T H E S I S.

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THE SEQUELAE OF ACUTE EPIDEMIC ENCEPHALITIS (ENCEPHALITIS LETHARGICA).

A Clinical and Pathological Study

By

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I hereby declare that the enclosed thesis, on the Sequelae of Acute Epidemic Encephalitis, is entirely of my own composition and was carried out unaided, unless where stated.

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The Sequelæ of Acute Epidemic Encephalitis. (Encephalitis Lethargica)

This account is based upon personal observation of sixty cases showing various sequelæ of Encephalitis Lethargica. No attempt has been made to describe all the clinical conditions that may be permanent relics of this disease, but only those that were seen during routine hospital practice.

Date of the Acute Attack. In twenty-seven cases, or nearly 50 per cent of the total, the acute illness occurred during the year 1920, the figures for the remaining years are as follows:-

1917	1 case
1918	7 cases
1919	12 cases
1921	8 cases
1922	5 cases.

Age Incidence. (Age reckoned from the time patient first comes under observation).

Below 10		years	1 case
"	10 to 20	"	18 "
	20 to 30		11 "
	30 to 40		10 "
	40 to 50		11 "
	50 to 60		4 "
	60 to 70		5 "

The decade with the heaviest incidence is that of 10 to 20. Thirty cases or 50% of the total number occurred in persons below the age of 30. Of these seventeen or 60 per cent, were examples of Paralysis Agitans.

Sex. Twenty-five were males and thirty-five were females.

Average date between acute illness and onset of sequelæ. Leaving aside the cases of Paralysis Agitans, which formed the largest group in this series, namely, thirty-eight cases or 64 per cent of the total, the average period was under one month. In the Paralysis Agitans group the average latent period was four and a half months, the shortest interval was under one month and the longest interval three and a half years.

CRANIAL NERVES.

Ocular Affections.

Affections of the ocular apparatus were present in 46 cases, or over 80 per cent of the total number. Nystagmus was present in 6 cases. Nystagmoid movements on extreme lateral fixation was noted in 12 cases, the majority of these occurring in the paralysis agitans group. True ptosis was only present in 5 cases, in all of which it was unilateral. In one of these it was due to paresis of the cervical sympathetic. The following paresis of external ocular muscles occurred: 6th nerve 1, internal rectus (unilateral with divergent strabismus) 5; complete 3rd nerve palsy, 1 (unilateral, being part of a Benedict's syndrome). The pupils were markedly unequal in nine of the cases. Alterations in the reactions of the pupils to light and accommodation formed the largest group of ocular affections. In 9 cases there was deficient or absent reaction of the pupils on accommodation, the reaction to light being conserved; in 15 cases there was impaired reaction to light as well as to accommodation. In these cases the loss of accommodation was greater than the loss to light. In 6 of these myosis was marked; in the remainder the pupil was normal in size. In one case there was moderate loss of reaction to light with impairment to reaction on accommodation. In this

group of 25 cases showing alterations in pupil reaction, 19 were examples of Paralysis Agitans. No case of loss of accommodation was observed in which there was not an accompanying restriction of convergence; the latter was impaired or lost in 29 cases, the majority of these being in the paralysis agitans group. No case of optic atrophy consequent upon the disease was met with although several such cases have been reported in the literature. In the recent report issued by the Medical Research Committee on Encephalitis Lethargica (2), mention is made of two cases of bilateral and one of unilateral optic atrophy out of a total of 271 in whom the sequelæ were noted. In Morris Grossmann's (3) series of 92 cases of sequelæ no mention is made of the occurrence of optic atrophy. Ptosis although frequently met with in the acute and subacute stages tends to clear up and is somewhat rarely met with as a late sequel. The same remark applies to nystagmus. The most important sequelæ are the alterations in the reaction of the pupils to light and accommodation. Paresis of accommodation is the more frequent of these and may be permanent; it is met with alone or in conjunction with all types of sequelæ, i.e. in children with changes in moral character, in paralysis agitans, etc. It is always associated with some limitation of convergence, the latter may also occur alone and is of diagnostic importance. Impairment or loss of the light reflex may accompany the loss to accommodation. The pupils in such cases are

usually small and may be irregular in outline (thereby simulating the pupil of syphilis of the central nervous system very closely) but only one case approximating the Argyll Robertson pupil was observed. Ward A. Holden (1) in discussing the differential diagnosis from the luetic pupil lays stress on the accompanying defect in convergence which is usually present in Encephalitis Lethargica. In cerebral lues if there is paresis of accommodation there is usually dilatation of the pupil and this usually affects one eye only, whereas in encephalitis lithargica bilateral paresis of accommodation with a small pupil is the more usual finding.

The following two cases may illustrate the various ocular affections:-

Case 54. Female, aged 32. Was taken suddenly ill in January 1922 with marked vertigo, so that she rolled about when she walked; vomiting also occurred. These symptoms persisted; at the end of a week she saw double and also noticed that when reading the letters became blurred. At no time had she tinnitus or deafness. There was no disturbance of sleep. When examined in July 1922, vision was full, pupils equal, sluggish reaction to light and accommodation; fundi and fields were normal. There was slight paresis of the left external rectus; there was no ataxia and no deafness. The examination of the central nervous system was otherwise negative. The Wassermann reaction /

in the blood and cerebrospinal fluid was negative and there was no history suggestive of specific disease. The patient greatly improved as regards the ocular condition and in February, 1923, there was no evidence of external muscle palsy, but marked myosis with practically no reaction to light or accommodation remained, although convergence was nearly normal.

Case 55. Male aged 41. Was seen in June 1922, complaining of giddiness and diplopia. He said that in April 1922 he was taken ill with double vision, pains in the chest and between the shoulders, and general malaise. For the last month he had felt very sleepy during the day. Examination showed no ocular palsies; the pupils reacted fairly briskly to light and accommodation; there was no limitation of convergence; examination was otherwise negative. The Wassermann reaction in the blood and cerebrospinal fluid was negative. He continued to complain of giddiness. In July 1922, the pupils were now noted as being small and reacted very sluggishly to light and accommodation; no other organic signs were evident.

Case 32. Female, aged 29. During September 1920 became low and depressed and suffered from headache. She vomited off and on for three or four days, then double vision appeared. For a week or so she suffered from insomnia. In October 1920

examination showed divergent squint in both eyes, due to double internal rectus paresis; no ptosis; no paresis of other ocular muscles. The pupils were equal and reacted well to light and accommodation; no other cranial nerve palsies. At the beginning of November 1920 she had a severe headache, and on November 11th there was slight right ptosis and paresis of both internal recti as before. On December 23rd, 1920, there was divergent strabismus of right eye, and slight weakness of both internal recti. The ptosis of the right lid was less pronounced. On January 6th, 1921, the patient felt better and the headaches were less frequent, but ptosis of the left eye was noted, and very slight ptosis of the right eye; divergent squint of the right eye as before, slight paresis of both internal recti, right more than left; upward and downward movements of the left globe were now very defective. On February 10th, 1921, signs were as before, but were less marked. On March 3rd, 1921, there was no ptosis but weakness of both internal recti as before, and deficiency in upward and downward movements of the left globe was still present. 19th May, 1921, the right ptosis had recurred, otherwise the findings were as before. On June 23rd, 1921, right ptosis had cleared up and now there was slight left ptosis which persisted till August. In September 1921 no ptosis but weakness of left internal rectus; upward and downward movements of left globe full. On October 6th weakness of both internal recti. In January 1922 divergent strabismus of

right eye and weakness of right internal rectus, no weakness, left internal rectus, no ptosis. November 1922, right ptosis, still divergent strabismus left eye; pupils were noted as being small. From that time onwards the patient has improved. Fundi on all occasions normal. During the whole of this period the patient had been subject to headaches, occurring at times more or less corresponding with the relapses in the ocular condition, but unaccompanied by vomiting. Wassermann in the blodd and the cerebrospinal fluid was negative (August 1921).

Remarks. The condition in this case simulated myasthenia gravis, brain tumour, and syphilis of the nervous system. As regards a tumour, this seems very unlikely in view of the fact that the condition is improving, and that after two and a half years there has been no involvement of other cranial nerves. The fundi which have been repeatedly examined have always been normal. The normal findings in the blood and cerebrospinal fluid practically exclude syphilis as a cause. The persistence of the ocular palsies and their apparent lack of relation to fatigue, and the absence of involvement of other parts, after two anda half years seems to exclude myasthenia gravis. The marked mutability of the palsies in this case are striking, and are to be regarded as of diagnostic importance.

The following is an example of Benedict's syndrome following Encephalitis Lethargica.

Case 33. Male, aged 36. Came under observation in April 1920 with the complaint of squint in the left eye and tremor in the right arm. He stated he was quite well until one morning during July 1918 when on awakening he noticed his left eyelid had drooped. He felt "somewhat out of sorts". Within the next two weeks he developed double vision and his left eye turned outwards. The double vision disappeared within the next two months and the droop of the left eyelid became less marked. Four months later the eye symptoms again became worse and about the same time a tremor in his right hand appeared. At the same time he noticed twitching in the muscles of his right leg and back of the neck, especially at night. The tremor and the eye condition have remained about the same since. Examination in April 1920 showed a well developed man of healthy appearance; complete ophthalmoplegia externa and interna of the left eye; right eye normal in all respects, fundi normal and other cranial nerves normal. The right arm was the site of a rhythmical tremor, the chief movement being due to alternating extension and flexion at the wrist. Tremor was continuous; it was increased by excitement or voluntary movement; it could be inhibited for a short time when an effort was made to relax the muscles of the right arm. The rate of the tremor was about 6 to the second. Periodicity was regular but the range of movements varied, being much increased when he used the limb. There was slight increase in tone in all muscle groups, but it was

difficult to estimate the extent of this on account of the tremor. The motor power was good, there was no loss of sensation; reflexes were brisk and equal in the two arms. Abdominal reflexes were brisk and equal in all segments. The legs showed no increase of tone, no tremor, no paresis and no sensory loss. There was slight ataxia of the right leg. The right knee jerk was more active than the left, both plantar responses flexor in type. Wassermann reaction negative in the blood and cerebrospinal fluid; no evidence of arterial disease. In November, 1922, condition was unchanged; fundi normal.

Remarks. There was no evidence here of a specific lesion or of a tumour, nor is the history compatible with a hæmorrhage. On the other hand, the varying paresis affecting the left eye at onset, the relapse and muscular twitchings are points much in favour of encephalitis lethargica. Similar cases have been reported by Kirby and Davis[4] and Abruzzi[5] following encephalitis lethargica.

OTHER CRANIAL NERVE AFFECTIONS.

Facial paresis of peripheral type was only observed in one case, in which it has persisted for over two years. In 19 cases there was asymmetry of the face limited to its lower portion, present only on voluntary movement. All these cases were examples of Paralysis Agitans and the significance of this sign will be discussed later. The following is a case showing involvement of the lower cranial nerves :

Case 59. Male aged 45. Came under observation in January 1923 with the complaint of difficulty in swallowing and speaking and of weakness in the legs. He stated he was perfectly well until the spring of 1918. At that time he was working as a railway porter. One day whilst at work he noticed his voice becoming weaker and within an hour or so he found that upon collecting the tickets he kept dropping them owing to weakness in his hands; his legs also felt weak. His walk home which usually took half an hour was only accomplished in two hours. On reaching home he attempted to eat some food and found he could not swallow properly. He had no pain, so far as he remembers, and no disturbance of vision or sleep. At the end of two weeks he returned to work although his voice was still feeble and he had some difficulty in taking solid food. He remained at work until May, 1922, when he had to give up on

account of weakness in his legs. He has never had any trouble with micturition or respiration. His wife corroborated details of his illness, and added, that of late "he sits down and falls asleep during the day; and that he has become irritable". His memory was also noticed to be failing. Examination showed a thin, emotional man, who often smiled at quite inconsequent things. Attention and memory poor; no delusions or hallucinations. Intelligence below normal. Pupils equal, both react to bright light; reaction to convergence moderately good; ocular movements full; no nystagmus; fundi were normal, as also were the remaining cranial nerves, except 10 and 12. The voice was feeble and husky; soft palate moved well on phonation. There was slight defect in swallowing. Examination of the vocal cords by Mr. F.W. Walkyn Thomas showed paralysis of the right vocal cord in the cadaveric position, phonation being possible by fixation of the left cord. The tongue deviated to the right and was moderately atrophied on the right side. It was the seat of a fine fibrillary tremor. The limbs showed slight diminution in power, more so in the legs. There was also a slight increase of tone in the limbs, but the actual amount and distribution of this was difficult to estimate as the patient seemed unable to relax his limbs. All deep reflexes were equal but considerably exaggerated; plantar responses flexor in type. There was no disturbance of sensation, and no ataxia. There was a slight, rapid, coarse tremor in all the limbs on

voluntary movement; no disturbance of sphincters. The cardio-vascular system showed no marked abnormality. The Wassermann in the blood and cerebrospinal fluid was negative. The escape of the eleventh cranial nerve is to be noted. Grossmann [3] reports two cases of unilateral atrophy of the tongue as the only sequel of encephalitis lethargica. Similar cases have been reported in the literature.

SPINAL FORMS.

Involvement of the spinal cord, spinal roots, and peripheral nerves is now well recognised as a possibility in the acute stage, and many cases have been reported in which there has been some local residuary atrophy of muscles, (6, 7, 8, 9, 10). Myoclonic movements, fibrillary twitching, and typical root pains occur most frequently in cases where the cord or its meninges are affected. Paralysis of one or more limbs, or sometimes one group of muscles, i.e. small muscles of one or both hands, may follow these other manifestations, and such cases resemble acute poliomyelitis very closely. There is also a transverse myelitic form characterised by paraplegia or quadriplegia with loss of sphincter control, usually associated with, or preceded by diplopia or other signs of cerebral involvement. Cases clinically resembling polyneuritis have also been noted. All these various types tend to recover fully or partially, which is a point of diagnostic help. Spiller (11) and others have reported cases resembling disseminated sclerosis in which histological examination has shown distinct sclerotic patches accompanied by round-celled infiltration of these areas, and of the grey matter of the cord, and which are regarded as cases of epidemic encephalitis. But it seems possible that such cases may be examples of acute disseminated sclerosis. The following is the only example of the spinal forms of encephalitis lethargica in this series:

Case 14. Female, aged 19, was seen on 16th January, 1923 with the complaint of weakness of the right arm. She stated she was taken ill on October 19th, 1922 with a severe pain between the shoulders. She remained at her work, that of a typist, for one week despite the pain which became very marked, and then spread to the right shoulder and down the right arm. Later, pains were also felt in the left arm and in both legs; they were of a shooting character. On the 8th day of the pain she went to bed; she felt restless and could not sleep; she was delirious for one or two nights. On the 10th day of her illness she lost all power in her right arm; no weakness elsewhere was noticed. About the same date her right shoulder was thrust forwards and upwards and remained more or less in this position for about two or three weeks. (This statement was volunteered by the patient's mother and corroborated by herself). She felt twitching in the muscles running from her neck towards the right shoulder, and at times her right forearm was suddenly jerked upwards and she used to put her left hand on it to keep it down. She had no disturbance of vision. At the end of two months power began to return in her right arm and recovery quickly took place. She was able to return to work at the beginning of January, 1923, but noticed that her right arm became quickly tired. Since her illness she seems to have lost interest in things, according to her mother, and she has been sleeping badly.

1923

Examination on 16th January showed a pale, intelligent girl. Pupils equal and react normally to light and accommodation; no limitation of ocular movements; the remaining cranial nerves were normal. The right arm showed slight loss of power, which was more marked proximally than distally. There was moderate wasting of supra- and infra-spinati and deltoid on the right side. The biceps and supinator longus on that side were flabby as compared with those on the left side, but were not actually atrophied. There was no appreciable weakness of the trapezius, no wasting in the small muscles of the hand, although the right grip was weaker than the left. There was no fibrillary tremor, no sensory loss nor ataxia. Electrical reactions of the atrophied muscles showed no reaction of degeneration. The reflexes were sluggish in both the arms but more so in the right arm. Abdominal reflexes were brisk and equal. Power in the legs was good, the reflexes brisk and equal; the plantar responses being flexor in type. There was no sensory loss nor ataxia. At no time was there any sphincter disturbance. The resemblance of this case to a mild attack of poliomyelitis was close, but the following points seemed to be in favour of the diagnosis of the spinal form of encephalitis lethargica:-

1. The severity of the spinal root pain.
2. The long interval between the appearance of the pain and the onset of the paralysis.
3. The excito-motor symptoms as shown by the spasm of the trapezius and the myoclonic movements in the right forearm, and
4. The delirium and marked insomnia.

HEMIPLEGIA.

The possibility of this condition being caused by Encephalitis Lethargica was first pointed out in this country by Buzzard and Greenfield (12). The onset may simulate closely that of a hemiplegia due to more usual causes. Indeed it is extremely difficult to ascertain from the history evidence pointing to an encephalitic process in such a case, and it is certain that Encephalitis Lethargica as a cause of hemiplegia is frequently overlooked unless there are ocular or other palsies indicating a more diffuse process. In the majority of Buzzard and Greenfield's cases a diagnosis of Encephalitis Lethargica was not made during life. In cases that recover, especially those in which hemiplegia, with or without hemi-anæsthesia and hemianopia, is the only sign, it is practically impossible to make a diagnosis of Encephalitis Lethargica. I have seen one or two cases in which the possibility of encephalitis lethargica as a cause of hemiplegia had to be considered, but no definite proof could be obtained. The following is a case of pseudo-bulbar palsy. This condition may follow encephalitis lethargica, but is uncommon. The following is the only case in this series showing this condition:-

Case 31. Female, aged 45. Was seen in September, 1922, when she complained of inability to speak, difficulty in eating

Fig. 1. Case 31. aet 45. Acute attack Nov. 1921. Symptoms of Pseudo bulbar palsy began 2 months later. (See text).

and weakness in the limbs. She intimated in writing that she was more or less suddenly taken ill at the beginning of November, 1921 with 'tremendous irritability', shortness of breath, heavy feeling across the forehead, blurring of vision, sleeplessness and delirium, in which she thought dogs were running after her. Two months from the onset her speech became affected and she began to have some difficulty in swallowing, and later the arms and legs became weak. For the past few months she had been unable to speak.

Examination in September, 1922 showed an intelligent but extremely emotional woman; smiles and tears were easily provoked; the smile had not quite the fixed character of that occurring in a well-developed Paralysis Agitans; it developed and disappeared with much greater rapidity. The mouth was always open and dribbling of saliva was marked. The pupils were equal and reacted moderately briskly to light and accommodation. Ocular movements were full except on convergence, which was considerably limited. The fundi were normal. There was marked weakness of musculature of the face and jaws on either side. No deafness but considerable difficulty in swallowing, especially as regards solids. The soft palate moved moderately well on phonation; pharyngeal reflexes were brisk. The tongue could not be protruded beyond the line of the teeth, it was tremulous but without any definite atrophy. The patient was unable to speak and could only make a droning noise. The arms

were thin but no definite atrophy was noted. No fibrillary or other tremor was present. The posture was one of abduction and internal rotation of the shoulder, flexion at the elbow, pronation at the forearm, slight extension at the wrist with flexion at the fingers at inter-pharyngeal joints. The tone was moderately increased in all muscle groups, but predominated in those determining the posture. There was a slight but definite cog-wheel phenomenon . The power was considerably diminished in both arms, about equally, and the diminution was the same in the proximal and distal portions of the legs. The reflexes were extremely active in both arms. Sensation was normal; there was no ataxia. The movements were carried out somewhat slowly; the abdominal reflexes were brisk on both sides and equal. The legs lay in bed in the extended position. The tone was moderately increased in all muscle groups but predominated in the extensors. There was considerable loss of power in both legs, but this loss was less than existed in the arms, the distal muscles being more affected than the proximal. The reflexes were much exaggerated. A bi-lateral plantar response was obtained accompanied by marked flexion reflex. Sensation was normal; there was no disturbance of sphincter control. There was no evidence of gross arterial disease. The Wassermann in the blood was negative.

Remarks.

In this case the clinical condition resembled one of pseudo-

bulbar palsy. There is, however, evidence of involvement of the pallidal system on each side, as shown by the general increase in muscle-tone, the retention of the abdominal reflexes, the slowness of movement and the cogwheel phenomenon.

I wish to emphasize in this case the predominance of the changes attributable to the pyramidal tract. Ramsay Hunt (13) has given the name of Pallido Pyramidal Syndrome to this condition and has reported cases similar to this one following encephalitis lethargica. Lhermitte and Cornill (14) have also described cases showing affection of both the pyramidal and pallidal systems. Such cases as the one described are rare as sequelæ of encephalitis lethargica, but it is important to recognise the possibility of such a sequel.

In advanced cases of Paralysis Agitans, evidence of bilateral paralytic affection may appear (Cases 14 and 29), but the clinical picture is so dominated by the Paralysis Agitans element that the clinical signs of the latter predominate.

The following case is of considerable interest owing to the association of a Left unilateral Paralysis Agitans with a Right hemiplegia, the limbs on this side showing well-marked postural tonus.

Case 22. Female, aged 20. Came under observation in November, 1922 with the complaint of weakness of the right arm and right leg and inability to walk. She stated that she had

been quite well until April 18th, 1919, when she noticed that she saw double. The same night she became delirious; the following day she was exceedingly drowsy and this persisted during the next few weeks, but she was able to be roused for her meals. On the fourth day of her illness, on attempting to get out of bed she noticed that she dragged her right foot, and the following morning weakness in the right arm and the right side of the face was observed by her parents. She was removed to an Infirmary, where she remained for a year. Her present condition seems to have gradually developed - for the past year the condition has progressed.

Examination. Patient presented a definite Parkinsonian facies. Her voice was feeble, slow and monotonous. She had no difficulty in swallowing. There was moderate sialorrhœa. Her condition was typical of Paralysis Agitans. Her intelligence was fair but cerebration was somewhat slow. She seemed quite content with Hospital life after four or five months and said she was quite happy. Indeed, her general mental attitude was one of apparent euphoria out of keeping with her physical condition. She always slept in the morning, as well as soundly at night. The pupils were small, concentrically placed, and regular in outline. They reacted briskly to light and accommodation. The ocular movements were full, except convergence, which was ~~slowly~~ slightly limited. There were no nystagmoid movements,

and the fundi were normal. There was moderate bilateral facial weakness, especially as regards the action of the frontales. There was slight right lower facial paresis apparent only on voluntary movement. The movements of the jaws were slow and somewhat feeble. The tongue was protruded well and was not tremulous. The soft palate moved well. The remaining cranial nerves were normal. There was slight hypertonus in the neck muscles. Passive movements of the head did not produce any reflex movements in the trunk or limbs.

Arms.

Posture. This was strikingly dissimilar in the two upper limbs and must be considered in detail.

Left upper limb. The posture varied little in the recumbent or erect positions and was typical of that seen in a moderately well-developed Paralysis Agitans, namely, slight abduction and internal rotation at the shoulder, moderate flexion at the elbow, pronation of the forearm, slight extension at the wrist, flexion at the metacarpo-phalangeal joints and slight flexion at the inter-phalangeal joints. The thumb was adducted, so that the tip of the thumb rested against the palmar aspect of the terminal phalangeal joint of the index finger.

Right upper limb. The posture at rest was not constant and was dependent upon the condition of plastic tonus which was

Figs. 2. Case 22. Female aet 20. Acute attack epidemic encephalitis April 1919, followed within 2-3 months by right hemiplegia and left unilateral Paralysis Agitans. The photographs shew flexor and extensor rigidity in the right hand. (See text).

present (vide infra). The position of the limb which was observed most frequently with the patient in the recumbent position was as follows:-

Slight abduction and internal rotation at the shoulder joint, flexion up the elbow, which varied considerably in degree, the forearm midway between prnnation and supination, varying degrees of flexion at the wrist, flexion of the fingers into the palm, most marked in the little finger which was flexed, across the middle phalanx of the ring finger, whilst the thumb was adducted, and flexed at the terminal phalangeal joint and overlapped the middle phalanx of the index finger. (See Fig. 2.).

Tone.

This was estimated by passive movements at the joints, the patient being instructed to relax the limbs as much as possible.

The left upper limb was hypertonic. The tonus was distributed about equally to all the muscle ~~grips~~ groups. The cogwheel phenomenon was well-developed.

