallpike there had been some twenty or more cases in which the temporal bones had been examined post mortem and the symptoms in all these cases were practically identical, namely deafness, tinnitus, and spasmodic bouts of vertigo lasting a relatively short time. These bouts might occur at isolated intervals or in groups. The deafness had always been of the internal ear variety, and together with toxic deafness following quinine it was the only internal ear deafness which appeared to be reversible—a very important point he thought. Another thing about this deafness was the distortion of hearing which had accompanied it. The characteristic of the deafness in Ménière's disease was a dislike of musical sounds or high-pitched sounds. The sufferers disliked music on the wireless, they disliked children's voices, and he had even heard them say that they disliked going to restaurants because of the clatter of knives and forks on plates producing high-pitched sounds. All the cases which he classified as Ménière's disease, including two in which Hallpike and he had had the opportunity of examining the temporal bones, had exhibited these characteristics.

It was known that there were a large number of cases of so-called atypical Ménière's disease—patients with postural dizziness or who had bouts of vertigo but no deafness, and others who had vertigo which lasted for a day or two and which was accentuated when they turned over in bed. There was this fairly large mixed group which in the past had been collected together under the term " Ménière's syndrome ", and although it was reasonably certain that the vestibular apparatus was at fault, it was not yet possible to say exactly where the fault lay. He did not think it fair to call them Ménière's disease, because the pathological evidence was lacking.

The main difficulty in obtaining such evidence was that these attacks were never fatal and therefore the otologist never got the pathological material. He hoped that any otologist who had a fatal case of aural vertigo would ensure that the temporal bones and brain stem were made available for investigation. He was sure that the key to the better understanding of aural vertigo was more and still more pathological evidence of the underlying causes.

As to the ætiology of Ménière's disease he agreed with Mr. Wright that patients with Ménière's disease did not suffer more from allergy than did the ordinary run of patients. They had thought in the past that head injury played little or no part in the causation of Ménière's disease—here he was talking of Ménière's disease or hydrops of the labyrinth, and not of other forms of aural vertigo. But he could recall three cases of what he would describe as typical Ménière's disease so far as the symptoms and physical signs were concerned which seemed to be precipitated by a head injury. This was a small number, much too small to permit any conclusion to be drawn and he was just mentioning them because he thought it was worth while making further enquiries into head injury as an ætiological factor.

He had had one interesting case of a patient who presented a typical picture of Ménière's disease following an attack of mumps. The only atypical feature about this was that the patient had an almost complete deafness, but since the attack of mumps she had very typical attacks of giddiness lasting half an hour and going away, coming on again some days or weeks later. The similarity

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between that condition and hydrops of the labyrinth was so striking that he thought it worth mentioning.

On the question of assessing results, while naturally the vertigo was the important thing, he had found that the hearing was a delicate indicator of the state of affairs within the labyrinth. It was surprising how the hearing did fluctuate with the vertigo, and the hearing was something which could be measured much more easily than the vertigo. Admittedly one could do caloric tests, and the test results of vestibular function did vary, though not so quickly and delicately, he found, as the hearing, and he did think that in measuring the success or otherwise of conservative treatment the audiogram was an extraordinarily useful indicator. It had been to him a source of constant interest and, at first, surprise how the hearing in a case which by all tests was one of internal ear deafness, could vary as much as 40 decibels within a day. They had always thought that internal ear deafness was irreversible, but he knew hardly any other form of deafness which was so subject to variation as the internal ear deafness in Ménière's disease.

Dr. Gösta Dohlman (Lund, Sweden) considered allergy an important factor and cited the case of a young man with severe attacks of vertigo which were abolished by elimination of milk from the diet.

Mr. J. Angell James said that if a group of cases of aural vertigo were taken they could be placed in two divisions, one in which there was undoubtedly a hydrops of the labyrinth, and the other in which the pathology was uncertain.

The hydrops may be accounted for in two ways, either there may be an increased secretion, or there may be failure of resorption of the endolymph. To his mind the failure of resorption seemed the more probable explanation, and on that possibility Cairns and Hallpike made an interesting point, that in their sections there was a definite fibrosis around the endolymph sac. This seemed an important possibility in preventing the resorption of the endolymph.