The right upper limb. With the limb at rest and relaxed, passive movements at the various joints showed that there was a slight increase in tone in certain muscle groups but that the hypertonus was considerably less than in the left arm; also there was no cogwheel phenomenon, a point of considerable importance. A slight increment of tone was present in the flexors of the elbow, and more definitely in the flexors of

Fig. 3. Case 22. Posture of hands with arms outstretched. Note the flexor rigidity in right hand.

the wrist and fingers. There was no apparent increase in tone on pronation or supination, the resting tonus therefore approximated that seen in hemiplegia, but the very slight degree of increase in tone must be emphasized when the limb was at rest. During passive movements of this limb certain other phenomena were observed. (i) a passive movement of flexion and extension at the wrist could be carried out several times in succession without any resulting reflex alteration in tone, but occasionally when attempts were made to extend the wrist passively from a flexed position the following occurred:-

Extension of the fingers and wrist simultaneously followed by very slow and progressive pronation of the forearm. During one test 20 seconds elapsed before this movement was completed and finally when pronation was about three parts developed, more or less rapid flexion of the fingers into the palm took place, flexion being most marked at the terminal phalangeal joints. The wrist also became slightly flexed. There was no appreciable alteration in the angle of the elbow which was one of slight flexion at the commencement of the test. The arm would remain in this posture indefinitely. (ii) With the hand in the flexed position passive movements of extension of all the fingers sometimes resulted in slow tonic extension of the hand as follows:- Slight extension at the wrist was

followed by extension of the fingers at all joints, extension and abduction of the thumb and adduction of the fingers except the little finger, which was usually abducted. The hand remained in this tonic posture for a few seconds (see Fig. 2), then gradually the spasm passed off somewhat so that the thumb approached the index finger and the fingers became slightly flexed at the middle phalangeal joints. This posture was now maintained. (iii) If now one of the fingers was passively flexed it at once extended again and the extensor rigidity in the fingers again became marked. Occasionally, however, especially if more than one finger was passively flexed, the extensor spasm was quickly followed by marked flexion of the middle and terminal phalangeal joints of all the fingers; extension at the metacarpo-phalangeal joints, however, being maintained; the thumb being opposed to the radial aspect of the terminal phalanx of the index finger; the position of the wrist and elbow was inconstant but usually was one of slight flexion. (iv) Furthermore, any posture into which the right upper limb might be passively placed was maintained, it did not matter whether this was one of flexion or extension at the elbow, or adduction or abduction at the shoulder, such posture would be maintained without fatigue for apparently any length of time. When a passive alteration in the posture of the limb was made resistance was met with in any muscle or muscles that had been

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Fig. 4. Case 22. The limbs on the hemiplegic side exhibited well marked postural tonus. (See text). The posture of the right arm depicted in this photograph could be maintained for a considerable length of time without the appearance of fatigue. The flexor rigidity in the hand is also seen.

acting as agonists. This increment of tone was now redistributed, so as to maintain the limb in the new posture in which it had been passively placed. (v) If with the right upper limb relaxed as much as possible, the limb was suddenly jerked upwards by the observer with sufficient force to raise it to a level about right angles with the trunk, the limb instead of returning to the bed continued upwards rapidly so that the arm finally projected straight above the head, fully extended at the elbow, being in close apposition to the right side of the head, and the forearm usually pronated. (See Fig. 4.). This position could be maintained involuntarily for a considerable period, i.e. 30 minutes in one test, without the occurrence of fatigue. The sudden passive displacement of the limb probably excited a reflex contraction of the deltoid and trapezius. It is evident from this brief account that the phenomenon of plastic or postural tonus, as described by Sherrington (37) was well developed in the right upper limb.

Voluntary Movements.

In the left upper limb there was no appreciable loss of power at any of the joints in this arm, but all movements were carried out slowly, and occasionally were accompanied by a rapid coarse tremor.

Right upper limb. Power at the right shoulder and elbow

joints was only slightly less than at the corresponding joints in the left arm. At the wrist however power was somewhat less. The grip was moderately good. Movements at the shoulder and elbow were carried out slightly less quickly than in the left arm, and were accompanied by an intention tremor (vide infra). With the hand in the flexed position the limb being relaxed, if patient was now asked to open the hand extension took place comparatively quickly, but slower than in the normal person. Reflex extensor rigidity was superadded to the active movement of extension and this posture was involuntarily maintained for a few seconds; a slight relaxation then took place, but the hand remained in a more or less extended position. Occasionally, however, if the patient was asked to open the hand, extension of the thumb and index finger occurred and extension of the fingers at the metacarpo-phalangeal joints, but the remaining phalangeal joints became markedly flexed. The patient tried to extend these fingers, but was unable to do so. She then voluntarily flexed the index and other fingers at the metacarpo-phalangeal joints and at the same time strongly flexed the wrist. Extension of the fingers quickly followed; sometimes, however, she was compelled to pronate the forearm before she was able to extend the fingers. Yet another method of opening the hand was used by the patient but was only necessary when the wrist and fingers were actually in flexor

spasm, namely, acute flexion at the elbow and the wrist with internal rotation of the shoulder so that the dorsal aspect of the fingers approximated the chest wall. At the same time she pronated the forearm and the fingers became extended. Extension at the elbow then occurred and was followed by full pronation of the forearm, the extensor rigidity of the fingers being maintained. Gradually, however, this relaxed and the fingers became semi-flexed but the forearm remained fully pronated.

If the patient was asked to close the hand when this was in a position of extensor rigidity, flexion of the index finger and apposition of the thumb slowly occurred; then slowly the fingers flexed at the terminal phalangeal joints and then at the interphalangeal joints, the wrist became flexed, followed by flexion of the fingers; tonic flexor rigidity now became marked. (See Fig. 2.).

If the patient was asked to grasp the observer's hand tightly and was then told to relax her grip, she was unable to do so for periods varying in different tests between 12 seconds and 2¼ minutes; sometimes indeed the grip tightened instead of relaxing. In order to loosen her hold the patient voluntarily assumed one of the postures previously described as necessary when opening the hand, the more usual method being one of full pronation. An example of such a test is as follows.

The patient was asked to grasp the observer's hand and was then told to relax. At the end of 10 seconds from this last order moderate pronation took place but no relaxation of the flexor spasm; then slowly the forearm and hand returned to its former position midway between supination and pronation, with slight flexion at the elbow, and the grip slightly tightened, at the same time the patient said, "I can't". She then extended the elbow and over-pronated the forearm; extension now occurred at the metacarpo-phalangeal joints, and first interphalangeal joints, but the long flexors of the fingers continued in spasm, so that she was unable wholly to relax her grip of the observer's hand. Finally the patient supinated the forearm and the terminal phalanges became extended. This test lasted 2¼ minutes.

The patient obviously had much greater difficulty in extending her hand when it had previously gripped an object than when she was simply asked to open the empty hand.

When the patient voluntarily moved the right arm at the shoulder joint there was a slow - about 4 to the second - rhythmical bi-phasic movement of flexion and extension at the shoulder joints, which at first was of considerable range, and after a few seconds tended to become smaller and usually disappeared. If the arm was passively thrown upwards, as previously described, this tremor sometimes occurred, but did not do so if

the arm was passively placed in any particular posture. It seems analogous to the tremor described by Riddoch and Buzzard[16] as occurring in cases of quadriplegia and hemiplegia. They suggest that such a tremor is due to double reciprocal innervation and is a manifestation of action of two equal but antagonistic forces acting alternately, the stimulus starting the bi-phasic movement being the weight of the limb.

Sensation was normal in every respect.

Lower Limbs. The posture of the left leg when at rest in bed was one of extension at the knee and hip with slight inversion at the ankle, the foot pointing somewhat downwards.

The right leg was adducted, extended at the knee and hip, the foot usually being inverted; the hallux was strongly dorsiflexed.

Tone in the left leg. This was markedly increased in all muscle groups about equally; cogwheel phenomenon was well marked.

Right leg. There was slight hypertonus, chiefly in the adductors and extensors of the knee. At the ankle joints there was no resistance to movement producing lateral displacement, but if the foot was passively extended or flexed, then there was found to be marked hypertonus, more marked in the post tibial group of muscles. There was no cogwheel phenomenon. Plastic tonus was also apparent in the right leg. As

above described, the usual posture at rest in the right foot was marked inversion. If the foot was now everted it remained in this position. If now inversion was brought about this position was maintained tonically. The same phenomenon was not observed in passive movements of flexion and extension at the ankle.

If the limb flexed at the hip and knee joints were raised passively from the bed, it remained in this position unsupported, for several seconds at a time, then gradually returned to the bed. If the limb extended at the knee was passively lifted into the air, it remained in this position unsupported for a considerable time, tonically held by the flexors of the hip and quadriceps. If now passive flexion of the knee was performed, considerable force was required to overcome the resistance offered by the tonic quadriceps. This new posture of flexion at the knee was now maintained.

Reflexes.

The reflexes were active in both arms, more so in the right. The abdominal reflexes were brisk and equal in all segments; in the legs, the deep reflexes were exaggerated about equally in the two legs. The plantar response was definitely extensor on the right side. On the left the response was probably extensor and was accompanied by moderate withdrawal reflex.

If with the thigh supported and a condition of extensor rigidity at the knee produced, a nocuous stimulus was now applied to the sole of the right foot, the extensor rigidity was at once replaced by a well marked flexion withdrawal reflex. This flexed posture was maintained for a few seconds, the thigh no longer being supported, then gradually the limb extended again and extensor rigidity again occurred. This, however, only lasted a few seconds before passing off, the limb slowly descending to the level of the bed.

In the upper limbs, reflexes were obtained as the result of the application of nocuous stimuli (Riddoch and Buzzard (16)). In the right arm, a pin dragged along the skin for an inch or so produced a reflex movement of abduction and retraction of the limb. Such a response was obtained from the flexor aspect of the forearm and inner aspect of the upper arm; also from the extensor surface of the forearm, though the resulting displacement of the limb was less than from the other areas. The movement at the elbow varied, being sometimes one of flexion but more usually one of extension. In the left upper limb similar reflexes were obtained, although the flexion reflex was the more usual. No response could be obtained in either arm from the stimulation of the chest wall.

Well marked shortening and lengthening reactions as described by Sherrington (37) were observed in the right leg. If

with this limb rotated outwards and flexed at the knee, and supported by the hand placed under the thigh, a series of taps (usually only two or three were necessary) were applied to the patellar tendon, after each jerk the leg instead of returneng to its former position, as in the normal knee jerk, became progressively extended and remained in this position, tonically held by the quadriceps. The rate and strength of the stimulus mattered little. This shortening reaction was also present in the hamstring muscles of the right leg. A series of taps on these tendons produced progressive step-like flexion of the leg at the knee.

Riddoch and Buzzard (16) describe in their cases of quadriplegia, paradoxical extension of the knee after the first few taps on the hamstrings. This they attribute to post-inhibitory exaltation, as described by Sherrington (37), i.e. a depression of one reflex which accompanies the exaltation of its antagonist, is followed by a phase of increased excitability. This phenomenon was not observed in this case.

If, with the limb in a position of extensor rigidity, flexion of the knee was passively performed, this new position was maintained the quadriceps at once adapting itself to the new muscle length. This is an example of the lengthening reaction. No shortening or lengthening reactions were seen at the right elbow.

Fig. 5. Case 22, aet 20. Note the spastic smile and the posture of the right arm, i.e. extension, hyper pronation of the forearm and flexion of fingers. (See text).

Associated Movements. These were not prominent. When voluntary movements of the right arm against resistance were made no appreciable movements in the other limbs and no material change in the tone of their musculature was noted. When voluntary movements were carried out by the right leg, extension or flexion at the knee usually produced flexor rigidity at the right wrist and occasionally at the elbow, but no movement or appreciable alteration in tone could be detected in the contra-lateral limbs. Active movement of the left leg occasionally excited partial extensor rigidity in the right leg. No changes were noticed as a result of the active movements in the left arm. When a flexion reflex was produced in the right lower limb no extension reflex or movement or appreciable increase of tone could be detected in the muscles of the left leg.

The upright posture. The changes in posture on assuming the upright position were very striking and constant. (See Fig. 5.). On standing upright the right arm at once became rotated inwards and abducted at the shoulder, extended at the elbow and the forearm became hyperpronated, so that the palm of the hand looked outwards. Slight flexion at the wrist occurred, the hand became adducted and deviated towards the ulnar side; fingers were flexed into the palm. As soon as the right foot ~~tipped~~ touched the ground it became powerfully inverted with plantar flexion of the toes, so that the dorsal surface of the

Fig. 6. Case 22. Posture assumed on attempting to walk, i.e. abduction, extension at elbow and pronation of right arm with marked extensor rigidity of right leg.

toes alone ~~tipped~~ touched the ground. At the same time the quadriceps became tonically contracted, producing marked extension at the knee. The thigh was slightly flexed at the hip joint and rotated outwards. After half a minute or so the tonic rigidity in the right arm and leg passed off, the right arm now hung by the side, but extension of the elbow and hyper-pronation persisted. The foot was now able to be flat on the ground alongside the other one. If the patient was now asked to take a step with the right leg, the right arm at once became abducted to nearly a right angle, at the same time being retracted at the shoulder; the posture of the elbow and hand remaining as before. The right leg assumed the tonic posture of extension above described, suddenly over-flexed at the hip joint, sometimes nearly causing the patient to lose her balance. (See Fig. 6). Slowly the right foot approached the ground and the abductor spasm of the right arm relaxed. As the extensor spasm in the right leg passed off the heel approximated to the ground, the patient meanwhile transferring her weight on to the right foot. The posture of the left arm throughout was one of flexion at the elbow, the arm being moderately abducted at the shoulder.

This extensor rigidity in the limbs was also apparent when the patient was in the recumbent position in bed, any slight change of posture, as, for instance, attempts to turn over on her side, were at once followed by extensor rigidity in the right arm and leg.

Summary. There is no continued state of rigidity in this case such as is found in the decerebrate animal, but rigidity is easily produced in the right upper and lower limbs by both passive and active movements. The tone is obviously plastic, as is evident from the maintenance of any posture into which the limbs may be passively put. Although no constant posture is present in the recumbent position in the right upper limb, when the upright position is assumed, the limb at once becomes extended at the elbow with powerful pronation of the forearm. In the right lower limb extensor rigidity occurs on slight voluntary movements of the trunk but preeminently when the upright posture is assumed. It was at first thought that the tonic contraction in the right hand when an object was grasped by the patient, could be explained by the phenomenon of tonic innervation, but a comparison between this case and those reported by Wilson and Walshe (58) makes it fairly certain that we are here dealing with a different condition. Another striking feature of this case is the lack of muscular fatigue. The right upper or lower limbs if placed in a certain posture will remain for a considerable time in this position. The maintenance of this posture is reflex and not voluntary, and that fact explains the lack of fatigue. The presence of well marked shortening and lengthening reactions in the right lower limb are of great importance in the case. And finally the

replacing of a condition of extensor rigidity in the right lower limb by a well-marked flexion reflex, the result of nocuous stimulation must be emphasized. Sherrington (37) has insisted on the following features of plastic tonus as seen in the decerebrate animal:- (i) The distribution of tonus mainly to the extensor muscles; (ii) the lengthening and shortening reactions; (iii) the lack of muscular fatigue; (iv) the tendency to maintenance of posture and (v) the breaking down of extensor rigidity by stimulation of reflex movements. In this case there is evidence of the presence in the limb on the right side of the last four factors. Sherrington's experiments deal with the acute decerebrate preparation. Bazett and Penfield (40) have kept a cat alive for as long as six weeks after decerebration and at the end of that time the rigidity was still present. The absence of maintained rigidity in this patient may depend on the duration of the condition, or more likely, on the fact that being a pathological condition, and not an experimental one, the unilateral decerebration has not been complete. It is interesting to note that Bazett and Penfield found that in those animals surviving the operation for several weeks, a condition of flexor rigidity sometimes supervened; "the term decerebrate rigidity is generally taken to mean extensor rigidity, but in completely decerebrated specimens another type of rigidity sometimes appears, tonic contraction of the flexor aspect of the limbs.....After

semi-decerebration this phenomenon appeared much more frequently, alternating with extensor rigidity as though complementary to it", and later page 262, "Flexor rigidity as an entity may be described as tonic innervation of those muscles which are subjected to tonic inhibition during extensor rigidity. It is possible to speak of two types of decerebrate rigidity." It seems possible in the case of our patient to explain the flexor rigidity in the right hand and fingers on the above grounds, namely the existence of a flexor as well as as an extensor rigidity. Riddoch and Buzzard (16) in their study of cases of quadriplegia and hemiplegia have described the existence of plastic tonus in these cases and other phenomena depending on alterations in tone which closely resemble those described in this case, and originally by Sherrington. Associated movements which were present in their cases were not obtained by this patient except to a minor degree. The presence of Paralysis Agitans affecting limbs on the opposite side may, perhaps account for their absence. As to the site of the lesion causing the condition in this case, Sherrington in 1896 produced a decerebrated condition in animals by coronal transsection of the brain stem between the anterior and posterior colliculi, and found that trans-section as far caudal as the pons, produced the same condition, but when the trans-section reached the plane of the calamus scriptorius, rigidity dis-

appeared, he was also able to produce unilateral de-cerebrate rigidity by hemi-section.

Magnus ([36]) considers the trans-section must be as low as the anterior part of the mid-brain, and that destruction of the red nuclei is necessary for the development of the rigidity. Bazett and Penfield confirmed these results, especially as regards the possibility of the occurrence of decerebrate rigidity after destruction of both red nuclei. It seems from these facts that the lesion in this case may lie between the lower part of the mid-brain and the lower limit of the pons.

INVOLUNTARY MOVEMENTS.

These may be classified under the following headings:-

(1) Choreiform and Athetotic.
(2) "Tonic Spasms".
(3) Tremors.

Choreiform movements are rare as a late sequel. The following is the only case that occurred in this series.

Case 35. Male, aged 52, was taken ill in March 1919, with an illness diagnosed as "Influenza"; it was characterised by severe pain in the back of the neck and headache, marked drowsiness and diplopia. At the end of three weeks he felt much better but he soon noticed his knees gave way at times owing to sudden muscular spasms in his legs; when sitting or lying his legs used to shoot out; shaking movements of the shoulders developed, and he was unable to keep his arms and face still. He was admitted to Maida Vale Hospital in November 1919. The notes state that he had almost continuous writhing movements of the trunk and legs, clenching of the teeth, and spasmodic retraction of the lips. The movements were not rhythmical, but resembled those of Sydenham's choreiform. The armswere only slightly affected, the movements could only be restrained by an effort of will, but were thereby aggravated in other parts of the body. The condition improved and he was discharged with a diagnosis of Huntingdon's Chorea. He resumed

work in May 1920; by 1921 the movements had disappeared in the arms. In January 1922, the patient was seen by me, when he showed involuntary movements of the head and tongue. The head movements were always in an antero-posterior direction and varied in amplitude, being exaggerated when he talked or became excited. There were also constant choreiform movements of the tongue. Patient stated that these movements go on all the time except when he is asleep.

Examination of the Central Nervous System was negative except for slight dysarthria due to the movements of the tongue. He was last heard from in December 1922, when he stated that the movements were still present.

Pure choreiform movements are not uncommon in the early stages of the disease but in my experience arerare as late sequelæ.

No case showing athetotic movements was observed, although reference has been made in the literature to several such cases.

Tonic spasms. Under this heading I wish to include a type of involuntary movements characterised by tonic spasms occurring usually fifteen to twenty times to the minute and each lasting one to twenty seconds. They affect always the same limbs, or limb, and produce the same displacement, though in varying degrees. The following are examples of this condition

Case 37. Female, aged 34. In November, 1920, began to suffer from insomnia; on December 14 she saw double and the diplopia persisted for some days. On December 15 drowsiness developed, which later became marked; she slept day and night.

Examination on December 23rd, 1920, showed patient to be very drowsy, but she could be roused and answered questions rationally; speech slow and monotonous; no cranial nerve or ocular palsies; no diplopia; no myoclonic or other movements. During January, 1921, she improved. In March she became more drowsy and involuntary movements were first noticed; these have persisted with varying intensity ever since. She relapsed in June and developed an acute arthritis of the left shoulder-joint as a result of the violence of the movements. There was a further slight relapse in September when a divergent strabismus with loss of power of convergence and defective accommodation were noticed and this condition is still present. At no period has there been any evidence of involvement of cranial nerves or of pyramidal tract; the deep reflexes, sluggish at onset, are now brisk. Plantar responses have always been flexor. The involuntary movements which are present are rhythmic and uniphasic, occurring about fifteen times to the minute, each spasm lasting about one second. They occur synchronously in the various parts affected. They vary slightly in intensity and regularity, but unless controlled medicinally they are extremely violent and painful and make the patient's

life a misery to her.

She can inhibit them to a certain extent, but the next spasm is reinforced. They are increased by emotion and disappear entirely during sleep. Muscular tone in the limbs, in the intervals between the spasms, is not increased.

During an involuntary movement the chin is turned slightly to left; the occiput is retroflexed and approaches the right shoulder. At first, the angle of mouth on the left side was drawn downwards, but now there is usually no such movement. Left arm is internally rotated and pulled slightly backwards, extended at elbow and wrist; forearm pronated and fingers powerfully flexed into the palm. There is shrugging of right shoulder and slight abduction of whole of right arm. The trunk is flexed to the left. The left leg is slightly flexed and sometimes abducted at hip; the knee is powerfully extended; the feet and toes point downwards and the foot is slightly inverted. In the right leg there is slight contraction of hamstrings and dorsiflexion great toe.

The patient has continued to improve and the movements are now of smaller range. Luminal alone of the hypnotics that have been tried seems to control the movements. For the first few months she was under observation she was given 6 grs. daily, but recently it has been possible to reduce the amount to 2 grs. a day. Beyond slight paresis of accommodation no toxic effects from the drug were observed.

Case 51. Male, aged 52, became ill on December 9, 1919. Pain back of neck. Slept for two weeks; delirious. Afterwards found he could not read properly; also had difficulty in speaking and weakness in left arm and left leg. In January, 1920, involuntary movements began which have persisted since; left shoulder first affected.

When examined in June, 1921, he shewed the following:- Pupils equal; react normally to light and accommodation. No ocular palsies. Speech slow and slurring. Cranial nerves normal. Slight loss of power left arm. Reflexes and sensation normal in upper and lower limbs. The involuntary movements affect chiefly left face and left arm. They are uniphasic and rhythmic, occurring about sixteen times to the minute. Each spasm lasts about one and a half seconds. They disappear during sleep. They occur at irregular intervals, two following each other often in quick succession; movements of arm sometimes occur without any accompanying movement in face. Peripheral stimulation and emotion increase the amplitude of the movements. In an involuntary movement the head is laterally flexed to left, the chin is depressed, the left angle of mouth is drawn outwards and left cheek sometimes sucked in. The left shoulder is slightly raised, the whole arm being pulled backwards, with the elbow extended, the forearm pronated, and the wrist slightly flexed. The index finger is either flexed or extended, but the middle finger is constantly flexed and the thumb abducted.

Movements in the arm are often not so complete as those described above. There is occasionally slight contraction of the extensors of left knee. The involuntary movements do not involve the right arm or right leg.

This patient slowly improved and was under observation until May, 1922. In the following month however, he was admitted to an Infirmary as a case of "Cerebral hæmorrhage" and died within twenty-four hours.

Remarks. The similarity between the involuntary movements in these two cases is striking. They seem to resemble the movements described by Marie and Levy (15) to which they gave the name Bradykinesia. The movements are uniphasic and have a fairly constant and similar periodicity, i.e. fifteen to eighteen times per minute. They are of large range, producing considerable displacement of the limbs and trunk. There is no increase of tone between tonic spasms in the parts affected and there is an absence of paresis or pyramidal involvement in both cases. More striking still is the posture of the affected limbs during a spasm, which is practically identical in the two cases. The chin is turned to the ipso lateral side, the occiput approaching the opposite shoulder. There is tonic spasm of the facial muscles. The arm on the same side is internally rotated and retracted to the shoulder and extended at the elbow. The forearm is fully pronated, the position of the wrist varied in the two cases.

The fingers are flexed. In Case 37 the trunk is flexed to the left and the leg on the same side shewed well marked extensor rigidity with inversion of the foot and pointing down of the toes. In the other case there was contraction of the quadriceps, but this was insufficient to cause a displacement of the limb. In Case No. 37 there was in addition abduction of the opposite arm and a tendency to flexion of the opposite leg.

The condition underlying this tonic discharge at more or less regular periods is more or less problematical. Many similar cases following Encephalitis Lethargica have been reported. Ramsay Hunt (13) attributes the condition to disorder of the striatal mechanism. Similar movements may be limited to the face or the limbs. In the face the most usual form is that of tonic contraction of the facial muscles on one side occurring often with a regular periodicity, the rate of which may be sixty or so to the minute. In other cases the periodicity and the range of movement varies. Similar movements may occur in the muscles of the neck. These conditions are often labelled tics and their true nature may be overlooked. Marie and Levy (15) have given an excellent description of these movements.

The following is a case in which the movements were confined to one leg.

Case 36. Male, aged 48, was suddenly taken ill in December 1920 with vertigo, consequent diplopia and weakness of the left side of his face. For several nights he was delirious. Later he felt very drowsy during the day and was much troubled with salivation. A month or so later involuntary movements began in the left foot and have been present ever since. Since this illness he has felt nervous and experiences a tight feeling in his head. He complains of always feeling self-conscious. Examination, September 1922 showed no abnormality in the pupil or cranial nerves. The upper limbs were normal in every respect; the abdominal reflexes were brisk and equal. The left foot was at times the seat of an involuntary movement resulting in dorsi-flexion and inversion of the feet due mainly to a slowly developing tonic contraction in the tibialis anticus. The tonic spasm was maintained for a few seconds and then relaxed partially or completely. Such movements would be repeated at frequent intervals for a few minutes at a time. The condition was aggravated by emotion and was stated by his wife to occur during sleep.

Tremors.

Apart from those occurring in Paralysis Agitans, under which heading they will be discussed, only twc cases of true tremor have been observed. Case 33, an example of Benedict's syndrome, has already been described. In Case 22, which is fully described on p.29. the tremor was limited to the right arm and was most prominent in the proximal part of the limb; it only occurred on voluntary movement and the range was considerable. Similar tremors, most marked at the root of the limb and often of very considerable range, do occur as a sequel, possibly the only one, of Encephalitis Lethargica; they may be mistaken for the intention tremor of disseminated sclerosis.

NEUROSES AND PSYCHOSES.

These occur more frequently as sequelæ than is supposed. Morris Grossman (3) noted in his study of 92 cases that fifteen suffered from insomnia and seven from various forms of neurosis. Kirby and Davis(4) state that in eighteen cases which they had observed, only two returned to their normal mental state. These patients complain of feeling depressed and are easily worried. They are very subject to fatigue and may complain of headache, general pains and other neurasthenic symptoms. They are irritable and often self-willed. They complain of morbid fears, of failure of memory, and their concentration is usually found to be poor. Some cases showed marked depression at times. The prognosis in these cases is quite good and with suitable treatment and correct surroundings they improve comparatively rapidly. The majority of the cases in this series shewed some alteration in their mental outlook, but only 4 cases of neurosis without any other sequel, occurred. (Cases 43, 44, 46, and 47).

Psychoses may be divided into two groups (a) in children, (b) in paralysis agitans. Apart from these only one case of psychosis was seen namely, a case of dementia præcox.

Case 48. Male, aged 19, came under observation in December 1922. His mother stated that her son was quite well and normal in every way when he returned to school after the

Fig. 7. Case 48, aet 19. Acute attack Jan. 1919. Condition resembling closely Dementia Precox followed and has persisted since.

Xmas holidays in 1918. About the second week in January he was suddenly taken ill and became delirious; he remained in this condition for about a week. Unfortunately no other details of the events during the first week are obtainable. At the end of ten days from the onset he was well enough to return home and seemed to be progressing well. On February 22nd, 1919, he had a relapse; he had difficulty in swallowing and later became unconscious and remained in this condition for about a week. His temperature averaged about 100° during this period. Dr. Walter Sheldon of Bayswater who attended him during this relapse has been good enough to inform me of these facts and was of the opinion at that time that he was suffering from meningitis. On recovering consciousness it was noticed that he had changed mentally. He had delusions of persecution and thought people were poisoning him. After getting up he would sit all day with a vacant expression as if he had lost all interest in everything. He was later admitted to Kensington Infirmary where the diagnosis of melancholia following meningitis was made. His mother stated that for the next year he suffered from insomnia and that on the whole his condition has improved very little.

On examination in December 1922 the appearance of the boy strongly suggested dementia præcox. He was content to lie in bed all day long doing nothing, but repeating unintelligible

phrases to himself, from time to time, and a meaningless smile often spread over his face. He had one or two mannerisms, i.e. suddenly kerking the right arm to look at a wrist watch (which he did not wear). If asked what time it was, he looked at his wrist and said "Three o'clock" or some other hour in the afternoon. If asked his age he replied "Fifteen", (actual age being 19). The date he usually gave as February 22nd.(His relapse took place on his fifteenth birthday which is on February 22nd). It was difficult to obtain an answer to any question and it was usually monosyllabic. When handed a cigarette case he at once used it as a mirror and for ten minutes was absorbed in studying his face, teeth, etc., with frequent smiles. Perception and orientation seemed fairly good, attention, however, was very poor. There was no evidence of hallucinations or delusions. He ate moderately well, but paid no attention to the calls of nature. When standing, his head was usually dropped forward and he frequently made quick purposeless movements of his arms. On physical examination no obvious stigmata of degeneration were present. Pupils were equal and reacted normally to light and accommodation. Catatonia was moderately well developed without, however, there being any appreciable alteration in tone in the limbs. The reflexes were exaggerated. The plantar reflexes were flexor in type. The muscular power was poor; there was no evidence

of testicular atrophy. Wassermann in the blood was negative. The initial illness, starting with delirium and insomnia, followed later by relapse characterised by pyrexia, difficulty in swallowing and coma, suggesting at the time meningitis, seems to resemble very closely an attack of epidemic encephalitis. A few cases showing mental disturbances suggesting dementia præcox, following encephalitis, have been reported (19 & 20).

Laignel Lavastine, C. Tretiakoff and Nic. Jorgonlesco (21), in three cases of the ordinary type of dementia præcox of several years standing, found the maximal lesions in the corpus striatum. These findings are of interest in relation to the above case and the well known incidence of encephalitis lethargica on the basal ganglia.

ALTERATIONS IN MORAL CHARACTER IN CHILDREN.

These are very striking in similarity in most cases. Five cases showing changes in character were seen.

Case 42. Female, aged 16, seemed a normal child in every way up till June 1920 when she developed encephalitis lethargica, characterised by diplopia with delirium and later marked sleepiness, so that she slept for a fortnight but could be roused for her meals. On returning home, four months later, her mother noticed that she was restless and at times drowsy. She seemed nervous and was subject to outbursts of temper. The change in her character gradually became more marked; she was sent to a convent where she smashed windows and fought the other girls. She was seen by me in November when when she was an inmate of a large Colony for Epileptics and Mental Deficients. She was reported to be extremely interfering, spiteful and untruthful. She was always annoying the other patients, hitting them or pulling off their hats for no apparent reason. The patient excused herself for these actions by saying that the other patients annoyed her.

On examination, the face was slightly expressionless, and there was a frequent prolonged smile. Mentally she was fairly intelligent and was able to do simple sums; she knew the date of Armistice Day, what it signified, and also the duration of

the War. She answered questions readily and to the point and was able to carry out other simple tests satisfactorily. Memory was fairly good. The pupils were markedly unequal, the right more than the left. The reaction to light and accommodation was extremely sluggish; there was a slight convergent strabismus of the right eye. There was diplopia on looking upwards and downwards and forward, but no ocular muscular weakness could be detected by ordinary rough tests. There was slight myosis and some limitation of convergence. Fundi were normal; no apparent facial weakness. The tone was slightly increased in the left arm in all muscle groups, but predominated slightly in the flexors at the elbow. Cogwheel phenomenon was present. The reflexes were brisk and equal in the arms and abdomen. There was a general slight increase of tone in the left leg and the reflex was slightly more active on the left side than the right. The left plantar response was extensor in type, while the right was flexor; there was no sensory disturbance. On walking the left arm was held in a flexed position and did not swing.

Case 42. Female, aged 12. Was seen in May 1921, during the acute stage of encephalitis lethargica. There was headache, marked drowsiness and diplopia with absence of the deep reflexes in the legs. When she had recovered a marked change was observed in her manner. She was despondent and subject to violent

outbursts of temper. This patient was seen in the same Institution as in the previous case, in November 1921. She was reported to be very restless and irritable, interfering with the other girls and quite devoid of self-control. She had to be excluded from the school because of the disturbance she caused, and owing to her conduct she was confined to bed most of the day; but at times she would get out of bed and roam about in her night attire upsetting the other patients.

On examination she seemed to be a bright and fairly intelligent little girl; she complained of headache which came un usually when she was in a temper. Her mentality corresponded to that of a child of 10; she proved to be extremely loquacious and the reverse of reserved. Physical examination was negative.

Case 41. Female, aged 16. The patient was seemingly normal in every way until November 1919, her age then being 14. At that time she had an attack of Encephalitis Lethargica characterised by diplopia, lethargy and choreiform movements. On returning home her mother noticed that she was very excitable and greedy, both as regards money and food. Later she used to have attacks about every three weeks, in which she complained of headache, became extremely excitable and interfering, she would tell tales about her girl friends, etc. She has

been turned away from Church meetings because of the disturbance she caused by knocking other people's hats off and generally proving a nuisance. She came under observation in January 1922. She said she felt fairly well except for severe headaches at times, and when she closed her eyes she felt "as if she was going over the other side".

Examination showed an excitable girl with some impairment of intelligence; she was unable to do simple sums; she said her memory was bad and that she had forgotten all she had learnt at school; in conversation however she seemed fairly bright. Pupils equal and reacted to light and accommodation. There was an involuntary tonic spasm of the musculature of the left side of the face at times, but no apparent facial weakness on voluntary movement. Examination of the central nervous system was negative. Whilst under observation she slept well and at times behaved fairly rationally; other times she became very excitable and showed marked lack of control; she became extremely interfering, argued with and upset the other patients. She frightened them when asleep by getting out of bed and putting her hands on their faces. She was often found hiding under the bed. She refused to obey the Sister and nurse; and on one occasion she locked herself in the bathroom and refused to come out. She had also fits of crying.

Case 40. Male, aged 9. Was normal in every way until December 1920 when he had an attack of encephalitis lethargica, which commenced with pains in the stomach, marked drowsiness, double vision and muscular twitching in his limbs. His mother stated that on his return from Hospital he seemed nervous; he made curious noises when he breathed at night. She had also noticed twitchings in his arms. In the autumn of 1921 a change was apparent, he became very cheeky, shouted names at people in the street and threw stones at them. He was very untruthful and spiteful; at meal-times he tried to snatch food from the plate of the person next to him. He screamed when anything was refused him. At Sunday school he knocked other children's hats off. As regards his progress at school, despite his interfering habits he progressed quite well and his master reported that although he was so objectionable he showed average intelligence in his lessons.

Examination in October 1920, showed an intelligent-looking boy who answered questions readily, but who obviously had difficulty in keeping quiet. The pupils were regular in outline and reacted sluggishly to light. There was practically no reaction to accommodation; all ocular movements full except convergence which was moderately limited. Examination of the central nervous system was otherwise negative. His condition in February 1923 remained about the same.

Case ~~39~~ 17. Female, aged 16. Patient was under observation from November 1922 to February 1923. She was perfectly normal in every way until March 1920 when she had a definite attack of encephalitis (for details see page 76). Since then she has been much troubled with sleeplessness and general nervousness. In August 1921 the first symptom of paralysis agitans appeared (see p.110). About February 1922 for the first time the change in her character became evident. The patient says that she began to lose her former affection for the various members of her family, she felt that they were neglecting her and did not give her the attention she should have. The patient says she often loses her temper and that she frequently wishes to hit people for no apparent reason. She quarrels with her sister with whom she previously was on the best of terms. She says she feels she must be "in at everything", and as a result she interferes in things that are no business of hers. She states she is very restless and is unable to concentrate on anything for any length of time. Sometimes whilst engaged in knitting she will have a sudden impulse to go out for a walk, this she does and returns home relieved. When she is walking in the streets she sometimes sees people falling; she realises she only "sees them in her mind", but she has to stand still for some time until the 'vision' passes away. Her mother further stated that the patient made little effort to help in the house-

Fig. 8. Case 27. aet 16. Acute attack March 1920. An interval of 18 months elapsed before first symptoms of a unilateral Paralysis Agitans appeared and several months after this a change in character was first noted. Classical tremor right arm and right foot. Limbs on left side normal. Pyramidal signs right side.

work and the patient seems to think that her mother is very unkind to her. At times she becomes very depressed and at other times excitable. More than once she has struck her mother, when in a temper.

Examination showed a mentally alert and intelligent girl, (see Fig. 8); she had excellent insight into her condition and fully recognised that her character had changed, but stated that she had no control over her temper, nor her tendency to interfere. She displayed no expression of worry or anxiety as to either her mental or physical condition. She answered intelligently several questions relating to important happenings appearing recently in the daily papers. The condition of unilateral paralysis agitans which was present is fully described on p.110

Remarks.

These changes in the moral character occurring in children who have had Encephalitis Lethargica are now fairly well recognised (22, 8 and 23) Auden (55) reports six cases showing changes in behaviour very similar to those reported in this paper. He points to the importance of differentiating these cases from moral imbeciles especially from the point of view of disposal and treatment. He deals also with these cases from the medical-legal point of view.

The clinical aspect is very striking and similar in the cases in this series. In all of them prior to the attack of Encephalitis Lethargica they seemed mentally normal. The alteration in behaviour was noticed in four out of five cases within two months from the original attack. In one case (39) an interval of nearly two years elapsed. The main points in the mental changes in these cases are, lack of voluntary control resulting in spitefulness, untruthfulness, interference with others and a desire to be "in at everything", as one patient put it. There is usually marked motor restlessness. Some of these cases have periods during which they are very docile and seemingly repentant, but as a rule these normal periods are few and far between. Insomnia is often marked, and associated with this there may be a nocturnal exacerbation of the restlessness.

In none of the above cases was a history of stealing obtained, but theft may occur in these cases, and this point has an important bearing on the medical-legal aspect of the condition.

EPILEPSY.

Epilepsy may occur as a sequel and was observed in three cases in this series. In none of the three cases was there a history of previous fits.

Case 17. Female, aged 19. In March 1920 she had an attack of encephalitis lethargica characterised by headache, insomnia, diplopia, muscular twitchings and lethargy. Paralysis agitans followed in a month or so. In June 1922 she had her first fit and since then has had several major attacks and frequent minor ones. In these attacks she becomes cyanosed and the mouth is drawn over to the right; they are followed by severe headaches.

Case 19. Male, aged 11. During the summer of 1920, when the patient was aged 9, he was taken ill with a typical attack of encephalitis lethargica characterised by marked drowsiness and diplopia. A Parkinsonian syndrome gradually developed, and in addition he commenced to have slight fits in which his eyes rolled up and he seemed to lose himself. He was under observation for six months during the summer of 1922. Many petit mal attacks occurred each day. They have occurred whilst he was walking; his head would suddenly fall forward and frequently he would collapse on the ground. There was no evidence of respiratory

disturbance. Luminal and Bromide seemed to have very little effect during these attacks.

Case 45. Male, aged 31. This patient was quite well until June 1917. At that time he was in the Navy; he was proceeding home on leave and while in the train he felt dazed and went to sleep; he had not been taking alcohol. On reaching home he had general pains; fever, and became very sleepy. On the following morning on getting out of bed he became dizzy and fell unconscious. For the next week he slept practically all the time but could be roused in order to eat. Twitching movements on the left side of his face were noticed by his wife and doctor. He did not have any disturbance of vision, but after three weeks or so on attempting to read he noticed all the letters ran together. For the next three months he seemed to lose interest in everything and felt heavy and stuporous. In September 1917 he had a second fit followed by a third in January 1918, and at intervals since then, he has had similar attacks characterised by headache, a sinking feeling in the stomach and loss of consciousness; sometimes they occur during sleep. He has never been incontinent.

He was under observation for six weeks but during that time he had no attack. He complained, however, of feeling irritable and had frequent headaches. Physical examination was negative.

I heard from the patient again in January 1922. He had been working, but he stated he had several fits and following these he was subject to lapses of memory in which he did and said things of which afterwards he had no recollection. In June 1922 he was arrested for blackmail.

This case is of interest, firstly because the illness he had in 1917, which I considered to be one of encephalitis lethargica occurred nearly a year before the first case reported in England, although cases were reported as early as this in some parts of Europe; and secondly, because of the petit mal attacks followed by automatism, which in his case seemed to have an unfortunate termination.

DISTURBANCES OF SLEEP.

These are commonly met with in conjunction with other sequelæ, but may be the only remaining relic of the disease. Insomnia is the symptom most frequently met with and occurs in a large proportion of persons who have recovered from the acute attack. Its duration varies from a few months to a year or more. In children in whom particularly it may occur as the only sequel it is often associated with marked restlessness which comes on as the child is going to bed. Such a child may not sleep till the early hours of the morning. In paralysis agitans in which it occurs in about half the cases it is associated with drowsiness during the day so that the sleep rhythm is inverted. This inversion of the sleep rhythm is a very characteristic sequel. Pierre Marie and Mademoiselle G. Levy (24) give a lucid description of the post encephalitic child.

Vers la tombée de la nuit, le plus souvent vers 5 heures, parfois 7. 8 heures, l'enfant, qui frequemment semblé tout à fait normal et gentil au cours de la journée, commence á s'agiter. Certains se mettent à parler sans arrêt, ā courir, à s'emparer de tous les objets qui les environment pour les détruire. Frequemment reparaissent alors les mouvements

choréique, des secourses myocloniques, des crises de contracture des masseters avec grincements des dents, qui n'existaient pas pendant la journée. L'enfant fait des grimaces, se mouche, souffle éperdument, se met les doigts dans le nez, se gratte, se frappe lui même.

Certains commencent à dire des mots orduriers, renflent, crachent ou presentent des crises de bruyante..... Si l'enfant est couché il tourne et retourne ses oreillers, tire ses draps, les déchire, se met debout sur son lit et suate à pieds points, se déshabillé, se recouche, lève les pieds en l'air, se dans tous les sens, claque des mains... l'enfant ne dort que quelques heures dans la matinée car la crise cesse vers 6 heures du matin. L'après midi, l'enfant joue et semble normal.

W. M. Happ and V. R. Mason (8) described similar alterations in behaviour in children at night-time following Encephalitis Lethargica.

DISTURBANCES OF RESPIRATION.

These are relatively common in the acute stages, especially in the form of tachypnœa. Among the later manifestations, in this series the following in a few cases were noted. (1) Shallow breathing and occasional periods of apnœa succeeded by a long drawn loud sigh. This was especially observed in those cases showing Parkinsonian syndromes. (2) attacks of tachypnœa with occasional grunting were present in two children in this series. Loud noisy breathing, apart from sleep, occurred in one child at night. Pierre Marie and Mademoiselle G.Levy(24) in discussing the respiratory sequelæ of encephalitis lethargica classify them into three groups (1) true respiratory disturbances showing alteration in rhythm, i.e. polypnœa, bradypnœa and apnœa, they may be paroxysmal or permanent, but the paroxysmal form occurs especially towards evening and may last half an hour or a whole night. The respiratory rate may rise to 48 per minute, and it may be accompanied by a feeling of suffocation and tightness in the chest. In the permanent form the rate is usually between 20 and 30 respirations per minute, and the rate cannot be voluntarily slowed for more than a few seconds. (2) Spasmodic phenomena include sudden respiratory jerks without expectoration, resembling a dry cough. Such attacks may be paroxysmal, or may be constant. (3) Respiratory attacks. The

patient may complain of "a stuffed up nose", tight throat, or a sense of suffocation. The attack may consist of a blowing through the mouth or nose, or of a sniffing, sometimes associated with spitting. Occasionally the child remains motionless with closed eyes and blows through the mouth or nose without ceasing, this is followed by apnœa and the child may fall to the ground.

Physical examination of the nasal passages is negative.

These cases may be associated with the well known changes in moral character, or with inversion of sleep rhythm. Parker (25) records a series of eight cases, seven being in children, and one in a young adult in whom certain characteristic respiratory disturbances were present for some months, after an acute illness which was characteristic of encephalitis. In five of the cases the disturbances in respiration consisted in the assumption of the erect position with noisy breathing, holding of the breath with bodily contortions, and releasing the breath in the position best suited for complete respiration. Cyanosis with partial loss of consciousness occurred and sometimes these patients fell. The semblance to attacks of petit mal was very close: as in the cases of Pierre Marie and Mdlle Levy, the respiratory distrubance was most marked at night. None of the cases in this series have shown such marked respiratory disorder. Babinski and Charpentier (26) also

describe a similar condition. Happ and Mason (8) who studied the condition as occurring in children, in 1920, found diminished alkalinity of the blood in these cases, but the administration of alkalies by the mouth produced no beneficial effect on the condition, and they concluded that the condition was cerebral in origin. It seems clear that we are here dealing with a phenomenon which is strikingly similar in its main effects, and that only a disturbance of the central respiratory control would explain such changes satisfactorily.

ADIPOSITY.

Such cases are rare following Encephalitis Lethargica. The following is the only example in this series:-

Case 53. Female, aged 28, came under observation in 1920 during an attack of the myoclonic form of encephalitis lethargica. This case was reported in full in the Lancet.(17) She made a good recovery and was able to resume work within six months' time. She continued to feel fairly well, except for occasional swelling of her ankles. During 1921 she noticed that she was becoming stouter and that the swelling of the ankles occurred more frequently, otherwise she had no constitutional symptoms. She was again examined in February 1923; it was then noticed that she had become much stouter; the increase of subcutaneous fat was general. There was slight œdema of the ankles. Examination of the cardiovascular and renal systems was negative. There was no glycosuria, no polyuria; menstruation was regular. Pupils were equal and reacted well; there was no restriction of the visual fields, the fundi were normal. She stated that her usual weight before her illness was 11 stone. Her weight was now found to be 13 st. 10 lbs.

Other similar cases have been reported(27, 28, 29.) In the report recently issued by the Ministry of Health[2] mention is made of only 2 cases of obesity out of a total of 271 in whom the sequelæ were noted.

PART II.

PARALYSIS AGITANS.

Symptomatology of the Acute Attack.

It is important to consider shortly the various symptom complexes that may be presented during an initial attack of encephalitis lethargica. The protean character of the disease is now well known, and possibly there is a tendency at present to under-estimate the frequency of these diseases between the years 1918 and the present time.

Paralysis Agitans is met with comparatively frequently at the present time in persons much younger than the previously recognised age for the commencement of the disease. They give a history, often indefinite, of an illness sometime previously, so that we must enquire fully in such cases into the details of the preceding illness. Other conditions now well recognised as sequelæ of the disease are occasionally met with, in which no diagnosis of encephalitis was made, and in some cases it is difficult to obtain the history of an acute illness, although on further enquiry the patient often says that he was unwell for a week or so, and may give a history of some of the symptoms mentioned below.

Such ambulatory cases of encephalitis lethargica may be followed by the severest of sequelæ. In this series of cases

the history of a typical attack of encephalitis lethargica was met with in less than 50 per cent of the cases. In the remainder, headache, giddiness, lassitude, restlessness, insomnia, delirium, loss of accommodation, and less commonly diplopia were among the commonest symptoms remembered by the patient. "Jumps" in the legs or arms were present in a few cases; pains, general or localised at the back of the neck, or one or other shoulder were present in about 20 per cent of the cases at the onset. The illness was referred to in several cases as a "nervous breakdown". The following may be taken as examples of mild attacks followed by paralysis agitans:-

Case 7. Female, aged.36, was well until April 1918 when she began to suffer from headache, insomnia and pains in the left shoulder. She felt tired, there was no disturbance of vision; the symptoms persisted for about two weeks. Shaking of the left arm was first noticed in the following August, and patient noticed that she did not swing this arm when walking. Within a few months the stiffness became more generalised. When seen in January 1922 she presented the picture of a well marked paralysis agitans.

Case 20. Male, aged 41. In March 1920 he was more or less suddenly taken with severe headache, nervousness and restlessness. He was unable to sleep. There was no disturbance of vision. He remained at work for a few days with considerable

difficulty, but finally was compelled to take to his bed. Recovery was somewhat slow, and he did not resume work for three months. About December 1920 he noticed stiffness, slight shaking and a weakness in his legs.

He was first seen in September 1921 with well developed Parkinsonian syndrome.

Case 23. Female, aged 61. In July 1920 patient was more or less suddenly affected by giddiness, headache and a trembling sensation, which lasted for about one week. She had no disturbance of vision. Within the next month weakness and stiffness in all her limbs appeared and at the same time she noticed increased salivation. She was seen in July 1921, when the signs of an early paralysis agitans were evident.

Case 21. Female, aged 47. She was well until March 1922 when she was seized with a severe pain in the back of the neck and top of the head. There was marked lassitude and restlessness, she could not sleep, and had to rise at night and pace the floor. She felt depressed. There was no disturbance of vision. Two weeks later on she noticed an increase of saliva, and shaking and weakness in all the limbs. A generalised paralysis agitans was present, when she was first seen in June 1922.

Case 3. Female, aged 25. Was taken ill on the 14th April 1918. For the previous week she had been very constipated which was very unusual. Her head felt heavy, face became flushed, she felt dazed and restless and could not sleep. Her right big toe kept twitching at intervals and a few days later weakness of the right leg developed, but this only lasted two or three weeks. On the 26th April she had severe pain in the back of the neck which lasted ten weeks. She had no disturbance of vision. She quickly improved and by the end of May she felt quite well. In July 1918 weakness of the right arm developed and she noticed that she did not swing the arm while walking, and the condition has gradually progressed. In October 1922 she presented a typical picture of unilateral Paralysis Agitans.

Other cases may be cited, but the above should suffice to illustrate the possible mildness of an attack of Encephalitis Lethargica, and that paralysis agitans may follow such an attack even at a long interval. (See Case 28).

Sicard (30) in discussing "Les formes frustes" points out how difficult it may be to make a diagnosis of Encephalitis Lethargica at the time. He mentions among the symptoms of a mild attack (i) slight pain in the head, (ii) diplopia for some hours, (iii) slight evening temperature and gastro-intestinal upset, (iv) pain in the arm or violent pain in the

face. Some months following these apparently trivial symptoms a Parkinsonian syndrome may appear.

Interval between Acute Attack and the Onset of Symptoms.

In thirty out of a total of thirty-eight cases of Paralysis Agitans in this series, i.e. over 80 per cent., symptoms gradually supervened within six months of the acute attack. In eight cases, however, the patients seemed to have recovered almost completely, or completely, and all of them were able to resume their work. The first symptoms of paralysis agitans began some considerable time after the original attack, e.g. 7, 9, 9, 9, 10, 18, 18 months, and in one instance, 3 years and 9 months afterwards. These last 4 cases may be cited as examples:-

Case 8. Female, age 27. This patient was first seen in July 1921 complaining of general symptoms of nervousness. She stated these dated from a "nervous breakdown" in August 1920. On going carefully into details of this illness it was found that it had commenced with giddiness and headache followed by insomnia and delirium, diplopia and weakness of the left side of the face developed. She had also noticed sudden jerks in her legs which caused them to shoot out at times. She remained in bed one month, after which she went to the seaside

for a change. The weakness of her face partially disappeared. She was very much troubled with drowsiness during the day and sleeplessness at night.