With regard to the control of the endolymph pressure it was well known that pressure of the cerebrospinal fluid could be reduced 50 per cent. by severe dehydration, and it seemed rational to think that one could do the same with the endolymph. He had been interested in the matter since 1935, when he heard of Temple Fay's work on the treatment of epilepsy by dehydration, and since then he had used this method in all his Ménière's cases. It also seemed possible that tea was an ætiological factor, as so many patients admitted that they were heavy tea drinkers, and attacks decreased after giving it up. He thought that tea might be a stimulant to endolymph secretion.

The following also took part in the discussion: Mr. E. J. Gilroy Glass, Mr. W. H. Bradbeer, Mr. R. D. Owen, Mr. J. C. Hogg, Mr. H. V. Forster and Mr. E. D. D. Davis.

Mr. A. J. Wright, in reply, said that Mr. Cawthorne had rather supported the use of the term " hydrops of the labyrinth ". He was hoping they would get the name " Ménière's " attached to this group. The material in his paper was selected on the basis of cases which, Mr. Cawthorne would agree with him, they were in the habit of calling Ménière's disease.

A form of injury which he had encountered on one occasion was in the case of a lady who went for a long drive in the winter with the car window open and within a few hours she presented a typical picture of Ménière's disease.

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Mr. Davis had questioned whether one could have Ménière's disease in which there was deafness and afterwards a return to normal. Occasionally one did find such cases. Out of the whole bulk of hospital and private cases he could recall two or three in which there was a considerable defect in hearing and afterwards a complete return to normal, but this was very exceptional.

There was no reason why any lesion of the labyrinth should not produce a somewhat similar type of clinical picture. Mr. Bradbeer had suggested that these cases arose because the function of the labyrinth had worn out in elderly people. But the point which seemed to him to be against that was the fact that this complaint was quite common in young people.

Mr. Owen had asked about middle-ear disease. That was a question they had discussed before. His own view was that it would obviously seem quite likely that inflammatory diseases in the neighbourhood would make the labyrinth itself more likely to become diseased, but from such studies as he had been able to carry out it did not seem likely that middle-ear disease was a causative factor in these cases. He was interested in the suggestion that sometimes the extraction of the teeth would apparently start the disease. He regarded that as evidence in support of the infective hypothesis.

Dr. Dohlman had mentioned milk as causing allergy ; he himself had come across one case in which if the man took pork he got vertiginous attacks.

He suggested as a possible hypothesis for the mechanical explanation of obstructive attacks, alterations in the consistency of the endolymph. One had only to think for a moment of the series of small chambers communicating by extremely narrow passages through which the circulation had to take place, to realize how this might arise.

Mr. Angell James had stressed the suggestion that fundamental interference with resorption was a big factor. Possibly the reason for the attacks was a sudden obstruction in a portion of the labyrinthine circulatory system.

Purulent Pachymeningitis

By Sir Hugh Cairns, K.B.E., F.R.C.S., and F. Schiller, M.D.

In this paper we report four years' experience of penicillin in the treatment of purulent pachymeningitis. Formerly the condition was almost always fatal, even after the introduction of sulphonamides : since the advent of penicillin 7 of our 15 cases have recovered, and these results should be greatly bettered now that penicillin is freely available and we are beginning to understand the problems of treatment. We have seen 33 cases of this disease in the last twenty years.

It will be best to begin defining purulent pachymeningitis by describing a typical case from the days before penicillin.

This patient was a man of 47 seen by one of us with Mr. F. C. Capps in 1936. He had suffered from chronic pansinusitis for years and had recently developed an infected mucocele of the frontal sinus with a lump on the forehead. Pressure on the lump produced a discharge of pus from the right nostril. Three months later both antra were drained of foul pus by the nasal route (*Str. hæmolyticus* and in small numbers *Staph. aureus*), and drainage of the frontal sinuses was established by removing the anterior ends of the middle turbinate bones and

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external resection of the inner part of the floor of the right frontal sinus. For nine days the patient did well. Then he developed a spreading osteomyelitis of the facial bones with fever, swelling and abscess formation about the eyes and upper jaw, for which further operations were required. His wounds discharged much pus and he became weak, wasted and anæmic.

He was given sensitized streptococcal vaccine, prontosil and blood transfusions, but the facial osteomyelitis continued and, twelve weeks after its onset, spread to the frontal bone. During the next five weeks the osteomyelitis gradually extended backwards and the patient had headaches, facial pain and slight fever, and he became much more irritable.