On examination in July 1921, the pupils were found to be equal and reacted normally to light and accommodation. There was slight nystagmus on looking to the left; the ocular movements were full. There was slight left facial paresis of the supranuclear type. There was no increase in tone in the arms and the power in the limbs was good. No tremor or ataxia were noted. Reflexes were brisk and equal, and plantar responses flexor in type. A diagnosis of neurosis and facial paresis, the sequel of encephalitis lethargica was made. She attended until September 1921, when she said she felt quite well and resumed her work as a packer of machinery. About February 1922 she noticed that her work tired her more easily than formerly and that she was beginning to lose interest in things in general. She became subject to fits of depression. About May 1922 she began to feel sleepy during the day and would fall asleep during her work; about the same time she noticed an increased amount of saliva in her mouth. On the 1st September 1922 she noticed that the left side of her face had become weaker and also that when reading letters tended to run into one another. She was seen again on the 7th December 1922 when she presented the picture of an early but definite paralysis agitans.

Case 27. Female, aged 16. Was first seen in November 1922 with the complaint of shaking in the right arm and the right leg with some weakness of these limbs. She stated that she was quite well until March 1920 when she had an illness characterised by sore throat, headache, vomiting, pains and at times "sudden jumps" in the right leg. She was unable to sleep and for some nights was delirious. She had no disturbance of vision. At the end of a fortnight she was able to get up and gradually improved, but felt nervous and had difficulty in sleeping. These symptoms gradually passed off and she felt quite well. About August 1921 she noticed an increased flow of saliva in her mouth and about the same time a tremor appeared in the right foot which later spread to the right leg and right arm. For the past year she had had difficulty in performing the fine movements with the right hand, as in piano-playing. These statements were fully borne out by her mother. About February 1922 a change in her character became apparent. This has been previously described.

Case 3. Male, aet 21. Came under observation in November 1922 with definite unilateral Paralysis Agitans.

History. Patient states that on Xmas Day 1920 he felt a sharp pain at times in both eyes; he went out for a long walk and returned for dinner at mid-day, but had no appetite. In the evening the pain in the eyes had become worse and he felt

out of sorts. He slept till 11 a.m. the next morning. On attempting to read the paper or in looking at near objects he noticed that the words were blurred; this symptom lasted one month. During this time he felt listless and tired and would drop off to sleep at any time during the day but as soon as he went to bed he became wide awake and could not sleep. During the next few months he gradually improved and was able to return to work in Sept. 1921 as a labourer. In Dec. 1921 owing to slackness in trade he was discharged. In Feb. 1922 he felt in perfect health and often walked ten miles. He joined the Army on 1st. Feb. 1922, and passed a medical examination without any difficulty except that his eyesight was somewhat below normal standard. On Feb. 5th while scrubbing barrack room utensils in cold water his left hand became chilled and stiff. Later the hand was swollen from knuckles to the wrist. No pain. One week later he was vaccinated in left arm. A few days later he experienced a sharp pain in region of right shoulder blade, and he felt sleepy and tired. The following day he saw double and had some difficulty in starting micturition which troubled him for 6 months afterwards. Chilblains broke out on fingers of left hand (he had never had chilblains previously). Left arm as well as hand felt stiff. He returned to duty beginning of March, but he felt lifeless and trembled easily. He was discharged in April 1922 as being 'unlikely

to become an efficient soldier'. His condition was obviously considered to be hysterical. Since then he has been nervous and apprehensive and becomes exhausted after moderate exertion. For past 2 months condition has become worse.

In this case there is an interval of over a year between subsidence of initial illness and the initial symptoms of the sequel. The sudden appearance of a relapse following vaccination is of interest.

Case 28. Female, aet 44. Came under observation in Dec. 1922 with an early but definite Paralysis Agitans; more marked on left side with bilaterally fixed pupils. On enquiry into previous illnesses she said she had been well within last few years except 'influenza' in Nov. 1918. Towards beginning of that month she began to suffer from headache and felt 'out of sorts'. These symptoms persisted for 2 weeks and then she was seized with severe pains around lower chest. She went to bed and during the next fortnight slept a great deal both during the day and night; she had no double vision, but after being one week in bed, she noticed when she looked at near objects as in reading, that they became blurred and tended 'to run together'; the left side of her face also became paralysed. At end of 4 weeks she was able to be up and soon resumed her work; the weakness left side of her face and trouble

Fig. 9. Case 28. aet 44. Acute attack November 1918. Complete recovery. Relapse August 1922, followed by early signs of Paralysis Agitans. Pupils myotic with extremely sluggish reaction to light and accommodation. Note the posture of the arm.

with her eye gradually disappeared. On enquiring from the doctor who attended her during the illness, he states Dec. 1922, that she had a temperature varying between 99° and 100° for a few days, and he noticed a weakness of the left side of her face. Patient further states she remained perfectly well and continued her work as a saleswoman until August 1922, when she began to feel listless and became easily tired. She began to sleep badly. She continued at her work for some weeks. At beginning of October 1922 she noticed difficulty in reading and that the letters became blurred, as had happened previously in November 1918. She consulted an oculist. In the middle of November 1922 she was troubled with palpitation for a few days, and also felt as if her 'stomach was turning over'; this occurred apart from excitement or emotion. During the day she felt sleepy but had some difficulty in sleeping at night.

Remarks.

The history of an attack of encephalitis between Nov. 1918 is quite clear. The patient seemed to make a perfect recovery. However, 3 years and 9 months afterwards there was a relapse with gradual appearance of Paralysis Agitans (See Fig. 9.).

The Mode of Onset.

In those cases in which paralysis agitans develops during the acute attack, or closely follows it, it is often difficult to obtain a clear account of the initial symptoms of these sequelæ. The patients on recovery from the immediate effects of the acute illness complain of weakness and trembling in their limbs. Increased salivation is an almost constant early sign. Stress is laid upon this by Mdme. G. Levy (34). In those cases, however, in which an interval elapses before the onset of the Parkinsonian condition, it is easier to obtain from the patients a description of the first symptom. In addition to sialorrhœa a sense of exhaustion and a feeling of weakness in the legs, is often complained of. Then the patient notices a trembling of one or more of the limbs, especially on voluntary movement. More rarely the typical tremor of paralysis agitans appears as the earliest sign. A slowness of movement and a stiffness in the limbs often noticed for the first time while the patient is engaged in washing, brushing the hair, or dressing, are soon apparent. Inability to concentrate, nervousness, general lack of interest, and sometimes irritability or drowsiness may be remarked on by the patient or his friends. These are the chief initial symptoms.

GENERAL DESCRIPTION.

The mode of onset is fairly constant, excessive salivation is frequently the first symptom. The patient is then aware of a general weakness in the limbs often associated with a coarse tremor on voluntary movement. His friends may notice some loss of facial expression, later a slowness and difficulty in moving the arms becomes apparent and the speech becomes slow and monotonous. Sleeplessness, signs of exhaustion and irritability may be complained of. The appearance of such a patient is striking and is recognisable even at a distance. The facial expression is vacant, the mouth is usually open, a slow expansive smile spreads over his face at frequent intervals; the head is frequently bent forward, as is the trunk. The arms are flexed at the elbows and the fingers and thumbs extended at the terminal joints. He walks on his toes, with short, shuffling steps and the pace of his walk usually tends to progressively increase so that he may break into a run. When standing there is a tendency to retropulsion. The voice is somewhat feeble and monotonous. On examining the eyes, convergence is usually limited and there may be pupillary changes. Weakness of one half of the face is frequently apparent and all voluntary movements of the face are slowly and feebly performed. The limbs are felt to be rigid and the movements are seen to be slow and at times tremulous.

Posture. This is remarkably constant in its distribution, and gives the patient such a striking appearance in a typical case. The head is somewhat thrust forward with varying degrees of flexion of the head nearly to the chest. In a small percentage of cases the position of the head is one of retroflexion and similar to that affected by a person with a carbuncle on the back of his neck. In two cases in this series the head was flexed almost at right angles with the trunk. In one of the cases (No. 6) in addition the head was constantly rotated so that the chin was turned to the left and the occiput approached the right shoulder. In Case 19, with an effort the patient could hold his head up but only for a moment or so, it then resumed its former position. The posture of the arms is usually constant and is as follows:-

(1) Abduction and internal rotation at the shoulder.

(2) Flexion of the elbow usually to a right angle.

(3) Pronation of the forearm.

(4) Slight extension at the wrist, flexion of the metacarpal phalangeal joints and extension, or very slight extension at the remaining phalangeal joints with adduction of the fingers.

(5) Extension of the thumb with apposition, so that the tip of the thumb rests against the terminal phalangeal joint of the index finger.

This posture of the hand occurs at a comparatively early stage of the disease. The loss of the usual flexion of the fingers at all joints, greatest in the little and ring fingers, which occurs in the normal hand at rest is a diagnostic sign of great importance. In unilateral cases the difference in posture of the two upper limbs is very striking.

The trunk is usually flexed so that the whole body is bent forward, but in early cases this is absent. In the recumbent position, the posture of the legs varies somewhat. In a well-marked case the legs lie in bed extended at the knees and the feet point downwards more than normally, owing often to definite contracture in the tendo Achillis. In a few cases there was definite pes cavus. In walking the patient tends to walk on his toes with short steps; in some cases the heels do not touch the ground (See Fig. 14), In early cases by a voluntary effort the patient may be able to walk upright for a time, but when tired the head tends to become flexed to the shoulders. As the condition progresses no correction of this posture by the patient is possible.

CRANIAL NERVE AFFECTIONS.

Nystagmoid mo vements were present in a large proportion of the cases on extreme lateral fixation of the eyes. A true nystagmus occurred in only four cases. Ptosis was uncommon and was only present in one case . There was one example of paresis of the right cervical sympathetic (Case 58). The eyes were often staring in appearance; in a few cases there was slight but definite exophthalmos. Twitching of the orbicularis oculi was marked in several cases and appeared both spontaneously and on a voluntary movement of closure of the eyes. The ocular movements are carried out as a rule slowly and in a jerky fashion In a well marked case there is usually loss of association between the movements of the eyes and the head; also on looking upwards there is no corresponding wrinkling of the frontales. Three cases of paresis of external ocular muscles were met with, the affected muscle being the internal rectus.

The pupils show in the majority of cases definite disturbances in their reactions to light and accommodation. There was loss of accommodation with preservation of the light reflex in six cases, or 17 percent. of the total number. Thirteen cases, or 33 per cent. of the total number showed impairment or loss of the reaction to light as well as to accommodation. One case showed a normal reaction to accommodation but a diminished response to light. This was the only case observed that showed

a condition resembling Argyll Robertson's pupil. Myosis occurred in more than 50 per cent. of the cases and occasionally was found without any alteration in the reaction of the pupil to light and accommodation. The resemblance of these pupillary changes to those seen in the luetic type has already been discussed. Lack of convergence in varying degrees occurred in nearly 90 per cent. of the cases of Paralysis Agitans and must be regarded as typical of this condition.

The smile in Paralysis Agitans is characteristic, being easily evoked, developing slowly, and with corresponding slow relaxation. In severe case it is accompanied by a noisy braying inspiration which is very characteristic of the post-encephalitic form of Paralysis Agitans. The speech in slight cases may be nearly normal, but there is usually a lack of inflection in the speech. In a marked case the voice is feeble and the speech monotonous. In a very advanced case it may be impossible to understand what the patient says.

No involvement of the lower cranial nerves was observed in any of the cases of Paralysis Agitans.

Tone.

Disturbance of muscular tone forms the basis of this condition. In a typical case the exaltation of tone is general; it affects in varying degrees the whole voluntary muscular system, but is often more marked in the limbs on one side. The most characteristic feature of this hypertonus is its equal

distribution to agonists and antagonists. If the arm be passively flexed and extended at the elbow, the resistance is nearly equal in the two cases; this at once distinguishes the hypertonus from that existing in a hemiplegic limb in which, although the extensors as well as the flexors show increased tone this considerably predominates in the flexors. In the arm the greatest rigidity is usually at the wrist, at least in early cases. In the leg its distribution affects proximal and distal portions of the limb about equally. If a limb be passively flexed it will be noticed that the hypertonic extensors relax in a series of jerks producing the so-called cogwheel phenomenon, which is a constant feature of this disease. This is observable during passive movements of any part of the body. There is a marked tendency in most cases to catatonia or maintenance of posture. If in a case in which the rigidity is marked the patient's arm be lifted up it will remain in this position often for a minute or so, and then gradually it will fall in a series of jerks. The musculature of the head and neck is the earliest to be affected. The tone in the neck is mainly distributed to the extensors and flexors of the head. The lateral rotators and flexors are very little affected in a case of moderate severity. Movements to command are more easily performed than voluntary movements.

When pyramidal signs are present in addition to the paralysis agitans, there will be no appreciable alteration in the distribution of tone in the limbs if the rigidity due to the Paralysis Agitans

is marked. In earlier cases of Paralysis Agitans, accompanied by hemiplegic signs, tone is predominant in the flexors of the elbow and extensors of the knee.

VOLUNTARY MOVEMENTS.

The most striking feature of the voluntary movements in Paralysis Agitans is that the movement is carried out slowly, stiffly, and apparently with great effort. There is a latent period which may last for ten to twenty seconds, often before the first movement of the limb takes place. These pauses may occur in the middle of an act, as for instance, in washing the face the patients sometimes declare that their hands become "stuck". One patient used to take on an average twenty minutes to wash his face. In the severe cases where the rigidity is very pronounced, simple acts, i.e. feeding, dressing, or even turning in bed, are impossible. Mlle. Gabrielle Levy (34) has designated this type "La forme Cachectisante". Wasting is certainly prominent in many of these cases.

Despite the rigidity and slowness of movement in many cases, certain things can be carried out apparently quickly, i.e. female patients who have marked difficulty in washing or brushing the hair may be able to knit with comparative ease. Running is usually accomplished better than walking. The tongue is protruded with difficulty and usually it is not projected beyond the line of the teeth. It is flabby and often indented at the edges. The movements of the jaw are feeble and slow, so that mastication may be a matter of considerable difficulty in advanced cases. Muscular power is usually well retained in the

limbs despite the rigidity, even in advanced cases. Muscular fatigue, however, is usually a prominent feature and the patient complain of inability to walk far or use their arms for long in any manual labour.

The difference between the static and dynamic muscular power has been pointed out by several observers. In cases where dorsiflexion of the feet is moderately weak, if the patient be asked to keep his feet in a dorsiflexed position and to resist passive movements of plantar flexion, it will be found that a surprisingly large amount of force will be necessary to overcome the patients efforts. In a normal person static force is always greater than the dynamic, but the difference becomes more marked in the Paralysis Agitans. Fine movements with the fingers are often impossible.

A study of the handwriting shows some interesting features. In the most advanced cases writing is practically impossible owing to the rigidity. In the less affected patients the rate of writing is often extremely slow and the patient will take five minutes or longer to write three or four lines of a letter. There are usually frequent halts during which the hand becomes fixed and the patient is usable to move the pen; these sometimes last for half a minute or more and are most usually observed when the patient has to write a word of more than six or seven letters. The most characteristic feature, however, of the handwriting is micrographia; the individual letters are

smaller than those of the person's normal handwriting. In a number of cases the initial words do not show this micrographia but after the fourth or fifth word the letters tend to become smaller and smaller. In one case the reverse was noted, i.e. the letters tended to become larger. The individual letters in addition to being smaller are often misshapen and irregular in their contour owing to a fine tremor. Treatment with Hyoscin hydrobromide produced usually definite changes in the handwriting, the letters became larger and the writing more regular, and the speed of writing was increased; one patient who had not been able to write a letter for three years after three injections of hyoscine was able to do so with comparative ease. In a few cases, especially those in whom the rigidity was marked, hyoscine treatment produced a coarse rapid tremor which rendered the writing more shaky than before, although the rate was increased. Froment (31) and others have observed similar changes in the handwriting.

Fig.10. Case 9. aet 31. Acute attack February 1918. Paralysis Agitans 3-4 months later. Divergent strabismus right eye. Pupils myotic; extremely sluggish reaction to both light and accommodation. This case is of interest because of the minimal amount of hypertonus in the limbs as compared with the typical posture, etc.

LOSS OF ASSOCIATED MOVEMENTS.

This is an early and very characteristic sign of Paralysis Agitans. In walking this loss is typically seen in the failure of one or both arms to swing with each step. In rising from a sitting posture, especially from a low chair, the patient does so en masse, as it were, and does not put his hands on his knees or on the edge of the chair, as does the normal person, The loss of associated movements between the head and eyes, and between the eyes and the frontalis on looking upwards has already been mentioned. Souques (32) has described two other signs illustrating the loss of associated movement: (i) "Le Procédé du moulinet." The patient is asked to execute rapid movements of circumduction with one arm; the other arm does not show the oscillations accompanying those movements which occur normally; (ii) With the patient seated in a chair with his back against the back of the chair, his knees being flexed and the feet on the ground, attempts are made to upset the chair and the patient. In the Parkinsonian syndrome the legs do not extend at all or to a very slight degree, contrary to what occurs to a normal person in these parts. In a unilateral case the movement of extension at the knee is less than at the sound side.

What relation has this loss of associated movement to rigidity? That they may occur independently of each other is shown by the loss of associated movements in early cases, in which no increment of tone can be detected by ordinary passive

Fig. 11. Case 15, aged 17. Acute attack December 1919, Paralysis Agitans, followed in 1-2 months. The slight retroflexion of the head and typical posture of the hands are well seen; the latter were the seat of a tremor of the classical type. The hypertonus was minimal.

movements, or where any increase of tone that may be present is infinitesimal.

Two cases Nos. 9 and 27 in this series come under this category, and in both there was loss of associated movement. (See Figs. 10 & 11). Souques (32) reports a case of unilateral Paralysis Agitans following Encephalitis in a woman of 40 in whom tremor of the classical type was present in the right arm. There was complete absence of rigidity or paresis in that limb. In walking the right arm remained quite motionless while the left arm swung normally. In Unilateral cases the loss of associated movement, as for instance, the swing of the arm in walking is present only in the affected side. The arm on the unaffected side swings normally; as the case progresses the arm on the previously unaffected side may now cease to swing, yet examination of this limb may fail to detect any increase in tone.

REFLEXES.

The deep reflexes are generally more active than normal, and in unilateral cases are more active on the affected side.

It was found that if a series of reflexes be evoked in a limb, best seen in the case of the knee-jerk; - in the majority of cases the range of movement in the limb varied considerably with each tap. Moreover, a brisk reaction was usually followed by several very feeble contractions, and occasionally by none at all. If a sufficient interval was allowed to elapse between each stimulus, then the responses were approximately equal. Foix and Thévenard (35) attribute this phenomenon to temporary inexcitability. They do not give a reason for this inexcitability, but it is reasonable to suppose that repeated fatigue might be the cause of it. There is, however, no evidence of such a fatigue occurring in the muscles of Paralysis Agitans on electrical stimulations. It seems more likely that this phenomenon is dependent on the increased tone in the hamstring muscles, or slowness of relaxation of the quadriceps.

TREMOR.

Tremor was present in some form in over 90 per cent of the cases of Paralysis Agitans. In five cases, or 13 per cent of the total number the tremor could be described as that typical of the idiopathic type of Paralysis Agitans; in three of these cases it affected both arms; in one case the tongue in addition to the arms; in one case the lower jaw and arms, and in another case it was unilateral, affecting the arm and foot. The tremor is of considerable range which, however, varies in different circumstances. It is increased by emotion and may be absent for some hours. It is decreased on voluntary movement. The tremor may be simple or compound. In the simple form there is alternating contraction of two opposing sets of muscles producing a rhythmical tremor. In the other cases, and these are the more usual, the whole of a limb is involved in the tremor and the contractions of the various muscle groups produce varying displacement of the distal portion of the limb. The average rate of this tremor was six per second, the slowest being four and the most rapid eight per second. No pill-rolling movement such as is found in the idiopathic form was observed. In the second group which was more commonly met with the tremor was rapid and coarse and aggravated by voluntary movement and emotion. In some cases the tremor was present at rest and almost constant. In other cases it arises spontaneously in one or

more limbs without apparent cause, more frequently emotion or a voluntary movement on the part of the patient determines its onset. As a general rule it may be said that the more marked the rigidity the less often is the tremor found. This was well brought out after the administration of hyoscine in several cases in which the hypertonus was marked and in which there was almost a complete absence of tremor. After hyoscine medication the rigidity became less pronounced, but the previously existing minimal tremor became more marked.

Tremor of the idiopathic Paralysis Agitans type may occur under two totally opposite set of conditions, (1) where there is no appreciable increase in tone in the limb which is the seat of tremor, and, (2) where the tone is markedly increased. The following two cases illustrate this point:-

Case 15. Male aged 17. Was well until an attack of Encephalitis Lethargica in December 1919 which was characterised by pains in the neck, headache, diplopia and marked drowsiness. The Parkinsonian condition gradually developed within the next few months. He came under observation in September 1922 with a typical condition of Paralysis Agitans. There was a well-marked tremor of the tongue and lower elbow and both arms of the idiopathic type, the rate being from 6 to 7 per second. The movement of the tongue consisted in an alternate protrusion and withdrawal, it ceased when he talked. The tremor in the arms was more marked on the left side, it was not constant, its

amplitude was increased by emotion or voluntary effort, especially against resistance which involved other parts of the body. The tremor was lessened, however, by voluntary movement of the limb itself. On passively moving the arms, especially if the patient was asked to relax, no appreciable increase in tone in any of the muscle groups could be detected, although a slight general hypertonus developed when the patient's attention was withdrawn. (See Fig. 11).

Case 13. Male aged 41. Had an attack of Encephalitis Lethargica in May 1921 (p.146). He came under observation in September 1922 with a marked degree of Paralysis Agitans. The general hypertonus was very pronounced. The patient had difficulty in turning in bed and was unable to feed or clothe himself. In the arms the tone was markedly increased in all the musculature but predominated in the adductors, shoulder flexors and the elbow flexors of the wrist and the long extensors of the fingers. The hands adopted a typical Paralysis Agitans posture. Occasionally a very slow (4 per second) rhythmical tremor appeared in one or both arms affecting chiefly the hand and fingers, due to alternating contraction and relaxation of the flexors and extensors of the fingers, and to a less extent of the wrist. The tremor occurred when the limb was at rest and no tremor of any kind was observed on voluntary movement.

Remarks.

It seems certain, therefore, that we are dealing with two

entirely different types of tremor. (1) the idiopathic Paralysis Agitans type which is not influenced to any degree by the condition of muscle tone, though occurring perhaps more frequently when the hypertonus is not marked; (2) The more common rapid coarse tremor which is aggravated or initiated by a voluntary movement and seems to vary directly with the amount of hypertonus. The presence of the first type is sometimes taken as a distinguishing point between the idiopathic and the post-encephalitic types of Paralysis Agitans and to a certain extent that is true, although as shown above, there are exceptions.

PYRAMIDAL INVOLVEMENT.

There was evidence of pyramidal involvement in twelve out of the thirty-eight cases of Paralysis Agitans (34 per cent); and of these, eight were examples of Unilateral Paralysis Agitans.

The evidence of a pyramidal affection was based on the occurrence of a facial paresis of the supranuclear type, accompanied by the exaggeration of reflexes on that side, with an extensor response or a definite difference between the plantar responses on the two sides. The abdominal reflex was found to be unreliable as a guide owing to the general hypertonicity of the abdominal musculature. A double extensor plantar response was present in four cases.

In Case 6 who died of melanotic sarcomatosis the plantar responses were flexor until within two months of death, they then became extensor and remained so. (see Fig. 12)

Cases 14 and 29 were under observation for three months in hospital and in each case the plantar responses were indefinitely flexor on admission and remained so until two to three weeks in the former, and one week in the latter, before discharge, when a definite extensor response was obtained and persisted. The condition in both these cases was progressive.

In four Cases there was a definite unilateral extensor response. The condition of the plantar responses frequently varied, a definite extensor response may be present for a few

days and then be succeeded by an indeterminate one for the same period.

In seven cases there was a definite unilateral right lower facial paresis without any other evidence of pyramidal tract involvement.

CONDITION OF THE SKIN AND THE VASO-MOTOR SYSTEM.

The most constant alteration in the condition of the skin is seen in the face where a greasy appearance in very commonly met with. This fact has been noted by many observers. It is not necessarily associated with any other manifestation of vaso-motor disturbance. The explanation of this seborrhoeic condition probably lies in the facial immobility but some other factor is probably at work, as it does not occur so frequently in the idiopathic form of Paralysis Agitans. As a rule these patients object to cold weather as it seems to increase rigidity and discomfort. Often a sense of exaggerated heat, flushing, or of cold is complained of at times, especially when the trembling is worse. Usually there is no accompanying hyperhidrosis, although this may occur locally. Souques (32) mentions the occurrence of œdema in one or both inferior extremities without obvious disturbance of vessels, heart or kidney. I have observed œdema in one case (No. 9) which was confined to the left lower limb and for which no explanation could be found. The feet and hands are frequently cold and blue, and in unilateral cases these differences in the limbs on the two sides is very noticeable.

Sialorrhœa is an early and constant sign in these cases.

Psychical Changes.

Psychical changes varying in degree are a constant feature of the post encephalitic type of Paralysis Agitans. In a few cases there was no impairment of the intellectual faculties, and the association of ideas were normal, but in the majority of cases there was evidence of slowness of cerebration. A lack of control of the emotions was frequently met with, well seen in the too easily provoked smile. These patients cry remarkably little, although fits of depression are common. A more constant condition is one of euphoria - they seem happy and contented out of all proportion to their physical condition. Some of these patients showed considerable interest in their own symptoms, and when in Hospital they proved a great nuisance to the Nursing and Medical Staff by repeated requests and questions. They are frequently very interfering and loquacious and ready to argue. In a few cases there was evidence of mental defect associated with childishness. General nervousness and a dislike of being alone was present in about half the cases. Insomnia may be troublesome, The two following cases showed a definite psychosis.

Case 24. Male, aged 18, had an attack of Encephalitis Lethargica in September 1920, characterised by headache, diplopia and marked lethargy. Paralysis Agitans developed gradually within the next few months, and when he came under observation in June 1921, he was unable to clothe or feed himself. Towards

the end of 1921 he developed hallucinations of hearing; he said he heard voices telling him he could not sleep, or eat, and that he was going to die that night. These hallucinations became almost constant, and were most distressing to the patient. He had marked fits of depression, during which he cried; at other times he would smile at trivialities. During the day he slept well, but at night became extremely restless. He showed a moderate degree of mental hebetude, and was inclined to be irritable. A marked feature was his enormous appetite; he said he was always hungry. On one occasion he ate eleven pieces of bread for tea, and on another occasion he was seen to lick the other patients' spoons. One day I went into his room and found him commencing to eat an old tin of jelly which had a thick coat of mildew on the top, and which he had obtained from some other patient's locker. He often tried to steal the other patients' food. Sometimes he would refuse all food because the voices told him he could not swallow. After having been in Hospital for several months, he was discharged in May 1922, and died in an Infirmary in June 1922. No autopsy was obtained.

Case 57. Female, aged 63. Was quite well until August 1922, when one day she had a severe headache, accompanied by giddiness. She was delirious for two or three days. Later she ntoiced, on reading, that the letters ran together. Her daughter stated that from that time onwards she noticed a failure in the patient's mental faculties. She would sit all day doing

nothing, and seemed to have lost interest in everything. She was suspicious - it was also noticed that she trembled considerably at times, and that her legs seemed weak.

Examination in February, 1923, showed a small, frail woman, with a well developed Parkinsonian syndrome. Her mentality was much below the normal; attention, perception and cognition poor. She talked in a disjointed fashion, and it was impossible to understand her meaning. She suffered from hallucinations; she said she had seen people walking on the roof and looking at her. When she became depressed she said she felt that everyone was against her and watching her. She also suffered from delusions. After a few nights in Hospital, she told the Sister that she had had a baby, and wanted to know why it was being kept from her. On Visiting Day she kissed the grandfather of one of the patients, much to his discomfort.

The pupils were small, equal, and reacted promptly to light. Accommodation was practically absent in both eyes, her convergence was limited, otherwise the ocular movements were full. The limbs, neck and facial muscles were markedly hypertonic, and the cog-wheel phenomenon was present; there was no evidence of pyramidal involvement. On walking the posture was one of general flexion.

The following is a case of Paralysis Agitans associated with Acromegaly and Melanotic Sarcomatosis.

Case 6. Male, aged 28. First came under observation in May, 1922. (See Fig. 12)

He stated he was well until Easter of 1920, when he was suddenly taken ill with headache and paralysis of the right side of his face. He was delirious and only semi-conscious for one week. He had no disturbance of vision. At the end of one month he felt quite well. In July, 1920, however, he found he became easily fatigued, and wanted to sleep during the day; he also had slight tremor affecting all his body, especially on exertion. He went on a trip to America in November 1920, and remained there until January 1921. On his return, the drowsiness became more marked, and he noticed a slowness of movement in his legs and arms, and a little later that he did not swing his arms whilst walking. About this time he noticed, after reading a short time, that the letters tended to run together. His condition gradually progressed. In September 1921 his mother noticed that in addition to the lack of facial expression his nose had become broader, his face longer, and his lower jaw more prominent. The opinion of a Consultant was sought, and she was told that there was no disease in the nose. During this month, i.e. September 1921, the patient mentioned to his mother that he had a mole on the right side of his chest. A Surgeon was consulted, but owing to the general condition of the patient

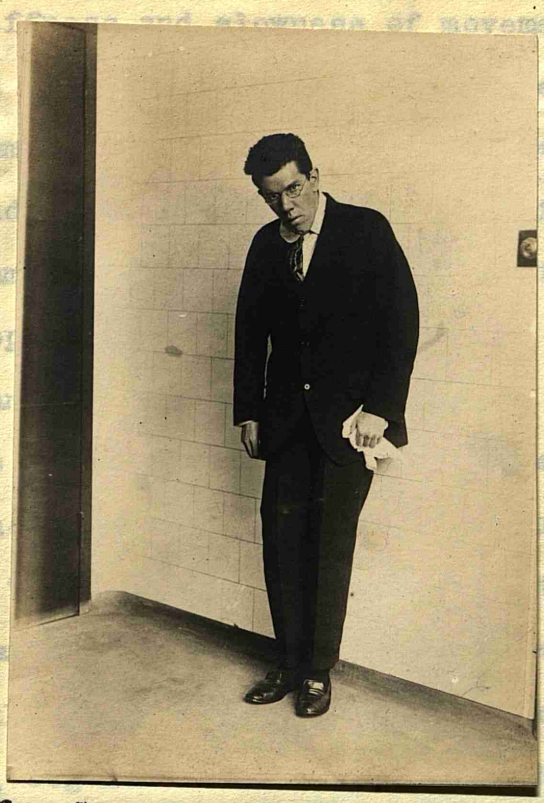


Fig. 12. Case 6. aet 28. Acute Epidemic Encephalitis, March 1920, followed by Paralysis Agitans 8 months later. Patient died of generalised melanotic sarcomatosis. The acromegalic facies was first apparent about September 1921.

he did not recommend its immediate removal. In March 1922, the general stiffness and slowness of movement had progressed, and the patient noticed that the mole had become larger, and had extended somewhat under the skin. A small piece was excised, and the condition was found to be one of Melanotic Sarcoma.

On examination in May 1922, the patient was found to be a well developed and intelligent man, his facies were typically Parkinsonian, but in addition there was a very definite acromegalic aspect. His fact was elongated, the supraorbital ridges pronounced, the nose large and broadened, the eyes were deep set. There was a slight tendency to prognathism, but no osseous changes elsewhere, and no kyphosis or lordosis. An X-ray of the head showed a normal Sella turcica. The pupils were equal, regular in outline, and both reacted briskly to light and accommodation, the visual fields were full, there was no nystagmus. Fundi were normal. The musculature of the jaws lacked power and rapidity of movement. In addition there was slight lower facial paresis. The limbs and trunk showed marked general flexion and rigidity, typical of Paralysis Agitans, with slowness of voluntary movement. The patient was unable to feed himself. There was no tremor, and no evidence of pyramidal involvement. A large, deeply pigmented subcutaneous nodule was present on the right chest wall, near the costal margins, the axillary glands on the right side were much enlarged. At first the rigidity was alleviated by hyoscine, but the patient was unable to feed and dress himself. The sarcomatosis became general with persistent melanuria, secondary

deposits in the liver and lungs, and many secondary nodules in the skin of the trunk and limbs.

For the last two months prior to his death both plantar responses were extensor in type. The patient finally died in December 1922. No autopsy was obtained.

Remarks.

The patient was in charge of an X-ray Department during the War, and probably the sarcoma was attributable to this.

The signs of acromegaly, which were definite, although confined to the face, were certainly not the result of the sarcoma, as the latter had only just appeared as the mole at the time when his mother first noticed the enlargement of his nose.

Changes in the pituitary gland have been reported in Encephalitis Lethargica by Howe(41). The changes are usually limited to the anterior lobe, and are characterised by a decrease of basophilic cells, areas of focal necrosis and capillary thrombosis.

It seems difficult in this case to co-relate these destructive lesions with an increased amount of secretion, as evidently occurred in this case.

SENSATION.

No objective disturbance of sensation was found in any case, although in view of the fact that the thalamus is not spared in this disease the absence of sensory changes is somewhat difficult to understand. Subjective sensations of pain were present in about twenty per cent. of the cases. Case No. 20 suffered considerably from pain which he described as a "vibration feeling." The distribution of this was general. The pain was sufficient to keep the patient awake and was not relieved by various hypnotics.

Pain, often of a sharp character, or "nipping", as one patient described it, was localised in a number of cases to the back of the neck, one or both shoulders, or the muscles of one arm. In one case it was confined to the lower jaw. The pain may be constant or paroxysmal and is often aggravated by movement of the affected part. The etiology of these pains is uncertain. In one or two cases, as in Case 20, the nature and distribution of the pain suggested the Déjerine - Roussy Thalamic Syndrome (56) although in no case was loss of sensation found.

No evidence of over-reaction to peripheral stimuli, such as was described by Head and Holme (57) in their study of thalamic cases was met with. Many of the advanced cases complained of marked general discomfort which necessitated frequent change of position, this seemed to relieve the discomfort, at least for a time.

Unilateral Paralysis Agitans.

Eight cases, or 20 per cent of the total number of cases of Paralysis Agitans observed showed a complete or almost complete unilateral affection.

Case 26. Male aged 21. Was taken ill in December 1920, with pains in the eyes, paresis of accommodation and sleeplessness (see p. 76). Examination in December 1922 showed a well built young man with a stolid and somewhat expressionless facies, the head was slightly retroflexed and held in a position suggestive of a carbuncle on the back of the neck. He was intelligent and his memory was fair. He was extremely loquacious and very interested in his own symptoms, which he frequently wished to discuss. He argued and quarrelled with the other patients and proved a considerable nuisance to the nursing staff. He had a huge appetite and would supplement his ordinary hospital fare by much additional food. The pupils were small and irregular in outline, with practically no reaction to a bright light and complete absence of reaction to accommodation in both pupils; there was an alternating divergent strabismus. The ocular movements seemed full but were poorly sustained; occasionally there was a tremor of the eyelids and facial muscles, especially when talking. The fundi were normal. The musculature of the face and jaws lacked power, the movements were performed slowly. In addition there was a left lower facial paresis apparent only on voluntary movement as opposed

Fig. 13. Case 26. aet 21. Acute epidemic encephalitis December 1920. Good recovery, Relapse 14 months later with signs of left unilateral Paralysis Agitans. Divergent strabismus right eye. Fixed pupils. Pyramidal signs on left side as well as Paralysis Agitans.

to emotional movements (see photograph 13 A.B.). The tongue could not be protruded beyond the line of the lips, and it was somewhat tremulous, flabby and indented at the edges. There was slight sialorrhœa; speech was monotonous and rapid. The muscles of the neck showed increased tone, especially the extensors of the head and trunk.

Posture of Limbs.

The left arm was constantly flexed at the elbow, and the fingers less flexed than in the case of the right hand. The right arm was normal as regards posture, as also were both legs in the recumbent position.

Tone.

Hypertonus and cogwheel phenomenon were present in all the muscles of the left arm, but tone predominated in the flexors of the elbow. The musculature of the right arm showed no appreciable increase in tone. In the left lower limb there was slight rigidity affecting all the muscle groups about equally and this was apparent also in the right lower limb, although to a slighter degree.

Associated Movements.

The left arm did not swing when walking but the right arm did so. The patient rose from a low chair in nearly normal fashion, but sometimes he did so without the aid of his hands.

A.

B.

Fig. 13.A. Left lower facial paresis on patient attempting to shew teeth.

Fig. 13.B. No apparent facial paresis when patient smiles. (See text).

Power was normal in the right arm, in the left arm it was moderately diminished, especially distally. The left leg showed about the same loss of power as the left arm; power in the right leg was nearly normal. All voluntary movements performed by the limbs on the left side were carried out more slowly than in a normal person.

Reflexes were active but more so in the limbs on the left side. The abdominal reflexes were brisk and equal, both plantar responses were flexor in type, but that on the left side was much less definite than on the right.

Vaso-Motor System.

The left hand was markedly cyanosed and cold. There was no definite changes in the left foot. Sensation was normal.

Gait was normal except for loss of associated movements of the left arm and the somewhat stiff attitude of the head and neck was noticeable; there was no retropulsion.

Case 27. Female aged 16. Had an attack of Encephalitis Lethargica (see p. 76). The present condition began in September 1921. (See Fig. 8.) When examined in November 1922, the patient appeared to be an intelligent girl, who was cheerful but whose memory was poor; she was extremely affectionate towards the other patients and nurses, but otherwise no marked alteration in her character was noted whilst whe was in hospital.

The face was slightly expressionless, the patient smiled frequently but there was no appreciable prolongation of the smile. The eyes were normal except for slight limitation of convergence Nystagmoid movements occurred in extreme lateral positions. There was no voluntary movement of frontales, but good emotional movement occurred. Both orbiculares oculi wereweak. There was a right lower facial paresis, apparent only on voluntary movement. The tongue was tremulous and protruded somewhat slowly; the palate moved well; there was slight sialorrhœa. Speech was practically normal. The posture of the right arm was typical of that seen in Paralysis Agitans. There was no appreciable increase of tone in the right arm except in the flexors. There was a compound bi-phasis tremor in the right arm and hand, more marked distally and similar in all respects to that seen in classic Paralysis Agitans, except that there was no pill-rolling movement of the fingers. The rate was 6 per second. The tremor was not constant, the range was greatest when the arm was at rest and was diminished by voluntary movement. The muscles of the upper arm and right shoulder including the pectoralis shared in this rhythmical tremor, but there was no displacement of the upper part of the limb. A similar tremor was present in the foot and consisted chiefly in alternating flexion and extension of the hallux. The posture of the right lower limb was normal except that extensor longus hallucis was constantly hypertonic producing a dorsi-

flexion of the great toe. The tone in the right leg seemed normal at the knee joint but was slightly increased in extensoes and flexors of the foot, especially in the plantar flexors. The power was normal in the limbs on the left side, and, but very slightly diminished in the limbs on the right side. The movements on the right side were somewhat slow. The reflexes were brisk but definitely more so on the right side. Abdominal reflexes were brisk and equal. The right plantar response was probably extensor, the left being flexor in type. The gait was normal except for the posture of the right arm. There was no retropulsion.

Case 3. Female aged 29, came under observation in October 1922. She had an acute attack of Encephalitis Lethargica in April 1918 (see p.73). The present condition began about July 1918. The patient first noticed that she did not swing her right arm whilst walking and that she could not use it as well as formerly. She was able, however, to perform her duties as a pianist fairly efficiently. In October 1918 she became married; whilst pregnant in 1919 she was much troubled with drowsiness during the day; her child was born at full time and was healthy. In 1920 she noticed slight weakness and trembling in her right leg. Shortly afterwards the right arm became weaker and stiffer and tremor began to affect it. She has been unable to play the piano for the last two years.

For the past year she has had marked precipitancy of micturition. Since 1921 she has had attacks in which she loses her voice for hours and days (presumably hysterical). Since the summer of 1922 she has had difficulty in looking at near objects as they became blurred.

Examination: Showed an intelligent Jewess whose memory was quite good; no abnormalities in behaviour were noted. She was, however, somewhat introspective. The facial aspect was typically Parkinsonian; the pupils were equal and regular in outline but reacted less briskly than normally to light and accommodation. The ocular movements were full except convergence which was slightly limited. The fundi were normal. The tongue was tremulous; the facial and jaw movement were slowly and somewhat feebly carried out. Speech was slightly monotonous; the smile was prologued and relaxation took place slowly. There was very slight hypertonusin the neck muscles. Tone, posture, and power in the limbs on the left side showed no appreciable alteration from normal, The tone in the right upper limb was increased considerably in all muscle groups, more especially in those determining the posture. it was more pronounced distally than proximally. In the right lower limb gene ral hypertonus was marked especially in the post-tibial group of muscles. The posture of the right arm was typical of Paralysis Agitans especially as regards the hand. The posture of the right leg was one of extension at the knee,

the foot pointing dowwards, the hallux being dorsiflexed. The power in the limbs on the right side was moderately diminished especially in the right arm. There was a rapid coarse tremor in the right upper limb which appeared spontaneously at rest but was aggravated by voluntary movement; occasionally this was present in the right leg. Movements were carried out very slowly in the limbs on the right side; there was loss of associated movements in the left arm as wlll as in the right in walking although, as before mentioned, there was no appreciable increase in tone in the left arm. Reflexes were brisk, more so on the right side; the right plantar response was equivocal, the left was flexor in type. The gait was normal except for the flexed posture of the right arm; the loss of associated movements in both arms and a somewhat stiff attitude of the head and neck. There was no festination and no retropulsion.

Case 16. Female aged 17. was first seen in January 1922 during an acute attack of Encephalitis Lethargica which began during the last week in December 1920 with a catarrhal condition in the nose accompanied by severe pain in the face. Diplopia then developed. The patient was unable to sleep, and latterly became markedly lethargic with double ptosis.

The cerebro-spinal fluid howed no abnormalities. The drowsiness persisted for one month. In April 1921 it was noticed for the first time that she had a right lower facial

paresis; no other physical signs were detected except that the right plantar response was indefinite. The condition of the patient gradually improved and she was discharged in June 1921 with no positive neurological signs except slight mental hebetude and a right lower facial paresis. In September 1921 it was noticed that the face had become somewhat expressionless and that the voice was monotonous. No loss of associated movements or increase of tone in the limbs could be detected. When seen in January 1922 patient said she did not seem so well and that on reading the letters became blurred. The expression now was distinctly more masklike, and in walking she tended to stoop; also there was no swing of the right arm, which was carried in a slightly flexed position. The pupils reacted poorly to light and scarcely at all to accommodation. There was slight limitation of convergence; there was no voluntary movement of frontalis; the right lower facial paresis remained as before. The right arm now showed slight but definite increase in tone in the flexors and pronators of the forearm. Cogwheel phenomenon was now thought to be present. The movements of the right arm were slightly slower than those of the left; there was no tremor and the lower limbs were normal. In October 1922 the facies was more Parkinsonian, the pupils were three-quarters dilated and still reacted sluggishly to light and scarcely at all on accommodation; convergence now was more

limited. Hypertonus was slightly more marked in the right arm and was now present in the right leg. The limbs on the right side were normal. Of additional interest in this case is the impairment of reaction to accommodation, and then considerably later, the partial loss of the right reflexes; the dilation of the pupils is also unusual. (No midriatic had been given.)

Case 32. Female aged 35. First came under observation in December 1921 with the complaint of weakness and trembling and of pains and ~~incomplete~~ pins and needles sensation in the left upper and lower limbs. She stated that she had had an attack of influenza in 1919; no further particulars of this illness were asked for at that time. On the second day after getting up she fell off a ladder about a distance of 6 feet, she felt bruised and was much shaken; about three weeks later she had a severe pain in the left ankle which caused her to limp and this was shortly followed by trembling in the left arm and leg. She also noticed that she did not now use her left arm as well as before and that she tended to drag her left leg slightly in walking. On examination in December 1921 nothing abnormal was found in the eyes or cranial nerves. The left arm was kept in a flexed position and there was considerable resistance to passive movement; the same rigidity was found in the left leg; the left foot was inverted and tended to assume a pes cavus position. There was considerable loss of power in the left arm and leg. A rapid coarse tremor was present in the limbs on the left side at times, especially on exertion or emotion. The deep reflexes were present and equal on the two sides and the plantar responses were both flexor in type; sensation was normal. Examination of the blood and cerebro-spinal fluid was entirely negative. The case was considered as one of slight hemiplegia with possibly a superadded hysterical element;

with persuasion a certain amount of improvement was made as regards the power in the left arm and the left leg. The patient was next seen again in January 1922, when it was noticed that the condition had progressed and she now showed definite evidence of Paralysis Agitans, the limbs on the right side being now affected. On enquiry into the details concerning the attack of influenza in 1919 it was ascertained that it began with severe headache, pains in the back and neck and in the stomach. There was no disturbance of vision. She did not remember whether her sleep was disturbed. Examination now showd a very slight degree of lack of expression in her face. The naso-labial folds were conserved and unless one had particularly scrutinised her face it is quite probable that it would have been passed as normal. The movements of the face, jaws and tongue were carried out readily and as quickly as normal; pupils were equal and reacted normally; there was no nystagmus. There was slight weakness of the left lower face. The posture of the left arm and hand, particularly the hand, was typical of paralysis agitans; the right hand was held somewhat stiffly. The hypertonus in the left arm affected all muscle groups, and predominated in the flexors of the elbow. In the right arm there was slight increase in tone in the flexors at the elbow but more so at the wrist. Cogwheel phenomenon was present in both arms. Occasionally a rapid coarse tremor occurred in both arms, being more pronounced in the left than the right; it was increased by voluntary movement.

The movements were carried out somewhat slowly especially with the left arm; the abdominal reflexes were brisk and equal. The left foot showed moderate pes cavus, but the abnormal posture could easily be corrected. The tone was moderately increased in both legs, in the left more than the right, the distribution being general but more marked proximally. The cogwheel phenomenon was present. The deep reflexes in the arms and legs were brisker on the left side than the right and the left plantar response was less definitely flexor than on the right side. In walking she tended to walk on her toes with short steps and the general attitude was now one of flexion; there was no swing of either arm. There was a definite tendency to retropulsion.

Remarks. This case is of interest because of the very slight involvement of the facial muscles, and on this account it is probable that the true nature of the disease was not arrived at when she first came under observation. This is the only case I have observed in which the facial muscles were not affected from the onset, and in this respect the case more resembles one of classical Paralysis Agitans. The age of the patient, the absence of the typical kind of tremor, the presence of a unilateral facial weakness are points in favour of the post-encephalitic form. The details of the attack of "influenza" are indefinite, but it has been previously shown that Paralysis Agitans may follow an attack of encephalitis lethargica in which the symptoms were even less suggestive than

in this case.

Case 25. Male aged 12. Was first seen in December 1920 with the complaint of weakness in the left arm and left leg and inability to walk. His mother stated that he was quite well in December 1918 when he was taken ill with double vision and later became delirious. He had movements like "St Vitus's Dance"; he recovered in about two months but was much troubled with heaviness during the day, at night, however, he could not sleep. In April 1920 it was noticed that he carried his left arm in a bent position across his chest, then he began to drag his left leg and had difficulty in getting his left heel on to the ground. It was noticed also that his mouth was always open. Gradually the position has become worse, so that he has been unable to walk for some months.

Examination in December 1922 showed typical Parkinsonian facies and smile. There was frequent trembling of the eyelids and long-drawn sighs. He was extremely emotional and childish; memory was defective and his cerebration slow. The pupils were regular in outline, both reacted to light, but there was no appreciable reaction to accommodation. The ocular movements were full except convergence which was markedly limited. There was some loss of associated movements of the eyes and head. Fundi were normal. The musculature of the face and jaws was weak and all movements were performed slowly. There was slight left lower facial paresis. The tongue was protruded fairly well but was tremulous. The voice was feeble

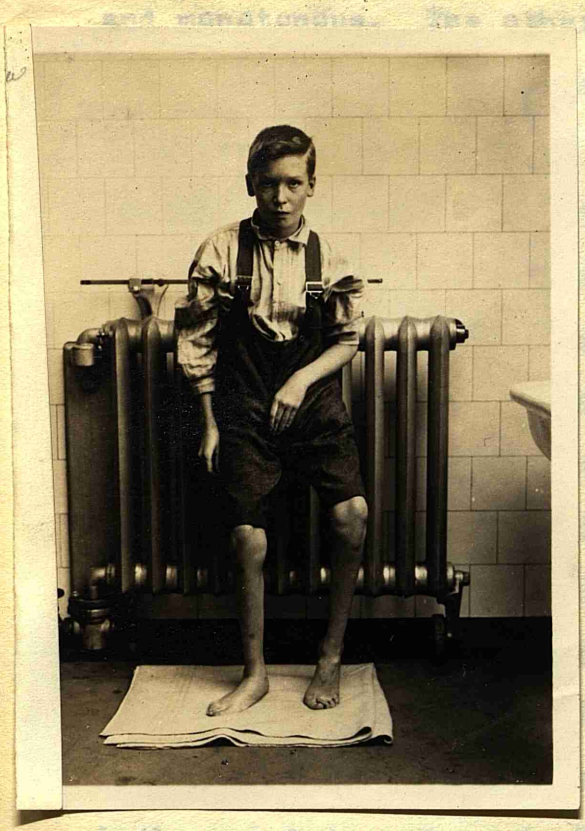


Fig. 14. Case 35. aet 12. Acute attack December 1919. Unilateral Paralysis Agitans 3-4 months later. This case was of interest because of the contractures of left leg. (See text). The right hand photograph (taken 3 months later than the other) shews the patient attempting to walk which he does on his toes. Retropulsion marked. The retroflexed position of the head is well seen.

and monotonous. The other cranial nerves were normal. The head was usually held somewhat retroflexed. The tone was considerably increased in the muscles of the neck and predominated in the extensors of the head.

Arms. The posture of the left arm was typical of that seen in a well marked paralysis agitans especially as regards the hand. The right hand adopted the same posture, but this was less marked than in the case of the left arm. The fingers of the righ hand being slightly more flexed than those in the left, but were held somewhat stiffly. Tone in the left arm was increased in all muscle groups but at the elbow predominated in the flexors. The right arm showed very general slight increase of tone, cogwheel phenomenon was present in both arms but more so in the left. There was moderate loss of power in the left arm and all movements of this limb were carried out slowly. The same alterations were present in the right arm but were less marked. There was a rapid, coarse tremor in the left arm on voluntary movement but none in the right arm; sensation was normal; the muscles of the abdomen were hypertonic and the reflexes were brisk and equal.