Purulent pachymeningitis first showed itself on *February 4th*, 1937, about sixteen weeks after the onset of facial osteomyelitis. The patient noticed a weakness and numbness of the right leg, and twelve hours later slight numbness and difficulty of control of the right hand; he vomited twice, had slight headache and fever (100·4° F.).

On examination there was slight hemiparesis and sensory loss in the right upper and lower limbs, more marked in the lower limb. Eighteen hours after the onset of these symptoms the patient began to show slight dysphasia, and right homonymous hemianopia. On the next day, *February 5th*, he had gross aphasia, almost complete right hemiplegia, weakness and sensory disturbance of the left lower limb, incontinence of urine and fæces.

Operation on this day showed gross osteomyelitis of the skull, extending as far back as the parietal region, with subpericranial pus and extradural granulations. On opening the dura thick pus was found in the subdural space and small amounts could be collected for some time by depressing the brain away from the dura. Films of the pus showed streptococci and cultures yielded *Str. viridans*. The patient grew steadily worse and died on *February 9th*.

In previous studies of intracranial spread of infection from the paranasal sinuses and mastoid little attention has been given to the subdural space. In their admirable work Logan Turner and Reynolds (1931) figure the dura as being in immediate contact with the arachnoid. In fact these membranes are separated from one another by a narrow space which usually contains a very small amount of fluid. This space may be occupied by a film of pus of variable thickness: the pus is not circumscribed in the first instance and may spread over part or whole of one or both cerebral hemispheres. This condition is called purulent pachymeningitis. If the condition is not cured at this stage, and the patient continues to survive, the pus becomes loculated by adhesions between dura and arachnoid to form one or more subdural abscesses. It is necessary at this stage to point out that not all subdural abscesses are secondary to purulent pachymeningitis; some, which are localized from the start, are secondary to necrosis of a patch of dura over the mastoid or frontal sinus, or are secondary to an abscess in the superficial part of the brain. We are not proposing to discuss these types of subdural abscess here.

In the early literature there was some confusion about the situation of subdural pus. Some cases of what was obviously purulent pachymeningitis were described as leptomeningitis. These two conditions, it must be emphasized, are quite distinct. The subdural space is quite distinct from the subarachnoid space; it is a single continuous space over the surface of the

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brain and spinal cord, except where it is crossed by blood-vessels and nerves, or where arachnoid granulations are embedded in the dura. Air passes readily from one end of the cranial subdural space to the other. Penicillin, as we have shown, passes readily to and fro between the blood-stream and any fluids which may accumulate in the subdural space.

The subarachnoid space, on the other hand, is a channel traversed by numerous fine septa and containing cerebrospinal fluid. Air in it cannot move freely with alterations of head posture, and penicillin does not pass freely between the blood and C.S.F.

In purulent leptomeningitis there are many cells in the C.S.F., and there are neck rigidity and the other signs of meningism. In purulent pachymeningitis there are few cells in the C.S.F. and little or no neck rigidity, unless and until the condition becomes complicated by leptomeningitis; the symptoms are those of a rapidly progressive paralysis of one or both cerebral hemispheres—hemiplegia, homonymous hemianopia, sensory loss in the paralysed limbs and, if the dominant hemisphere is involved, aphasia. Fits may occur in the early stages of this cortical paralysis. The temperature is usually higher than in leptomeningitis, probably because of the absorptive properties of the subdural space.

Cause

Purulent pachymeningitis is usually secondary to spreading osteomyelitis of the skull which is an unhappy sequel in some cases of pansinusitis. In our 33 cases the primary infection was in the paranasal sinuses in 23 cases, in the petrous bone in 6 cases, while in 4 cases the infection was from a distant focus. According to Turner and Reynolds (1931) the condition arises most commonly in chronic pansinusitis after some operative interference, sometimes no more than simple puncture of the maxillary sinus. As Dan McKenzie (1913) said: "What seems to be an irreproachable operation is followed by progressive osteomyelitis." The condition is clearly an uncommon one, but it has always made a deep impression because of the rapid intracranial spread of the infection and the almost uniformly fatal issue. One of the older otologists, describing the rapid spread of infection after some relatively simple and well-executed operation, said it was like setting fire to shavings.