Legs. The posture ~~in~~ of the left leg in the recumbent position was one of moderate flexion at the hip and knee joints with eversion of the whole limb, the foot pointing downwards, the right leg lay in a normal position but the hallux was dorsiflexed. Tone in the left leg was markedly increased in all

muscle groups but very definitely predominated in the flexors of the hip and knee and in the post-tibial muscles. Considerable force had to be used to overcome the predominating posture of flexion in this limb. In the right leg there was slight general hypertonus especially peripherally. Cogwheel phenomenon was present in both legs. The muscular power in both legs was considerably below normal but more so in the left. The reflexes were present and equal in the arms; the deep reflexes in the legs were difficult to obtain owing to contracture; both plantar responses were probably flexor. On attemping to stand the patient tended to fall backwards and was unable to stand without support (see photograph). The flexion of the left knee became more marked and the right knee was also somewhat flexed. He tended to stand on his toes and on attempting to advance the left leg only the toes touched the ground, and he was unable to put his left heel on to the ground, so that walking was impossible, mainly however due to the marked retropulsion which was present. His arms assumed a striking posture especially as regards the left, namely, abduction at the shoulder ~~for~~ and internal rotation, ~~but~~ flexion at the elbow to right angle, pronation of the forearm, so that the palm of the hand looked downwards, and slight flexion of the wrist.

Remarks on Unilateral Paralysis Agitans.

There are certain points of similarity in these cases

1. In four of them there was a prolonged latent period between the original attack and the onset of the first symptom of Paralysis Agitans.

2. In five cases evidence of a pyramidal lesion on the same side as the unilateral Paralysis Agitans, i.e. supra-nuclear type of facial paresis, reflexes brisker on the same side and definite alteration in the plantar responses. I have not observed any case of unilateral Paralysis Agitans in which there was not facial paresis on the same side. In all seven cases the reflexes were brisker on the more affected side.

In cases of generalised Paralysis Agitans it is usual for the reflexes to be more brisk than normal, and so one can conclude in a unilateral Paralysis Agitans the reflexes would be brisker on the affected side, therefore this is not evidence per se of a pyramidal tract lesion, but in the above mentioned five cases there was a facial paresis on this side and alteration in the character of the plantar responses, and so involvement of the pyramidal tract must be presumed.

3. In all the cases there was a Parkinsonian facies, which was the earliest sign in every case except one. This loss of expression was extremely slight and could easily have been overlooked.

4. In five of the cases the limbs on the unaffected side showed no appreciable alteration in tone although in one case

there was a loss of associated movements in the left upper limb as well as in that on the affected side.

5. The posture of the arm especially that of the hand on the affected side was similar in all cases and appeared comparatively early.

6. In five of the cases there was evidence of partial internal opthalmoplegia.

Pierre Marie and Mlle. G. Levy (42) report eight cases of Unilateral Paralysis Agitans following Encephalitis Agitans which showed a very slight Parkinsonian aspect. The gait was normal except for some rigidity of the upper part of the body. They state that the arm on the affected side was flexed and resembled that seen in hemiplegia. In four cases the leg was slightly affected and there was facial asymmetry but no definite signs of pyramidal lesion, although reflexes were more active on the affected side. They do not state the nature of the plantar responses on the affected side. They attribute the facial asymmetry to greater rigidity on one side of the face than the other. I was not able to convince myself in this series of cases that this was the explanation of the lower facial paresis, because in all of the cases the facial weakness was apparent, or much more prominent on voluntary movement such as showing the teeth, and was not observed during spontaneous smiling. Again in those cases in which a voluntary movement of the frontalis was present there was no asymmetry when

patient was asked to raise the eyebrows. (see Fig.13A&B).

P A R T III.

DIAGNOSIS.

I think it is generally agreed upon that within the last three years or so there have been many cases showing unusual manifestations of the Central Nervous System, i.e. involuntary movements, ocular palsies, etc, that could not be explained by any obvious etiological factor. In some of these cases a definite history of Encephalitis Lethargica can be obtained. In others, possibly the history of some transitory indisposition in which pain was the prominent feature, but often no history at all suggestive of Encephalitis Lethargica was forthcoming. Yet, the very nature of the affection, i.e., Paralysis Agitans in a young person, makes it practically certain that an unnoticed and slight attack of Encephalitis Lethargica had occurred previously. In children, insomnia, often associated with marked nocturnal restlessness and sometimes with disturbances in respiration, should not be too rapidly labelled "neurosis", but a careful enquiry into the nature of all recent illnesses should be made. Again, in children, the changes in moral character, when marked, are almost pathognomic of a sequel of Encephalitis Lethargica. The condition is to be differentiated from that of moral imbecility. The most differential

important points between these two conditions are (i) in moral imbecility the condition has been usually present from an early age; (ii) Considerable cunning is invariably displayed in order to avoid detection; (iii) there is often an accompanying mental defect. In the post-encephalitic condition the child had been quite normal up to an acute illness. There is usually no attempt at avoiding detection. In the five cases in this series there was no history of theiving but this has been reported in several cases. In three out of the five cases there were other signs indicative of involvement of the Central Nervous System, i.e. a partial internal ophthalmoplegia, involuntary movements, or Paralysis Agitans. Three out of the five cases although showing disturbances of memory resulting in a certain degree of backwardness, were quite intelligent, the remaining two were above normal as regards their mental faculties.

Similar cases, in which the alteration in moral character is slight, exhititing itself merely as a restlessness, stubbornness, disobedience, and possibly insomnia,may easily be overlooked, but the more or less sudden change in the child's behaviour following a febrile illness should make one suspicious that this illness may have been Encephalitis Lethargica.

The resemblance between the form of respiratory disturbance characterised by rapid breathing, apnoea and falling of the child, and an attack of epilepsy has been already pointed out.

Such attacks may appear hysterical.

Involuntary movements . In case 35 which exhibited Choreiform movements of the tongue and head, a diagnosis of Huntingdons Choreiform had been previously made, no history of Encephalitis Lethargica at that time having been made. The amelioration in the condition and the lack of mental symptoms were points distinctly against such a diagnosis.

Case 36 showing involuntary movements of the left foot might have been labelled as hysteria.

The involuntary movements of a tonic nature which involve the head or face may be passed over as ~~tricks~~ ties unless the possibility of such a sequelae is remembered. Similar tonic spasms, as in Case 37 and 41, involving the limb as well as the face, are good evidence in ~~these~~ themselves of a previous attack of Encephalitis Lethargica.

Cases exhibiting choreo-athetotic movements and a condition resembling torsion spasm may be mistaken for the idiopathic forms of this disease. In the case of torsion spasm the racial element is of importance.

Spinal Forms. Case 49. ~~As a~~ The spinal form ~~sequel. this~~ may be difficult to differentiate from poliomyelitis, polyneuritis and myelitis. The history of diplopia, involuntary movements, especially myoclonic, and the tendency to complete

or almost complete recovery of function in the parts affected are of importance. In the myelitic form the resulting paraplegia and loss of sphincter control usually clears up comparatively rapidly and in the presence of a negative Wassermann Encephalitis Lethargica should be seriously entertained as a possible cause of such a condition even in the absence of affection of the cranial nerves.

It is very questionable if a clinical condition analogous to that presented by disseminated sclerosis can be produced by the virus of Encephalitis Lethargica, although several such cases have been reported.

Paralysis Agitans.

The resemblance of the post encephalitic form is strikingly similar in many respects to the idiopathic form of Paralysis Agitans. There are certain points of dissimilarity between the two which are of importance.

(1) Mode of onset. In the post-encephalitic form the facial and neck muscles are involved first, except in rare cases (Case 30), so that the facial appearances at a very early stage suggests the diagnosis. Except in the unilateral cases the process becomes quickly generalised. In the idiopathic form, on the other hand, the limb on one side, usually the arm, is

affected first and the advance of the disease is slow; the face also shows no material change for some months after the onset of the disease.

(2) In the post-encephalitic form rigidity dominates the picture. The tremor, if present, is usually rapid and coarse and is aggravated by voluntary movement. Tremor of the idiopathic type is present in a very small percentage (5%) of the cases, and rarely does one observe a true pill-rolling movement of the fingers as in the idiopathic form.

(3) Sialorrhoea is a prominent and early feature in the post-encephalitic form, whereas in ordinary Paralysis Agitans its appearance is not so constant nor does it appear so early.

(4) Mental changes are not prominent in the idiopathic form except in the terminal stages, indeed the clarity of the mental processes in these cases is often striking; whereas in the type following Encephalitis Lethargica a mental hebetude is often present at an early stage. In addition changes in disposition are almost constant even in the unilateral cases, and more rarely there may be definite psychosis.

(5) The age of the patient is of importance. Idiopathic Paralysis Agitans is rare before the age of 40. The juvenile

type as described by Ramsey Hunt, seems a rarity, so that the occurrence of Paralysis Agitans in a young adult is prima facie evidence of a previous attack of Encephalitis Lethargica. On the other hand, it must not be forgotten the Encephalitis Lethargica may attack people of all ages, so that in elderly persons we frequently meet with Paralysis Agitans which is not of the idiopathic type.

(6) The presence in a Paralysis Agitans of other signs suggestive of implication of the Central Nervous System would point to a previous attack of Encephalitis Lethargica, i. e. ocular palsies, changes in pupillary reactions, facial paresis, or evidence of involvement of one or both pyramidal tracts.

(7) Lhermitte (45) has drawn attention to the occurrence of Paralysis Agitans on a syphilitic basis and has described the autopsy findings in three cases who were all about the age of 50. These cases resembled the post-encephalitic form in that there was no typical tremor; in only one case was the condition of the pupils mentioned, and in that case they were normal. It must be remembered, however that a positive Wasserman in a Paralysis Agitans does not exclude the possibility of it being of post-encephalitic origin.

Considerable difficulty may arise in the diagnosis of an

early unilateral Paralysis Agitans. The condition most resembles a hemiplegia. A careful scrutiny of the face which, as has been previously pointed out is nearly always primarily involved, is important. If the head be passively moved, there is usually found to be present an increase in tone in the extensor and flexor muscles of the head. The posture of the arm in unilateral Paralysis Agitans closely resembles that of hemiplegia, except as regards the hand; even in early cases there is a diminuation in the normal flexion at the phalangeal joints, the fingers tend also to be adducted and the thumb extended at its terminal joint, whereas in hemiplegia the normal flexion of the fingers is maintained or exaggerated. The most important differential point, however, is the distribution of tonus in the limbs. If passive movements of ~~tension~~ flexion and extension be made in the arm of a Paralysis Agitans a constant resistance is encountered, whether the movement be one of flexion or extension it varies little throughout the movement. Moreover, in overcoming the resistance offered to passive movement the cogwheel phenomenon is apparent, even in early cases; there is also a tendency to preservation of any posture in which the limb may be placed. In a hemiplegic arm tone definitely predominates in the flexors at the elbow, so that only when extending the arm is a resistance met with, which is

usually greatest when such movement is half completed; also there is no cogwheel phenomenon. If the limb be extended it slowly flexes again, i. e. there is no tendency to maintenance of posture except ~~that~~ the one of flexion at the elbow.
In earlier cases of unilateral Paralysis Agitans in which there is pyramidal involvement on the same side tone at the elbow definitely predominates in the flexors, but the cogwheel phenomena can always be elicited. The presence of sialorrhoea, disturbances in the pupillary reaction, and a tendency to retropulsion will be corroboratory evidence of Paralysis Agitans.

Ocular Conditions. As previously shown the only relic of the disease may be a partially fixed myotic pupil which may also be irregular in outline. The semblance to the luetic pupil has already been discussed, and the importance of the recognition of this sequel of encephalitis cannot be over-emphasized.

Prognosis.

In dealing with prognosis, each type of sequel must be taken separately, as the outlook varies for each group.

Group 1 includes the neuroses, psychoses and changes in moral character. Those suffering from the various forms of neuroses usually recover, provided circumstances are favourable.

These cases, however, invariably possess an unstable nervous system from the psychological point of view, and the acute attack of encephalitis lethargica acts as other serious illnesses would do, viz. lowers the mental resistance, but is probably more prone to do so, in this disease, owing to its incidence on the central nervous system.

The outlook for the psychoses group is unfavourable, but it would be premature to state definitely that such cases do not recover. Case No. 48, an example of dementia praecox, has shown a very slight improvement, and it is doubtful in this case whether any further recovery will now take place.

As regards changes in moral character, especially in children, in well marked cases the prognosis is unfavourable. In three cases out of the five in this series no improvement has taken place. Two of these cases are now in Institutions. In the less severe cases much can be done by proper supervision and management on the part of the parents if they be intelligent and the home conditions suitable. Those cases in children, in which there are respiratory disturbances, associated frequently with nocturnal restlessness, and insomnia as the only sequelae, tend to recover in from 1 to 2 years.

Group 2. contains the various forms of involuntary movement.

Two cases 37 and 51, in this series showed a progressive diminution in the tonic spasms with which they were affected.

Case No. 51 however, suddenly died 2½ years after the initial attack- a clinical picture of cerebral haemorrhage.

Cases 33, 35 and 36 still have movements more than 2 years after the acute attack, only they have decreased in range and extent.

Judging also from the experience of others, it seems probable that in the majority of cases which show involuntary movements there is evidence of progressive recovery, and in many cases the movements entirely disappear. I have had no experience of athetotic movements.

Group 2 includes the ocular palsies. A large percentage of the original ocular palsies after an acute attack clear up within six months to a year; those remaining longer than that period persist, and it would seem as if they were permanent.

Those cases in which the toxic process remains active, judging by the mutability of the ocular palsies (Case 32) a guarded prognosis is necessary, as the disease may be expected to flare up in a more general fashion.

Paresis of accommodation and alteration in the reactions to light, often associated with ~~the~~ myosis seem in a number of cases to be permanent relics, and possibly the only ones, of the acute attack.

Group 3. Spinal forms. Progressive improvement usually takes place unless the original damage is extensive. Some evidence of the attack may be permanent, i. e. atrophy of the small muscles of one or both hands.

Group 4. Paralysis Agitans. J. Stephenson (42) in a study of over 30 cases noted improvement in all the cases examined. This is contrary to the findings in this series of cases, and also in many of those reported. None of the cases personally examined have improved; in only 8 cases has the condition remained stationary, in the remaining 30 the disease has slightly progressed, 3 cases (13, 24 and 58) have died 18 months, 2 years and 4 years respectively after the acute attack. Two cases (12 and 17) developed epilepsy more than 2 years after the original attack, and the former a psychosis in addition, which has necessitated her retention in the Asylum.

It is evident from these figures that the outlook for these unfortunate persons is bad. Accompanying the loss in weight, which is fairly common, there is a decreased resistance to bacterial infection and ~~a~~ pulmonary tuberculosis (Case 15) and bronchitis may supervene and prove fatal. Relapses may also occur.

TREATMENT.

Neuroses and changes in character in children.

The various neuroses in adults and in children are usually amenable to ordinary methods of treatment. An ample period should be allowed for the patient's convalescence after an acute attack, and on resuming work or school, care must be taken that no great strain is thrown on the individual. In children in whom there has been a change in moral character as the result of the disease much can be done by patience and understanding on the part of the parents. They should be informed of the nature of the trouble, and in the slighter cases should be told that with proper management the child will probably become normal again. Such a case should attend school, if only for a half day.

Insomnia and accompanying restlessness in children may be treated with sedatives, such as bromide and chloral; Luminal in small doses is often successful where these drugs fail. In the more severe cases of moral delinquency, if the home conditions are such that control of the child is impossible, retention in an Institution or Colony is advisable, where with proper supervision and discipline an improvement is sometimes brought about. Such a child should not be signed up as a moral imbecile; the medico-legal aspect of the question is extremely important, but has been dealt with fully by several writers.

Involuntary movement.

In the slighter forms, when only a small portion of the body is involved, as for instance the face, drug treatment as a rule is unnecessary. The patient should be reassured as to the ultimate disappearance of the movement. In the severer forms of athetotic movement or tonic spasms, an effort must be made to control them.medicinally. The most valuable drug in my experience is luminal. In Case 37. the tonic spasms were so powerful that they caused the patient a great deal of pain, and prevented her from walking. An acute arthritis of the left shoulder joint developed as a direct result of these movements. Luminal was given in 2 grain doses thrice daily. The range and intensity of the movements were thereby decreased considerably. The patient remained in Hospital for one year, and this dose was maintained, a diminution in the amount leading to an aggravation of the spasms. For the past year she has been attending as an out-patient on 4 grains daily, and quite recently this dose has been reduced to 2 grains. The movements are gradually decreasing in range.

Paralysis Agitans.

Any method of treatment adopted in these cases has no permanent effect, and only gives a temporary comfort to these unfortunate patients. In this series of cases the only drug that could achieve this satisfactorily was Hyoscine hydrobromide. In severe cases which came under treatment in hospital it was customary to give an initial hypodermic injection of 1/200th of a grain in order to ascertain whether there was any idiosyncrasy to the drug. This is especially advisable in the case of elderly patients. For the following few days one injection of 1/100th of a grain was given, and then 1/100th of a grain thrice daily by the mouth was substituted for the injections. In severe, advanced cases, however, a daily injection was continued for several months as the same benefit was not obtained from the oral administration of the drug. In advanced cases, who on admission were unable to feed, clothe themselves, speak or write a letter, and had difficulty even in turning in bed, the administration of two or three injections of 100th of a grain of hyoscine usually brought about considerable amelioration in the condition. They were now able to talk more audibly, feed themselves, and get in and out of bed with greater ease. One patient, who had been unable to write a letter for three years, was able to do so after two injections of $\frac{1}{100}$th

of a grain. Sialorrhoea is diminished, and the constant discomfort which the more severe cases experience is lessened, and restlessness at night is diminished, resulting in better sleep. In those cases which show tremor, the latter is not diminished as a rule by hyoscine, and may even become more marked.

The following case in which a fatal issue was probably averted by the use of hyoscine may be cited.

Case No. 20. Male, aged 42. Came under observation in September, 1921. with a well developed Paralysis Agitans accompanied by hemiplegic signs on the left side. No hyoscine was given. The condition remained the same until the middle of October, when he had a definite relapse, consisting in increase in the general rigidity, difficulty in swallowing and diplopia, associated with lethargy. The condition remained about the same until the middle of November, when he developed a follicular tonsillitis. For the next week his general condition was not so good; on the 7th December a second relapse occurred, with considerable increase of the rigidity and drowsiness, accompanied by marked difficulty in swallowing and a tendency to retention of urine, a mucus accumulated in the back of his throat, and he developed generalised bronchitis and signs of passive congestion at his bases. The chest symptoms

seemed largely to depend on the immobility of the chest wall, which scarcely moved on respiration. The general appearance of the patient suggested a fatal termination within a few days. On the 8th. December there was no improvement, and hyoscine hydro-bromide - grain $\frac{1}{75}$th was given in the morning, and again in the evening. After the first injection he improved, and at night the improvement had continued, the rigidity became much less marked, and swallowing easier. The signs in his chest cleared rapidly. The hyoscine, $\frac{1}{75}$th twice a day was continued until the 13th. December, when toxic symptoms became pronounced; gr.$\frac{1}{100}$th every other day was then substituted. By this time the patient was better than before the second relapse.

The Toxic symptoms of hyoscine are well known, and need not be discussed, beyond mentioning that headache, dizziness and dryness of the mouth and mydriasis were the symptoms most commonly met with. It was found that the doses necessary for the alleviation of symptoms in these patients always produced toxic symptoms, such as mydriasis and dryness of the mouth, and according to the patients the resulting improvement in their general condition more than compensated for the inconvenience of the mydriasis.

Gelsemium has been found by some observers to be of benefit in these cases; the tincture was tried in several cases in

in these series, but was discarded owing to its failure to improve the condition. If beneficial its use is preferable, as no toxic symptons are produced.

Arsenic in the various forms suitable for intravenous injections has been recommended by several observers, but there is no unanimity in its efficacy; it is difficult to understand the rationale of its use.

The precise method by which hyoscine lessens hypertonia in paralysis agitans it is impossible to say at the present time; its action on the central nervous system is that of a depressant. Pilocarpin, whose action isphysiologically opposed to that of hyoscine and atropine, might be supposed to aggravate the rigidity. Its action was studied in three cases - two unilateral, and one generalised paralysis agitans. The hyoscine was stopped for 24 hours previously. A careful examination of the condition of tone reflexes was made, and immediately afterwards $\frac{1}{10}$ th of a grain of pilocarpin was given hypodermically. Twenty minutes later the patient was re-examined. Flushing and moderate sweating was noted in all three cases; in the two unilateral cases there was no difference in these phenomena on the two sides of the body. In none of the cases was any change noted in their condition as regards the rigidity or slowness of movement. By the ordinary tests for estimation of tone, no difference in this could be detected as compared with that existing before the injection. The reflexes were unaltered, and in the two unilateral

cases, in which pyramidal signs existed, there was no accentuation of these.

Of additional drugs in treatment of paralysis agitans, mention must be made of luminal. In many cases this proves a valuable adjunct to hyoscine; it diminishes the restlessness and in a few cases tremor was lessened. It is especially valuable at night. In cases in which insomnia and nocturnal restlessness are prominent, one grain twice a day, or a single dose at night usually suffice. A certain amount of benefit may be derived from massage combined with passive and active movement.

Hydro-Therapeutic measures in the form of a hot bath, in which the patient lies from 10 - 15 minutes, the temperature of the water being maintained, is often valuable and promotes sleep.

Souques and Moquin (44) have tried in six cases the effect of injecting the patient's own cerebro-spinal fluid into the blood, on the supposition that the former may contain anti-bodies. In only one of the six did any improvement result.

PART IV.

PATHOLOGY.

Extremely few autopsy findings on cases of post-encephalitic paralysis agitans have been reported . Marinesco (46) reports the case of a man of 43 who had an acute attack of epidemic encephalitis in March 1920 followed by Paralysis Agitans; he died in February 1922. Although lesions were found in the globus pallidus they were much more intense in the locus niger; here the cells for the most part had undergone cytolysis and their place was taken by masses of pigment; the neuroglial cells were increased in size and number in this region, many of them contained pigment. The nerve fibres in the locus niger had largely disappeared; the vessels showed peri-vascular infiltration with small round cells. The endothelium of the capillaries contained black pigment; the region of the red nucleus appeared practically normal.

McKinley (47) reports fully the histological findings in a man of 51 who died of Paralysis Agitans of two years' duration, following an acute attack of Encephalitis Lethargica. The globus pallidus putamen and caudate nucleus contained insignificant changes as compared with those found in the substantia niger, and consisted of a moderate amount of chromatolysis and an occasional example of cytolytosis, but there was no reduction in the number of cells. Slight perivascular infiltration was

present in the globus pallidus but none in the putamen. In the thalamus the changes were rather more marked, but there was no evident reduction in the number of the thalamic neurones, nor was there any evidence of degeneration of nerve fibres in the basal ganglia. The lesions were most pronounced in the mesencephalon, especially in the substantia niger, The cells were reduced to a small fraction of their normal number and those remaining were without exception chromolytic. The pigment in the cells seemed to be increased, but this was attributed to shrinking of the cells which were smaller than those in a normal brain. The axis cylinders were markedly decreased in number. Considerable free pigment was scattered about and could be traced as far as the perivascular spaces. There was marked increase of glia cells and perivascular infiltration with round cells. Sections of the pons and medulla showed minimal changes.

Foix [48] reports a case in which the lesions were most marked in the substantia nigra, consisting in atrophy of the cells with disintegration of the pigment, this process proceeding in islets and finally resulting in cicatrization. In other cases of idiopathic Paralysis Agitans which he has examined, changes were most marked in the locus niger and globus pallidus, although slightly predominating in the former.

Francais and Lhermitte [49] report the autopsy findings in a male aged 57, who had an attack of encephalitis lethargica in January 1921; Paralysis Agitans followed in March 1921.

The patient committed suicide in September of the same year. Macroscopically de-pigmentation of the locus niger was noted. The cells of the locus niger were much reduced in number, the remaining cells were distorted and de-pigmented, In certain parts there was no trace either of cells or of myelinated fibres, There was marked neuroglial overgrowth. The vessels of the locus niger showed perivascular infiltration with lymphocytes and plasma cells. The large motor cells of the Corpus Striatum were reduced in number and the remainder showed chromatolytic changes. There was considerable neuroglial overgrowth and perivascular infiltration. The small motor cells in the putamen and caudate nucleus were less affected. Lhermitte, in accordance with his pathological findings in cases of idiopathic Paralysis Agitans concludes that the condition in this case was due to lesions in the pallidal system.

Mlle. G. Lèvy (54) described the pathological changes in four cases of Paralysis Agitans following Encephalitis Lethargica. She lays stress on perivascular disintegration in the basal ganglia producing changes resembling l'état criblé and pre-criblé of Vogt. (Precisely similar conditions to those depicted in her book were seen in my two cases and also in the normal brain which was used as a control, and they seem to be of the nature of artefacts.) Degeneration of fibres in the ansa lenticularis and in the internal capsule, changes in the corpus Luysii, red nucleus and fields of Forel were also present.

The locus niger in every case showed de-pigmentation. The lesions in the mid-brain were subacute. There was degeneration in the antero-lateral columns of the cord. She concludes from the widespread nature of the process in her cases that no conclusions can be drawn as to the pathogeny of Paralysis Agitans.

Goldstein (50) describes a case in which the changes in the substantia nigra were the most prominent feature, and his article is illustrated with excellent micro-photographs.

The following are the only two cases as yet in which the opportunity has occurred for pathological study.

Case No. 13, a male, aged 41, came under observation in September 1922 with well marked Paralysis Agitans. His wife stated that he had been quite well until an acute illness in May 1921, characterised by double vision and marked sleeplessness. For more than a week he slept day and night and had great difficulty in swallowing. He was acutely ill for four weeks; it was then noticed that he was stiff and had considerable difficulty in moving. He improved but was troubled with drowsiness for some months. The rigidity gradually became worse so that feeding or dressing himself was impossible.

Examination in September 1922, showed a very marked condition of Paralysis Agitans. It was impossible to understand his speech owing to the feeble voice; he was unable to dress and feed himself, and could scarcely move in bed; the head was

slightly retroflexed, the mouth open; sialorrhœa was marked; his eyes had a staring expression; pupils were regular in outline, equal and centrally placed. Both reacted promptly to light and accommodation. The ocular movements were full and carried out nearly as promptly as in a normal person. There were a few initial nystagmoid movements in the extreme lateral positions; convergence was normal. The fundi were normal. Voluntary movements of the facial and jaw muscles were carried out feebly and slowly. There was slight weakness of the right lower face which was apparent only on voluntary movement, as in showing the teeth . The tongue was protruded with difficulty and was flabby and tremulous. The palate moved somewhat feebly on phonation. There was considerable difficulty in swallowing. The muscles of the neck were hypertonic, and there was loss of associated head and eye movements. The posture of the arms was typical of that of paralysis agitans, especially as regards the hands. The tone was considerably increased in all muscle groups, and the cogwheel phenomenon was well marked. All movements were carried out slowly and with difficulty. The reflexes were brisk and equal. At times there was a very slow rhythmical tremor of the true paralysis agitans type in both hands, the chief movement being one of alternating flexion and extension of the fingers. The rate of the tremor was 4 to the second. The tremor was observed only when the limbs were at

rest and was never observed during voluntary movement. The musculature of the abdomen was hypertonic; the reflexes being excessively brisk. The posture of the legs was one of extension at the knees with the toes pointed downwards and the feet inverted; as in the arms there was moderate loss of power; the tone was markedly increased in all muscle groups but predominated in the post-tibial group of muscles and in the extensors of the knee. The deep reflexes were brisk and equal; there was no ankle clonus; the right plantar showed a doubtful extensor response, while the left was normal in type. There was no disturbance of sensation in the arms, trunk or legs.

Progress. The patient improved with hyoscine, his speech became clearer and he was able to turn more easily in bed. On the 26th September there was a rise in temperature with an accompanying rise in the respiration and pulse rate. The pyrexia became progressively more marked and on the day of his death - the 29th - the temperature was 104.6, respiration 60, and pulse 150. There was no evidence clinically of pulmonary implication. (Mlle. G. Lévy [54] describes a very similar termination in the severe form ("Cachectisante") of Paralysis Agitans.) An autopsy was performed ten hours after death. No abnormality was noted in the meninges; the brain and spinal cord were hardened in 10 per cent. formalin saline for 14 days. A series of six horizontal sections was made through the basal

ganglia, the thickness of each section being approximately 4 millimetres. A portion of the tissue, including the basal ganglia, was taken from each slab and numbered; those from one-half of the brain being treated by the Weigert-Pal method and those from the other by hæmotoxylin and Van Giesen. Photographs were taken of each section for reference. The mid-brain was cut in serial section.

The brain from a man aged 40, who died as the result of hæmorrhage following an operation for trigeminal neuralgia was used as a control and was treated in precisely the same manner as the brain under consideration, the levels of the horizontal sections being approximately equal.

Histological findings.

Cortex. Beyond capillary dilatation there was no appreciable deviation from the normal. The cells were normal except for very occasional cytolysis. There was no diminution in the number of cells, nor was perivascular infiltration observed.

Basal Ganglia. It may be said at the outset that no marked pathological changes were found in this region. The cells in the caudate nucleus and putamen were for the most part normal and were not appreciably diminished in number. Cytolysis was occasionally seen, especially in the putamen. Many of the cells stained poorly, were ballooned and had an eccentric nucleus

Capillary dilatation was general. For the most part the vessel walls were normal, except for an occasional increase of cellular elements in the walls. Perivascular infiltration with round cells was not pronounced, but each section showed a few examples of this. There was no appreciable glial cell overgrowth.

Globus Pallidus. Many cells stained palely; chromatin granules were not apparent in the majority of the cells. This absence of chromophylic staining was noticed in all the cells of the basal ganglia and also in the control brain, and probably depended on faulty fixation. The vast majority of the cells were in every respect normal; rarely a cell with a markedly eccentric nucleus and an indefinite outline would be seen. There was no diminution in the number of large motor cells. The cells in ten consecutive fields were counted, and this was also done in sections from the corresponding block of the normal brain. Two different levels were taken, one from the middle of the lenticular nucleus and the other towards its caudal extremity. In each case the count from Case 41 exceeded that from the normal control. The majority of the cells from the globus pallidus, and incidentally those from the thalamus showed a collection of granules which usually occupied half the cell. They stained green with toliudin blue. They were also present in the cells of the control though not to the same extent, and stained yellowish instead of green. They resembled the bodies

described by da Fano and Ingleby [51] except that no halo was seen with the staining used. In sections stained by Scharlach Red they appeared as reddish granules in the cells, which points to the possibility of their being of the nature of lipochromes. The granules also could be seen scattered about in the surrounding tissue and could be traced to perivascular lympathic spaces. Similar appearances, though less marked, were also seen in the normal brain. The vessels of the globus pallidus shared in the general vascular dilatation; occasionally perivascular infiltration with lymphocytes was observed, but this was only slightly more common than in the putamen and caudate nucleus. The walls in many instances showed an increase in the cellular elements.

In the sections stained by hæmotoxyln and Van Giesen, well marked calcareous degeneration in the walls of certain vessels was observed. Such vessels were few in number and were only seen in sections from about the middle of the basal ganglia. Further the affected vessels were situated in the anterior portion of the globus pallidus and were evidently ascending vessels from the anterior perforated spot. In this region the arteries, veins and capillaries were all affected. In the majority of the vessels the deposit was in the inner part of the adventitia or between the adventitia and the media. Hyaline degeneration was evident in the walls of those vessels that were only slightly affected. In some of these the deposit could be seen in the outer part of the adventitia. There was no thrombosis in any

of the affected vessels. In the smaller vessels the cellular element in the vessel walls was increased.

Thalamus.

The cells were not diminished in number. Cytolysis was relatively common, but the cells were for the most part otherwise healthy. Pigmentation granules were present in the majority of the cells. Perivascular infiltration was seen about as frequently as in the corpus pallidus.

Sections from the lower three blocks showed acute changes in the subendymal region of the thalamus and in that portion of the sub-thalamic region which adjoins the third ventricle. These changes consisted of numerous recent hæmorrhages in the perivascular spaces and surrounding tissue. Perivascular infiltration was here more marked than anywhere in the basal ganglia; similar acute changes were also noted in the infundibulum.

Corpus Luys. The cells appeared normal. Sections stained by the method of Weigert-Pal showed no evidence of degeneration in the system of fibres connected with the corpus striatum.

The mid-brain. In this region the changes were distinctly more marked than in the basal ganglia, the greatest incidence of the disease having fallen on the substantia nigra. The pig-

mented cells were reduced to a small fraction of their normal number and their place was taken by scattered particles of pigment which varied considerably in size. The few cells that remained showed various degenerative changes such as an eccentric nucleus, extrusion of the pigment, vacuolisation and loss of the normal processes. Macro- and micro-phages of glial origin were plentiful, and many were packed with pigment. They could be traced to the perivascular spaces and walls of the vessels. In the walls of the larger meningeal veins in the inter-peduncular spaces were seen numerous particles of pigment; these also were evident in the lumen of the vessels, usually in the interior of the macrophages. In similar veins in the control brain, pigment was also evident, but was very much smaller in amount as compared with this case. Perivascular infiltration was more prevalent in the mid-brain than in the basal ganglia. A few of the vessels showed hyaline degeneration of the walls.

Numerous recent hæmorrhages, similar to those described above as occurring in the thalamus, were present, especially in the ventral half of the mid-brain.

The glia cell overgrowth was not accompanied by a similar increase in the fibres. The cells of the locus cæruleus were not diminished in number, a few were de-pigmented and a large proportion of the cells showed chromolytic changes. The cells

of the 3rd nucleus appeared normal. The smaller cells of the red nucleus were normal except for fairly well marked cytolysis. Some cells of the pars magno-cellularis showed definite changes, such as vacuolisation, and several contained greenish granules of pigment; only a few of the cells appeared healthy. There was no apparent reduction, however, in the number.

Sections from the pons and medulla showed capillary dilatation and very moderate perivascular infiltration. No haemophages were apparent. The cells of the nuclei and the lower cranial nerves were for the most part healthy, although some showed chromolytic changes. Sections from the cervical and dorsal regions of the cord were normal. Weigert-Pal's method in sections from the pons and medulla showed no evidence of tract degeneration.

Case 58. Female, aet. 68, came under observation in February 1923, with a well developed condition of Paralysis Agitans.

She stated she had been in good health until an attack of 'influenza', about January 1920. This illness was characterised by headache, pains all over, and marked sleeplessness. She also noticed that on looking at anything close, such as on reading, that the letters ran together; she had never previously been troubled in this way. She gradually improved and at the

end of a month was able to get up, but'she had never felt the same since'. A few months later she noticed that she could not move her arms so quickly as formerly and that she had a difficulty in getting upstairs. Somewhat later a tremor appeared in the left hand. In January 1921, she suddenly lost the use of both legs. She remained in bed one month and the power in the legs gradually returned. In February 1922 a similar attack occurred, from which she recovered fairly well.

On examination she showed a condition of moderate general rigidity with Parkinsonian facies. Speech was slow and monotonous. Pupils unequal, the left being larger than the right; there was a definite right ptosis; this condition in the right eye was considered to be due to paresis of the right cervical sympathetic. The pupils reacted moderately well to light; there was no reaction on accommodation. Convergence was much limited, otherwise the ocular movements were full.

Jaw and facial movements were feeble and slowly performed. There was slight weakness of the left lower face. The limbs on both sides showed the characteristic rigidity of Paralysis Agitans, but this was much more evident in the limbs on the left side. Power was considerably diminished and movements were performed slowly. There was tremor in both arms, rapid, coarse and exaggerated by movement. The reflexes were more active on the left side, and ankle clonus on this side could be obtained. The left plantar response was indefinite, whilst the

right was probably flexor.

Examination of the heart showed evidence of left-sided enlargement; this was attributed to the general arteriosclerosis which was present (Blood pressure $\frac{240}{140}$.).

A diagnosis of ParalysisAgitans, probably post-encephalitic was made.

Course. The patient improved on hyoscine, but on February 16th suddenly became acutely ill with dyspnœa and pyrexia: the temperature progressively rose and reached 104 on the day of death which occurred on the 3rd day. Despite the tachypnœa, no adequate signs to account for the symptoms could be found in the limbs. The cardiac condition showed no appreciable alteration from that present when she first came under observation.

An autopsy was performed six hours after death. Only the brain was removed. The membranes showed no gross abnormality.

The brain was hardened for ten days in Formalin Saline.

It was then treated in a precisely similar manner to the brain of Case 13.

Pathological examination of this case has not yet been completed, but an examination of some of the sections enable one to briefly state the principal findings:-

(1) Marked general arteriosclerosis;

(2) Perivascular infiltration with round cells, most marked in the basal ganglia and sub-thalamic region.

(3) No appreciable diminution in the number of cells in the globus pallidus, although many showed varying degrees of cytolysis.

(4) Localised calcareous degeneration of certain vessels in the globus pallidus.

(5) Multiple small recent hæmorrhages into perivascular spaces and surrounding tissue; these were most marked in (a) the subendymal region of the thalamus (i.e. that border of the thalamus which adjoins the 3rd ventricle; (b) in the subthalamic region, especially in the corpora mammillaræ and the ~~lutei~~ tuber cinerem.

(6) The substantia nigra appeared normal on both sides, and indeed there were no gross pathological changes to be seen in the mid-brain.

SUMMARY OF PATHOLOGICAL FINDINGS.

(1) In both cases the occurrence of recent hæmorrhages was observed; these were typical of those found in the acute stages of encephalitis lethargica; their occurrence in these two cases, one 18 months and the other 3 years after the acute attack is very striking and indicates ~~the occurrence of a~~ a true relapse. In both these cases the mode of death was similar, i.e. tachypnœa and progressive pyrexia, and this can be attributed to the acute changes found.

(2) In both cases general vascular dilatation was marked and so gave a very characteristic appearance to sections from the basal ganglia and mid-brain.

(3) In Case 13 there were minimal changes in the basal ganglia, consisting of occasional perivascular infiltration and cytolysis; these were scarcely more prominent in the globus pallidus than elsewhere. In Case 58 such changes were rather more pronounced.

(4) In both cases localised calcareous degeneration in a small part of the globus pallidus was observed; no calcified vessels in any other part of the brain were seen.

(5) In Case 13 the most striking pathological condition was the destruction of the cells in the substantia nigra; in

Case 57 the substantia nigra was normal.

(6) In Case 13 perivascular infiltration glial cell proliferation etc. was more marked in the mid-brain than elsewhere: whereas in Case 57, no such changes were evident in this region, but were fairly prominent in the basal ganglia.

CONCLUSIONS.

Of some interest in two cases was the occurrence of localised calcification in certain vessels in the globus pallidus. Such calcification has been previously described by Buzzard and Greenfield (53) and later by Dürch (52). In Greenfield's case that of a young woman who died six months after the original attack, calcareous deposits were found in the vessels of the cortex but especially in those of the basal ganglia; this deposit was most marked in the adventitia.

Dürch examined the brains of 15 cases (ages varied between 20 - 60 years) who had died from epidemic encephalitis at varying stages from eight days to five weeks from the first onset. In 12 of them he found evidence of calcareous deposits and he remarks on the localised nature of this deposit.

Owing to the localised calcification it does not seem possible to attribute the symptom complex of paralysis Agitans to this condition, nor is it peculiar to encephalitis lethargica as I have observed well marked localised calcareous deposits in the globus pallidus from a case of idiopathic Paralysis Agitans. It is evident from the short survey of previously reported cases of autopsy findings in cases of post encephalitic Paralysis Agitans, that in the majority of them destruction of the cells of the substantia nigra was the most prominent feature, as was present to a marked degree in Case 13. In

Case 57, however, the substantia nigra was normal; whilst the globus pallidus and subthalamic region shewed fairly well marked changes. In the idiopathic form of Paralysis Agitans Vogt, Ramsay Hunt and Lhermitte have found maximal changes in the globus pallidus. Tretiakoff on the other hand (Thèse de Paris, 1920, the original of which I have been unable to obtain) describes in 9 cases of the idiopathic form changes in the substantia nigra to which he attributes the condition.

These facts support the view that lesions both of the globus pallidus and the substantia nigra may cause a condition recognisable clinically as Paralysis Agitans. It is probable that this condition, irrespective of its type, may depend on a lesion which is situated as low as the mid-brain and as far cephalad as the globus pallidus.

In conclusion, I am much indebted to the members of the Staff of the Hospital for Epilepsy and Paralysis, Maida Vale, London, for permission to use the Cases under their care, and also to Dr. J. G. Greenfield, Pathologist to the National Hospital for the Paralysed and Epileptic, London, for his invaluable advide, as well as for his kindness in preparing the microphotographs.

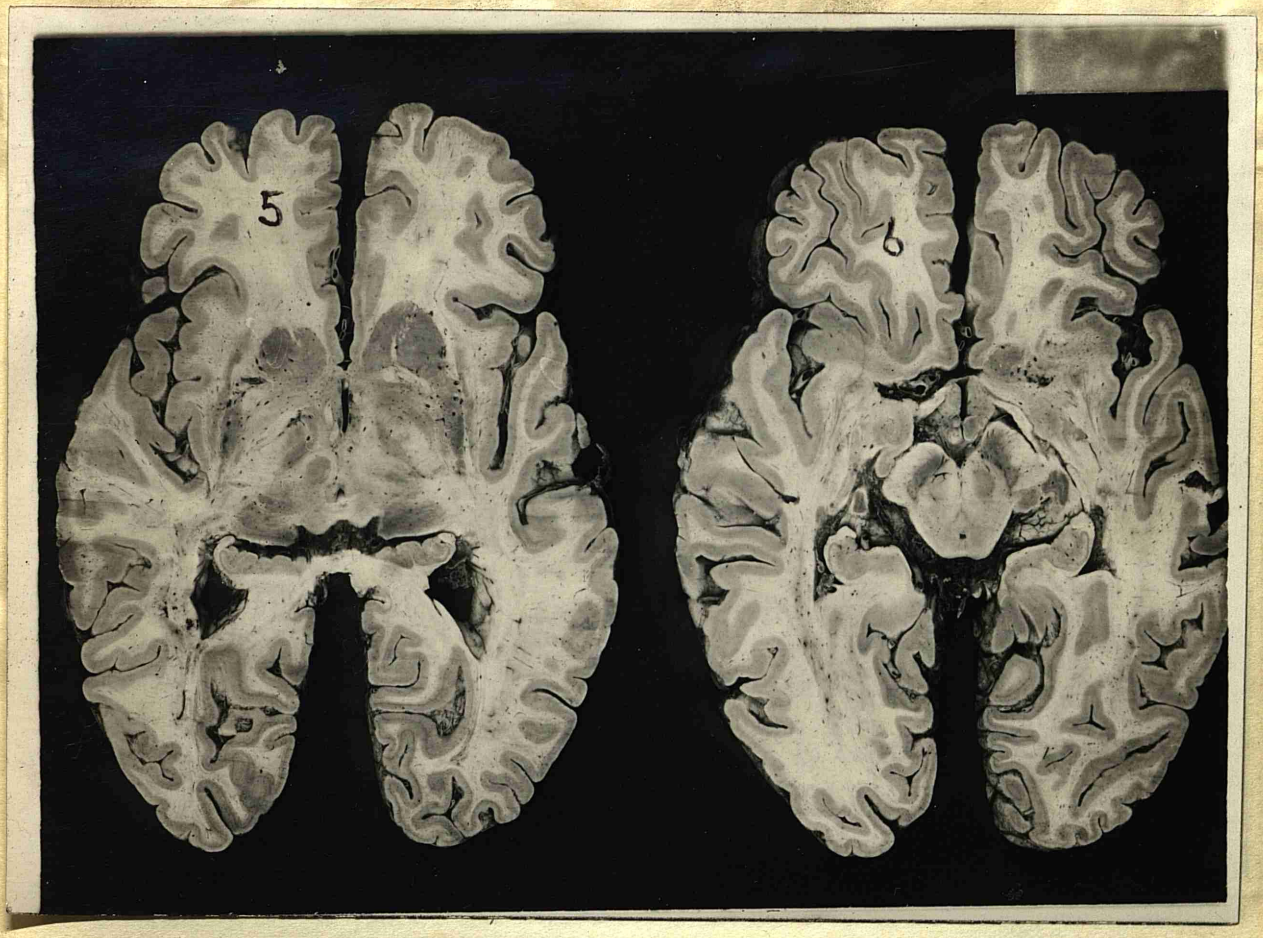


Fig.15. Case 22. Horizontal sections through the hemispheres. The vascular dilatation is evident, most marked in the basal ganglia and mid brain.

Fig. 16. Section of mid brain of normal control stained Nissl's method shewing cells of substantia nigra.

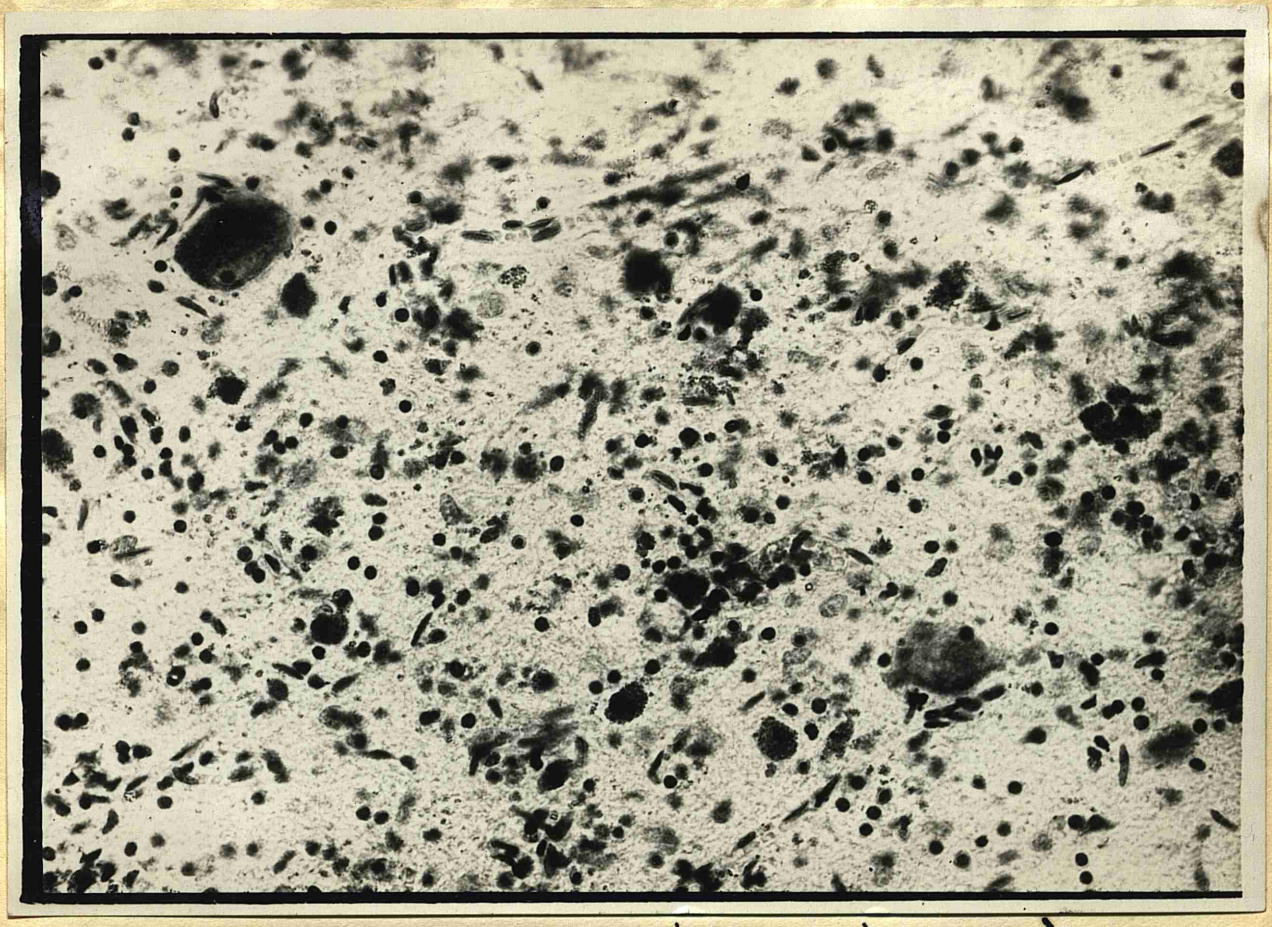


Fig. 17. Case 13. Photomicrograph of substantia nigra from a section stained by Nissl's method. The marked reduction in the pigmented cells is evident. (Compare with previous Fig. same magnification). There is considerable increase in small round cells. The few cells remaining shew cytolysis. A. masses of pigment lying free. B. cell of substantia nigra shewing loss of pigment, 'ballooning', vacuolisation and extension of the nucleus. C. another cell, less affected, though the nucleus is markedly eccentric.

Fig. 18. Case 18. A low power photomicrograph of sections from mid-brain stained Haemoloxylin and Van Creser, shewing perivascular infiltration with round cells and scattered masses of pigment in substantia nigra.

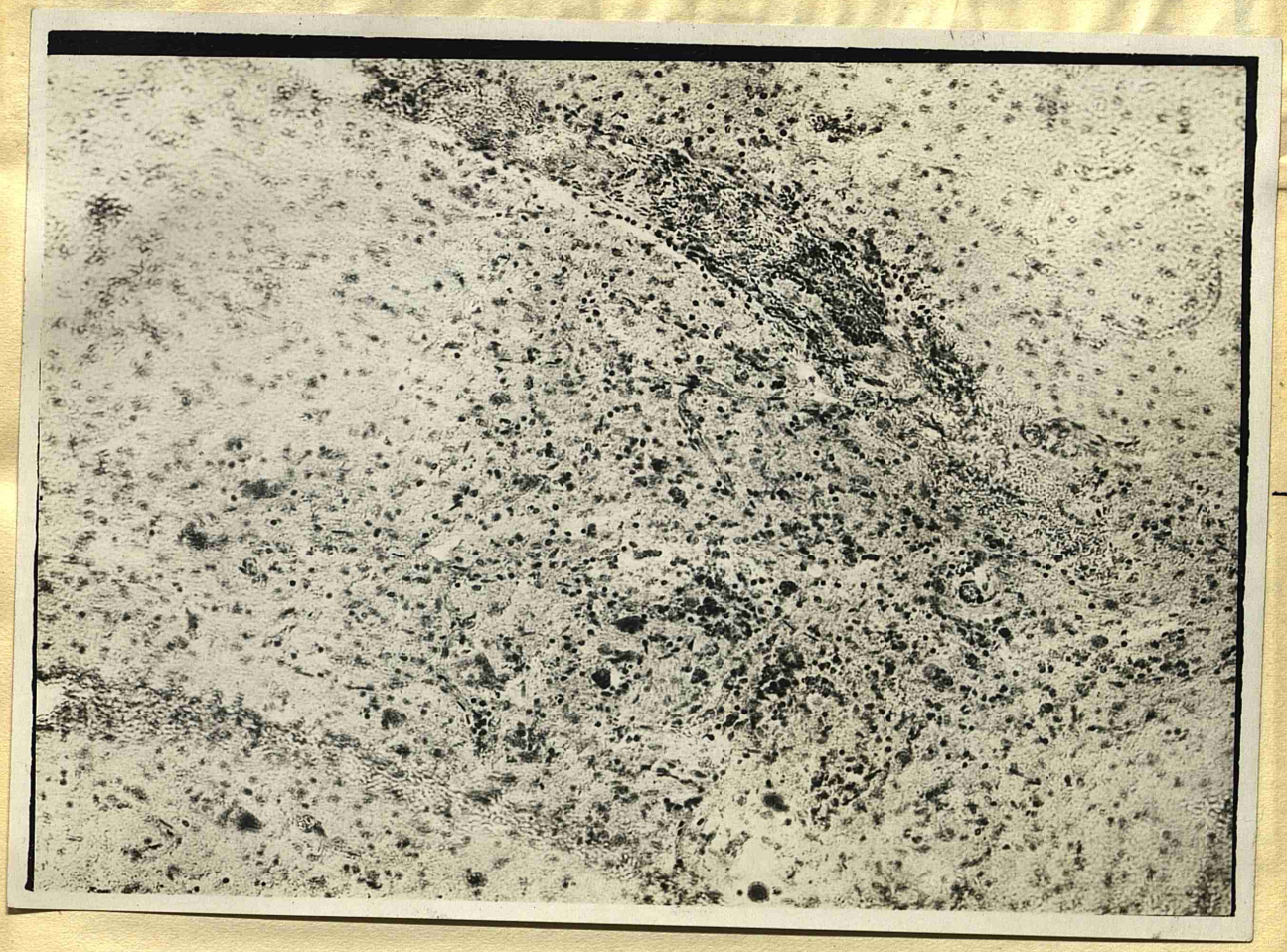


Fig. 19. Case 13. Lower power Photomicrograph of section (stained Hæmoloxylin and Van Cresen) from mid-brain shewing substantia nigra. The scattered masses of pigment and increase of round cells are evident.
A. indicates hæmorrhage into supporting tissue.