Associated Lesions

We have described the pathology of this condition elsewhere (Schiller, Russell and Cairns, 1948) and it is only necessary here to mention the lesions which are associated with purulent pachymeningitis.

Spreading osteomyelitis of the skull was present in 26 of our 33 cases—in at least 26 cases for, as Dan McKenzie observed, the osteomyelitis may be overlooked. We have had a case in which at necropsy the skull vault was passed as normal by the pathologist, though at operation we had found beads of pus in the parietal diploe. Now that we have an effective antibiotic for this condition it is even more likely that spreading osteomyelitis will be overlooked unless the skull is repeatedly examined radiologically.

The osteomyelitis usually produces œdema and great venous engorgement of the overlying scalp; at operation the pericranium strips very easily and the exposed bone exudes blood from many points.

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Thrombosis of the large dural sinuses or cerebral veins was present in 8 of our 33 cases, but Kubik and Adams (1943) found a higher incidence.

Multiple small cerebral infarcts have been found in some cases at necropsy. Loculated subdural abscess and cerebral abscess have become relatively common since we have been using penicillin and more will be said of these conditions later.

Leptomeningitis was a common sequel before the days of penicillin ; also ventriculitis, when needling of the brain for abscess assisted the passage of infection into the ventricles. But these conditions have now become uncommon.

Lung abscess and purulent bronchopneumonia were seen in our series, and in this connection it must be noted that Williams (1944) of the Mayo Clinic has described a group of cases of pansinusitis accompanied by bronchiectasis. Some of our cases may have had suppurative lung lesions before they ever got subdural infection.

Diagnosis

The multiplicity of intracranial infective lesions which are possible in any one case indicate the difficulties of diagnosis. However, the clinical picture of purulent pachymeningitis is sharply defined and although it bears some resemblance to uncomplicated cerebral thrombophlebitis it should usually be fairly easy to recognize. Cerebral thrombophlebitis as the sole cause of intracranial symptoms in cases of pansinusitis and spreading osteomyelitis must be very rare, if our experience is any guide. In cases of doubt there should be no hesitation in opening the dura to inspect the subdural space ; and this can if necessary be done through an infected field—through an extradural abscess, for example—now that the infection can be controlled by penicillin.

Bacteriology

The predominant causal organisms of our series were streptococci of anaerobic, or viridans, or non-hæmolytic forms (Schiller, Russell and Cairns, 1948). Staphylococcus and B-hæmolytic streptococcus were rare : although the pus from the sinuses usually contained these organisms, the pus from the skull vault and from the subdural space usually contained streptococci of the non-B-hæmolytic groups. These organisms may be difficult to culture, and their bacteriological classification is still very ill-defined. They are for the most part sensitive to penicillin : all the cases which we have treated *adequately* with penicillin have given a good clinical response, and in 3 of 4 cases where the *in vitro* sensitivity was tested the organism was completely inhibited by 0·04 unit-c.c. penicillin or less. However, in one other case the organism was completely insensitive *in vitro* at the usual dilutions ; there was some inhibition by 20 U-c.c. but none by 5 U-c.c. The *in vivo* sensitivity of the organism to penicillin could not be tested, owing to shortage of penicillin.

The occurrence of such relatively insensitive organisms indicates that in all these cases the sensitivity of the organism to antibiotics should be tested, and that until the results of the tests are available exceptionally large doses of penicillin should be given.

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Societies' Proceedings

Experience Since the Introduction of Penicillin

Since penicillin became available we have had 15 cases of purulent pachymeningitis. Five were incompletely treated owing to shortage of supplies, and, though the infection was modified, all died. Ten have been adequately treated and all but three have recovered.

The methods of treatment.—Systemic penicillin is given in doses of 100,000 units three-hourly, at least until the *in vitro* sensitivity of the organism has been tested. If the organism is normally sensitive the dose may be halved. As bone infection is notoriously prone to relapse, and as there is considerable risk of loculated subdural abscess, systemic penicillin should be continued for at least eight weeks.

It is usually impossible to drain the subdural space. When we tried to do it in the old days the brain plugged the holes in the dura (intracranial pressure is often very high in this disease). We no longer attempt subdural drainage and instead pass one or more rubber catheters into the subdural space through burr-holes. Through each catheter large quantities of dilute penicillin are instilled at frequent intervals—6 c.c. of a solution containing 500 U-c.c., or as much as the subdural space will comfortably hold. Most of this solution is evidently absorbed from the subdural space, for very little of it drains away through the catheter. The solution destroys bacteria, dilutes the pus, tends to prevent loculation and probably has the effect of producing a very high level of penicillin in the blood-vessels of the overlying skull, for some of the venous return from the subdural space passes through the skull bones.

We have not always succeeded in preventing loculation of the pus with formation of a subdural abscess, especially on the medial surface of the hemisphere, and at present we are not sure whether a catheter should be invariably passed along the medial surface of the hemisphere, and whether penicillin should also be instilled into the subdural space of an apparently healthy cerebral hemisphere. Further experience is required on these points. Our present belief is that the more the subdural space can be irrigated the less the risk of loculation.

Subarachnoid and ventricular penicillin is injected as required whenever leptomeningitis is considerable, or there is risk of ventricular contamination, and in the usual doses (10,000 to 15,000 units once or twice daily).

With systemic penicillin in full doses it seems unlikely that there will be need to remove large areas of skull on account of osteomyelitis. It should rarely be necessary to undertake massive removal of the skull vault in the acute stage, as used to be done. These mutilating and bloody operations are ill-supported by a patient who already has purulent pachymeningitis, and in our experience they rarely remove all the infected bone. In the later stages, however, it is important to remove any focus of sequestration and suppuration which remains, for, quite apart from the discomfort of discharging sinuses, these foci are apt to produce a recrudescence of intracranial infection once penicillin is stopped. It is well to note that osteomyelitis of the skull treated by penicillin produces novel radiological appearances and not every area of osteomyelitic rarefaction requires surgical removal.

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VARIETIES OF RESPONSE TO TREATMENT

The methods described have been evolved gradually, and there is reason to hope that future cases will be more successfully treated than the present series. Only 2 of our 10 fully treated cases have run an uncomplicated course under treatment. The remainder have developed a loculated subdural abscess and two of them have also had an intracerebral abscess. Sample cases will now be described.

An uncomplicated case.—A soldier of 28 who had suffered for years from bad dental sepsis developed pansinusitis and bronchopneumonia. After a fortnight his antra were washed out and next day he developed acute spreading osteomyelitis of the skull and purulent pachymeningitis (*Str. viridans*). When he came under our care on the following day he had right hemiplegia and had lost all speech. He was treated with penicillin intramuscularly (2·5 MU) and subdurally (0·15 MU for fourteen days through a catheter) and also had a few subarachnoid injections. The neurological signs disappeared almost completely; the osteomyelitis of the skull also recovered completely with discharge of pus and spicules of bone from the site of one of the burr-holes. During convalescence he developed signs of consolidation in his right lung but this also recovered. This patient was treated in *April* 1943. He was probably the first patient with this disease to be treated with penicillin. In the ensuing five years he has had several focal fits affecting the right limbs, but has been otherwise well and has been in regular work.

Purulent pachymeningitis followed by loculated subdural abscess.—A boy of 11 developed right maxillary sinusitis after toothache in *April* 1944. In *July* for the first time he became generally ill and a painful swelling appeared on the right side of his forehead. His maxillary antrum was washed out, and next day he became unconscious and showed right hemiplegia. He was observed to have focal motor attacks on the right side. Burr-holes were made and pus was found in the subdural space in the left frontal region; cultures yielded anaerobic streptococci. He was treated with penicillin, as in the previous case, also with sulphadiazine, for at one stage early in the illness he had severe leptomeningitis as well. After preliminary improvement he deteriorated in the fourth week of treatment and a further operation showed a loculated subdural abscess on the medial surface of the left cerebral hemisphere. This was drained. The boy was desperately ill for nearly two weeks, then he made a slow and complete recovery.

Eight months later, as his nose was still discharging, Mr. G. H. Livingstone performed a Caldwell-Luc antrostomy and removed nasal polypi and the anterior part of the middle turbinate bones. Three years later the boy was well and had no residual signs apart from an incomplete right lower homonymous hemianopia.

The onset of loculated subdural abscess may be suspected in these cases when the hemiplegia fails to recover, or when after a slight degree of recovery there is retrogression. The lumbar puncture pressure also rises. The common site for the abscess is between the medial and inferior surfaces of the hemisphere on one side and the falx and tentorium on the other. The pus is found by needling through the intact brain and it can only be distinguished with

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certainty from an intracerebral abscess or pyocephalus by thorotrast pyography. The characteristic appearance is that the medial and inferior walls of the abscess shadow correspond to the falx and tentorium.

In 2 cases a subdural loculation was not recognized because its development had been masked by continuing penicillin treatment, and the patient subsequently developed a cerebral abscess. We consider it important to establish by means of ventriculography that patients with purulent pachymeningitis have no form of intracranial abscess before their penicillin is stopped and they are allowed to leave hospital.

General management.—These patients may be extremely ill for three to four weeks. Stupor may interfere with swallowing, so that the risk of aspirating fluids into the trachea and bronchi is considerable. For this reason we usually nurse our patients with the head low, by means of low blocks to the foot of the bed ; they are usually fed for several days by indwelling stomach tube. Blood transfusions are valuable in the acute stage of the infection. A careful day-to-day clinical assessment and frequent examination of the pressure and cellular content of the lumbar C.S.F. are required in order to detect the onset of subdural loculation and other complications.

The primary focus.—Whenever a primary focus persists after the acute symptoms have subsided we believe that it should be dealt with radically. If possible this operative treatment should be deferred for some months and penicillin should be given systemically for a few days before and after operation.

Prophylaxis.—It seems likely that the incidence of purulent pachymeningitis, uncommon though it may be, could be further reduced with adequate prophylaxis with systemic penicillin, since a considerable proportion of the cases follow operations on the paranasal sinuses and petrous bones. Should penicillin be given before all such operations, or is it possible to foretell the cases in which such complications may arise ?

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MR. H. V. FORSTER desired to say a few words about prophylaxis. He would like members to tell if they had had experience of that rare complication osteomyelitis of the upper maxilla. It might follow quite conservative intranasal operations done to relieve chronic pansinusitis and which would include an intranasal antrostomy beneath the inferior turbinate.

He had seen very few examples of this complication, but the issue was fatal with eventual spread to the meninges, and in spite of post-operative treatment with the sulpha group of drugs in days before the discovery of penicillin. He could not account for the spread of this disease of the bone,

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except that one had sensed the poor general condition of the patient. One observed its slow advance upwards along the ascending nasal process and across the hard palate.

The surgeon would naturally dread the performance of extensive operations upon the bones of the face, though perhaps hope of recovery had rested with such drastic measures.

Ought we to use systemic penicillin treatment more often before and after operating intranasally on chronic cases of suppurative accessory sinus disease?

He had mentioned this complication in an earlier discussion at one of our meetings (December 5th, 1947, see *J. Laryng. and Otol.*), and had had helpful replies from the opener and from members taking part.

MR. A. M. ROSS asked whether in operations when there was sinus infection the authors could specify whether it was the frontal or the maxillary or ethmoid sinus which was concerned. Was it one particular sinus or all the sinuses?

MR. F. C. W. CAPPS said that he was unaware when he came to listen to this paper that the rather tragic case mentioned, and with which he had been intimately concerned, was going to form the basis of the discussion. That case was very fresh in his memory. It was a disastrous affair, and it was made the more disastrous in that the chronic sinusitis and the infected mucocele were found only in the course of a general examination of the upper respiratory tract. The man actually came for trouble in the external auditory meatus, and was persuaded that treatment was needed for the sinus disease.

He had had at least two other cases, one of which fairly recently had had a very happy sequel, thanks to the co-operation of a neurosurgical colleague, Mr. J. E. A. O'Connell. It was a relief to have now this penicillin regime, which could at least avert any trouble in a high proportion of cases. The question was whether in every simple intranasal operation on the antrum or ethmoid or other sinus they were to give prophylactic penicillin. It would seem at first sight an obvious thing to do, but penicillin had its disadvantages as well as its blessings. All those who had had experience of it would be prepared to say that it was a very unpleasant thing to have an allergic reaction in the case of perhaps essential second course of penicillin after a very thorough first course had been given. Would Dr. Schiller consider it adequate if they waited for the first sign of something going wrong before attacking the case with prophylactic measures? In a high proportion of cases they would still have their penicillin in reserve and it might happen at a later date that it could be given without the unpleasant sequelae which sometimes attended a second course of penicillin.

DR. SCHILLER had mentioned cases of thrombophlebitis as somewhat rare. He had certainly had two cases, both of which survived. The earlier was one in which he held his hand very considerably, as was now advised. It was the case of a girl who came in with an obvious orbital swelling, having had a sinus infection, and all that was done was to drain the peri-orbital tissues. She had a severe series of fits and the condition did rather suggest that it was not an ordinary case of meningitis. She recovered satisfactorily. This was before the days of sulphonamide or penicillin. At a later date he removed a deep sequestrum of the inner frontal crest from this patient. She had had a thrombophlebitis of the sinus with a spread of the phlebitis over the cortical area.

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Another case was a child who was extremely ill with septicæmia and a hemiplegia. She had had a transient swelling over one eye. In that case he called in his neurological colleague, Dr. D. E. Denny-Brown, who thought it might be a thrombophlebitis and advised exploring widely the frontal area. This was done and a small, narrow, frontal sinus was found with a little bead of pus lying over the sinus. That child made an uninterrupted recovery. Thus of these two cases the one recovered as a result of masterly inactivity and the other as the result of an extensive operation. It was to be hoped that these extensive removals in osteomyelitis cases were now at an end.

MR. R. L. FLETT said that he had seen osteomyelitis follow operation on the maxilla, but all the cases he had seen had been associated with polypi in the ethmoids or antra, with thick pus coming from the sinuses; and he thought that any case like that with cellulitis over the frontal bone should have injections of penicillin before surgery was undertaken. In this type of case penicillin was absolutely essential.

MR. NORMAN PATTERSON said that he could recall only one case of osteomyelitis following operation on the frontal sinus, but he could remember three following operations on the antrum. One of these was a case on whom an operation on the other antrum had been done ten years previously without any complication. He was called in to see her because there was a slight swelling over the side of the nose. Large areas of bone were removed. In another case hæmorrhage developed after intranasal antrostomy. The patient's nose was packed for about forty-eight hours; he soon afterwards developed osteomyelitis. The third case was one the late Mr. Herbert Tilley asked him to see. All three patients died. The other case following frontal sinus operation recovered after the removal of nearly the whole of the frontal bone.

MR. E. D. D. DAVIS was of the opinion that in cases where the possibility of an osteomyelitis was expected a course of systemic pencillin should be given. If extensive bone operation was to be done a course of penicillin should be undertaken before as well as after the operation. The earliest possible diagnosis of meningitis is of the greatest importance. Meningitis arising from the ear may be expected in certain cases. Children and young adults are more susceptible to meningitis particularly in cases of otitis media following scarlet fever and measles. The acute streptococcal mastoid of sudden rapid onset in children was recognized by a profuse discharge of serous fluid from the ear, and when the mastoid was opened, the cells were full of turbid serum: an osteomyelitis without localization.

Suppuration of the retrofacial mastoid air cells calls for a careful watch for threatened meningitis. A persistent headache with a slight rise of temperature and later vomiting is an indication of meningitis. An early diagnosis of meningitis cannot be made without an examination of the cerebrospinal fluid. Rigidity of the neck is a late sign and on two occasions he had seen a stiff neck resulting from acute adenitis of the glands of the neck. Both cases had been diagnosed as a meningo-encephalitis but they recovered in a few days. He examined the notes of 27 cases of meningitis with rigidity of the neck and only 4 recovered and these 4 were treated by large doses of penicillin and sulphadiazine. He believed the earlier the diagnosis and the more prompt treatment with penicillin and sulphadiazine the better the result.

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THE CHAIRMAN (Mr. Donald Watson), after saying how much the Section appreciated the paper, said that he had seen several cases of osteomyelitis in the frontal sinus cured practically without operation since the advent of penicillin. All the intervention that took place was the simple removal of pus. His own practice—he was thinking particularly of cases of polypi which had an underlying osteitis—was to use penicillin for twenty-four hours before operation and twenty-four hours afterwards. Thus one operated, so to speak, in a bath of penicillin and in that way infection was stayed. It was not necessary to give a long course of penicillin.

DR. F. SCHILLER, in reply to the question as to whether it could be told which sinus was involved—the infection related to practically all the sinuses, and it was very difficult to single out one in particular. Certainly antral infection played a great part.

He wondered how important the problem of allergy and acquired resistance to penicillin really was, considering the life-saving properties of the drug.

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