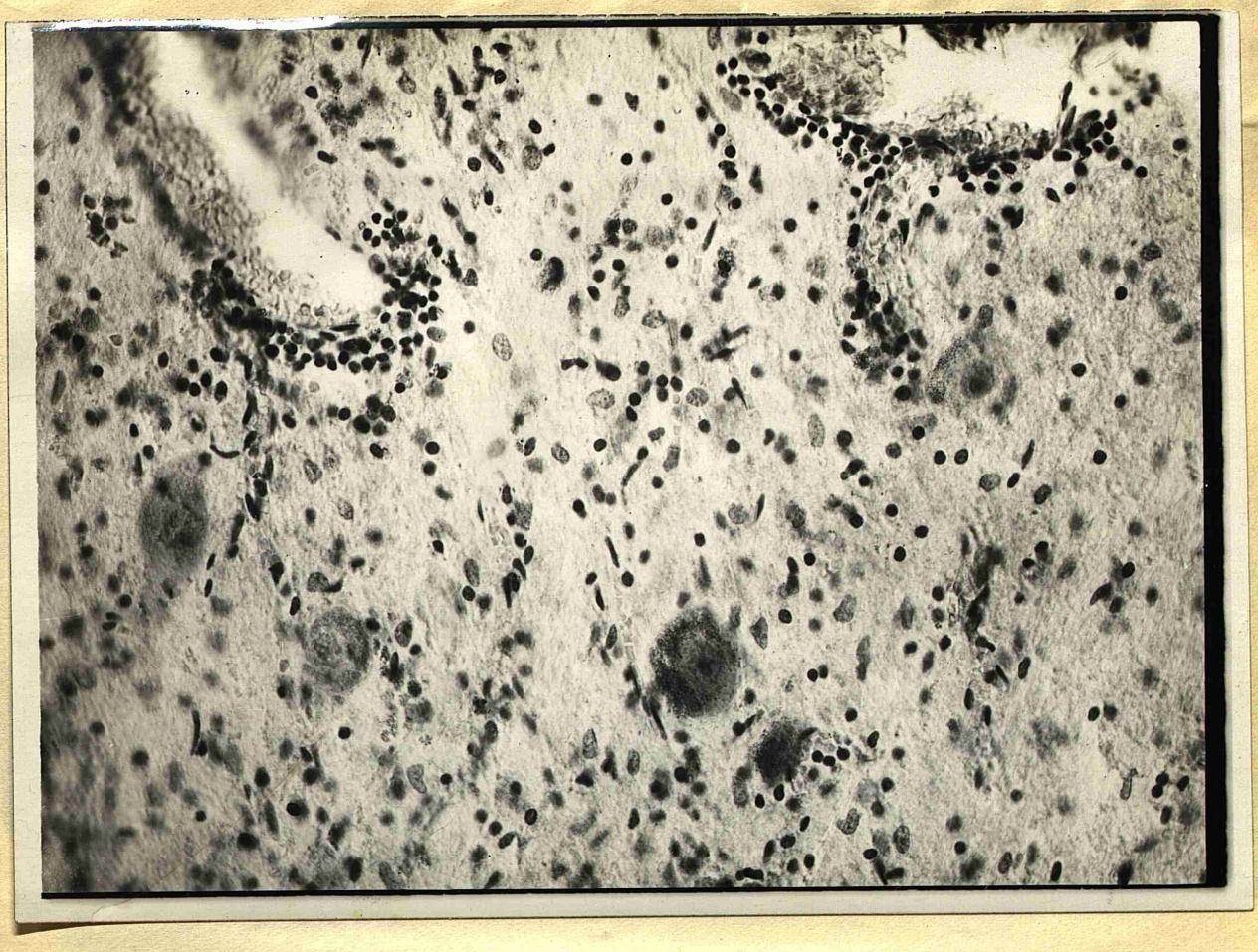


Fig. 20. Case 13. High power magnification shewing perivascular infiltration with round cells and depigmentation and other cytolytic changes in the remaining cells of the substantia nigra. It was unusual to find so many cells in a field of this proportion.

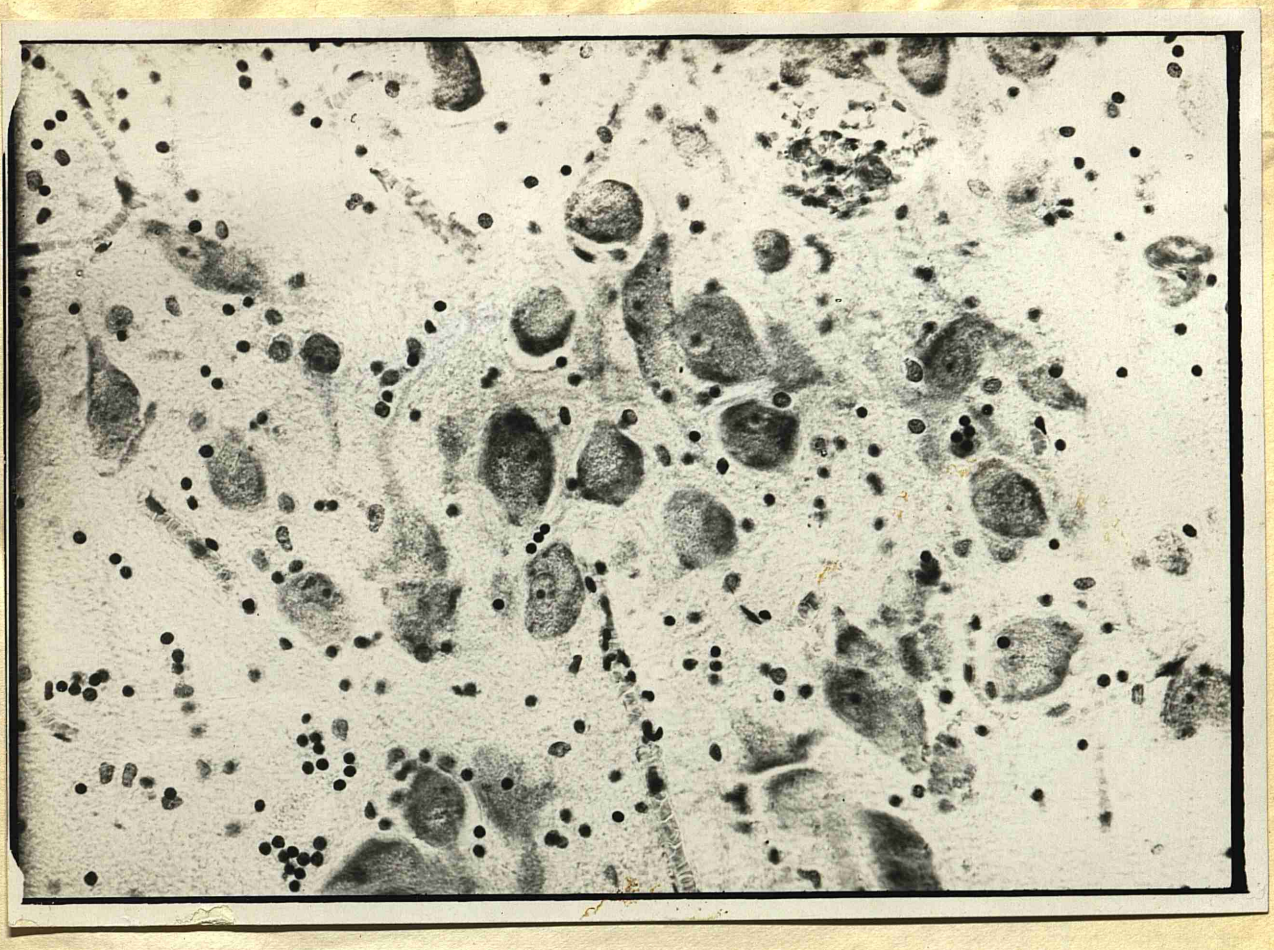


Fig. 21. Case 13. Micrograph of section from globus pallidus. Apart from pigmentation, and an occasional example of satellitosis, the cells appear normal.

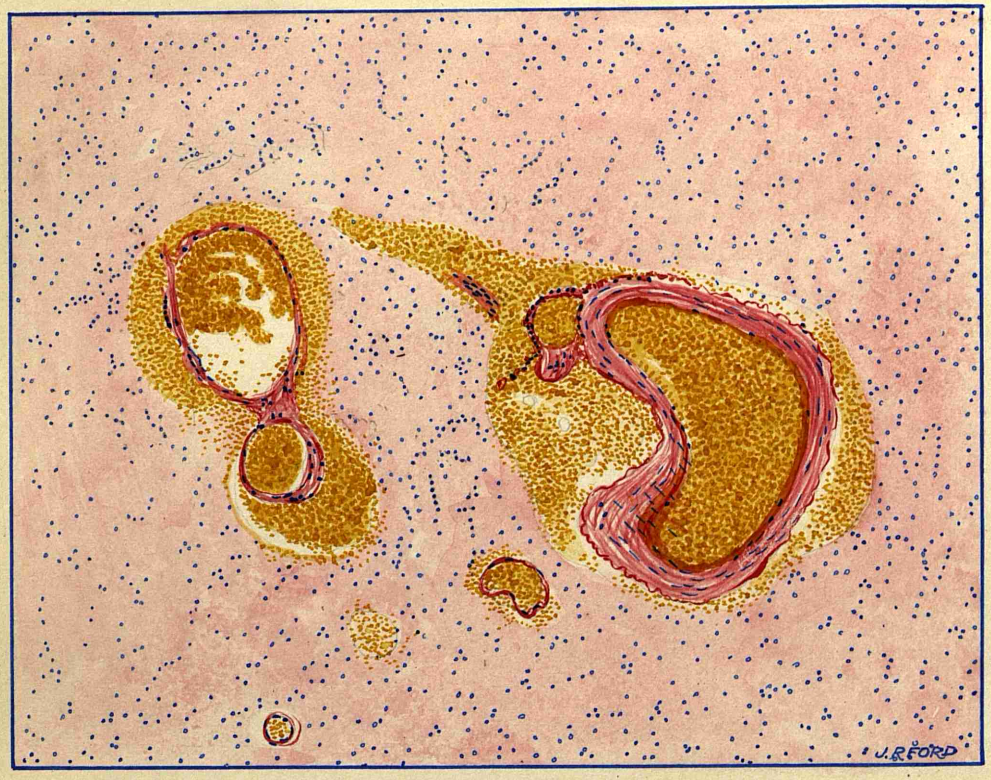


Plate i. Case 13. Camera Lucida drawing of a section from subendrymal region of thalamus. stained by haemoloxylin and Van Cresen. Hæmorrhages into perivascular space of this are well seen, identical with the changes found in acute cases of Encephalitis Lethargica. Similar changes of an acute nature were found in sections from the mid-brain in this case.

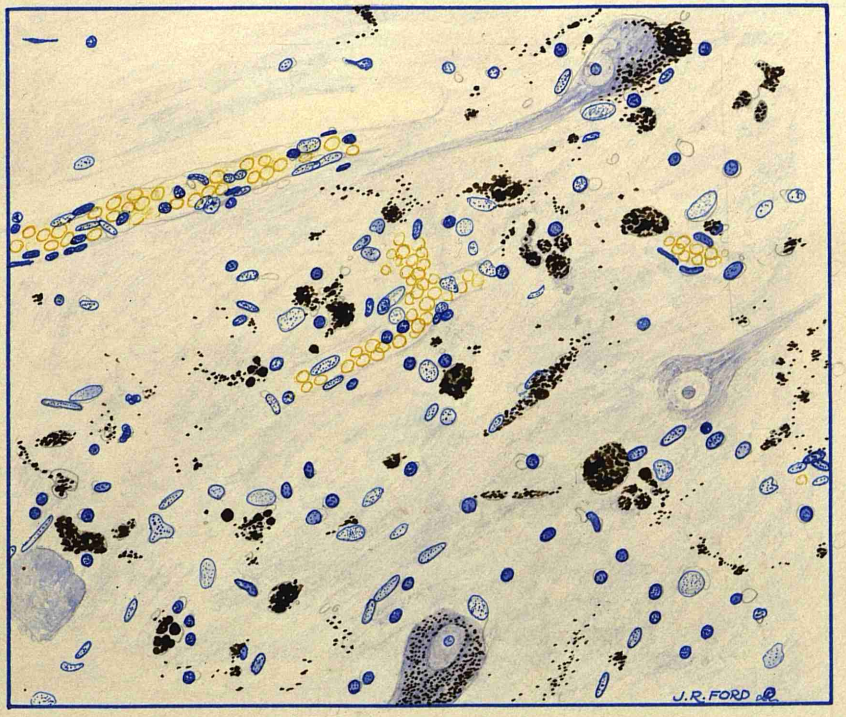


Plate ii. Case 13. Camera Lucida drawing from a section from mid brain stained by Nissl's method shewing similar changes in substantia nigra to those depicted in Fig. 17, i.e. poverty of cells and masses of scattered pigment.

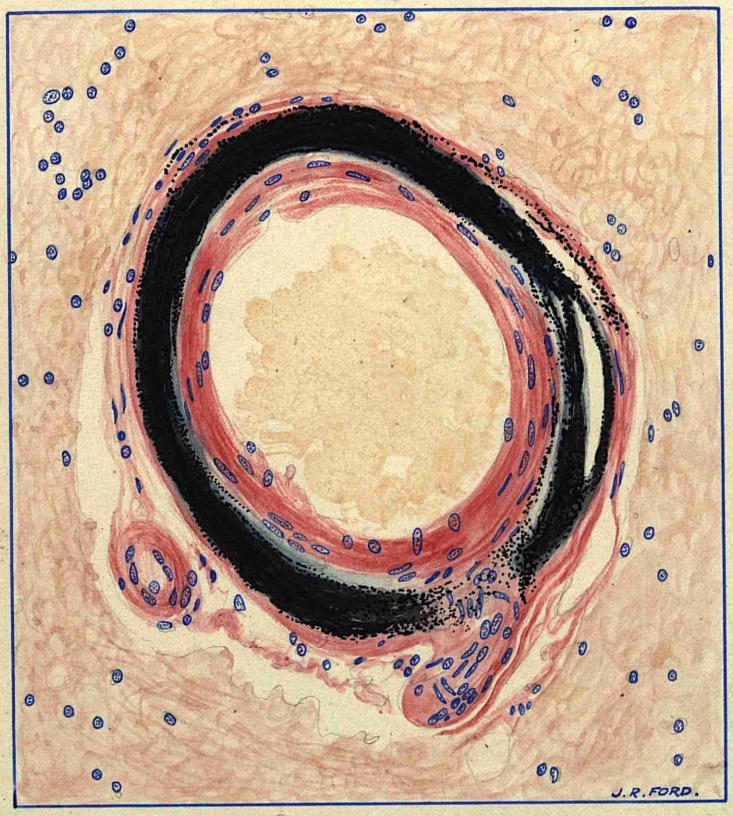
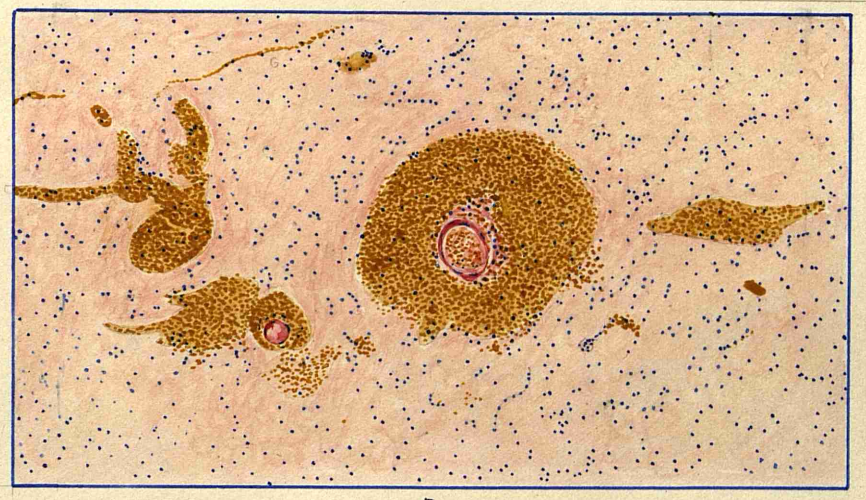
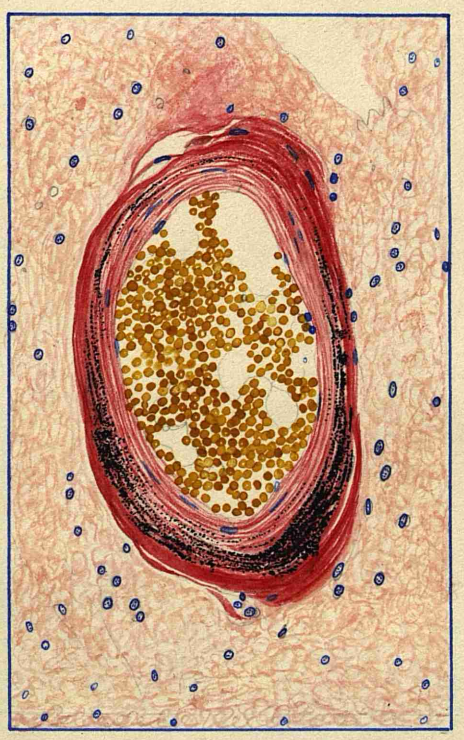


Plate iii. Case 13. Camera lucida drawing of section from Globus Pallidus stained Haemotoxylin and Van Giesen. shewing calcification of vessels.

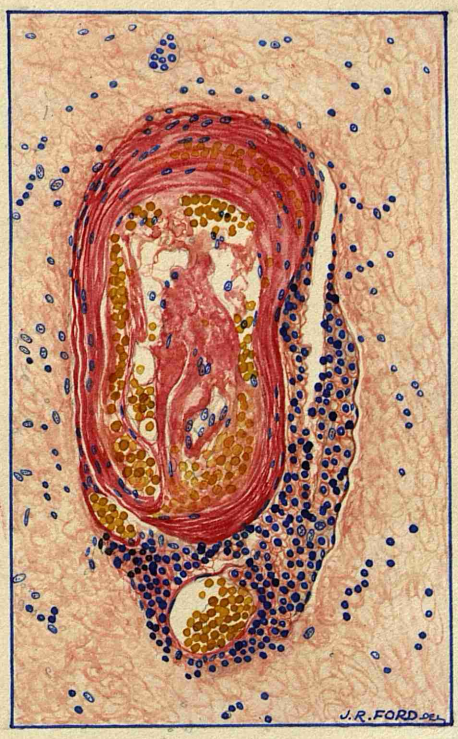
Plate iv. Case 58. Camera lucida drawings of sections from the second case. A. Shews perivascular infiltration with round cells in a section from the globus pallidus. B. Shews hæmorrhages into perivascular space and surrounding tissue in subendymal region of thalamus. C. Calcification of vessels in the globus pallidus.



B



C



A

TABLE GIVING SUMMARY OF RESULTS IN 60 CASES OF SEQUELAE OF ACUTE EPIDEMIC ENCEPHALITIS.

Case No.	Sex	Age	Date acute attack	Symptoms acute attack	Type at sequel	Interval between acute attacks and sequel.	Period under observation	Course.
1	M	23	Aug. 1920	insomnia diplopia lethargy.	P.A.	4 months	Dec:21 Feb:22.	Stationary
2	F	37	June 1920	Pains Restlessness and diplopia.	P.A.	4-5 months	June;22 Jan:23	Stationary
3	F	29	April 1918	Insomnia headache Pains in neck myoclonus.	unilateral P.A. + hemiplegia (rt.)	3 months	Oct-Dec. 22.	Progressive.
4	M	35	Jan 1920.	Lethargy Paresis accomod:	P.A.	1-2 months	Jan-Dec 1922.	Progressive
5	F	43	July 1920.	Nausea Vomiting Dizziness Insomnia Paresis accomod:	P.A.	none	Aug:22 Jan:23	Stationary.
6	M	28	March 1920	Headache rt.facial paresis insomnia delirium lethargy.	P.A. acromegaly melanotic sarcomotosis.	8-9 months	May:22 Dec:22	Died Dec. 1922.

Case No.	Sex	Age	Date acute attack	Symptoms acute attack.	Type at sequel	Interval between acute attacks and sequel.	Period under observation.	Course.
7	F	40	April 1918	Insomnia headache Pain left shoulder.	P.A.	4 months	Jan: July: 22.	Progressive
8	F	27	Aug: 1920	Dizziness headache, insomnia diplopia facial paresis.	P.A.	18 months	July 21 Oct: 22.	Progressive.
9	F	31	Feb: 1918	Tachycardia, Tachypnœa, diplopia, insomnia, lethargy.	P.A.	3-4 months	Jan:22 March 23.	Progressive.
10	F	20	March 1918	Headache, giddiness, diplopia, 'blindness', Lethargy.	P.A.	None.	Jan:20 Feb:21	Progressive.
11	F	19	Aug: 1920	Diplopia Lethargy.	P.A.	6 months	Aug- Nov: 21.	Stationary.
12	F	38	Oct: 1918	Headache Severe general pains.	P.A. Epilepsy Psychosis	none	March- May.20.	Progressive (asylum).
13	M	41	May 1921	Diplopia dysphagia Lethargy	P.A.	none	Sept: 22.	Died Sept: 1922.
14	M	36	Aug: 1921	Delirium paresis accomod: myoclonus lethargy.	P.A.	5 months	July- Nov: 22.	Progressive.

Case No.	Sex	Age	Date acute attack	Symptoms acute attack	Type of sequel	Interval between acute attacks and sequel	Period under observation.	Course.
15	M	17	Dec: 1919	Pains in back. headache Diplopia Lethargy.	P.A. Pulmonary tuberculosis.	None	April-Sept. 22.	Stationary.
16	F	17	Dec: 1920	Pain in face, Restlessness, insomnia, ptosis, lethargy.	Unilateral P.A.	9 months	Jan: 21 Oct:22.	Progressive.
17	F	25	March 1920	Headache insomnia, restlessness, diplopia lethargy.	P.A. Epilepsy (Aug.22)	1-2 months	Jan:21 Oct:22	Progressive.
18	F	60	Dec: 1920	Insomnia, restlessness, lethargy.	P.A.	2-3 months	May 22-Feb:23.	Progressive.
19	M	11	July 1920	Diplopia Lethargy.	P.A. Epilepsy.	None	April-Sept:22.	Progressive.
20	M	42	March 1920	Headache, nervousness, insomnia.	P.A.	8 months.	Sept:21 June 22	Progressive.
21.	F	44	March 1922	Pain in neck, depression restlessness insomnia.	P.A.	None.	June.22 March 23.	Stationary.

Case No.	Sex	Age	Date acute attack.	Symptoms acute attack.	Type of sequel.	Interval between acute attacks and sequel.	Period under observation.	Course.
22	F	20	April 1919.	Diplopia delirium Lethargy Rt. hemiplegia.	unilateral P.A. (L) Hemiplegia rt (R).	none or? 1-2 months	Nov:22- March 23.	Stationary.
23	F	61	July 1920	Vertigo trembling	P.A.	none	July 21 Feb:23.	Progressive
24	M	18	Sept: 1920	Headache diplopia lethargy.	P.A. Psychosis	4 months	June 21 May 22	Died June 22.
25	M	12	Dec: 1919	Diplopia chorea delirium lethargy.	Unilateral P.A. with contractures.	3 months	Nov:22 March23	Progressive.
26	M	21	Dec: 1920	Paresis accomod: Insomnia lethargy.	Unilateral P.A. + hemiplegia	14 months.	Dec:22 Feb:23	Stationary.
27	F	16	March 1920	Headache, Vomiting, Insomnia, Delirium myoclonus.	Unilateral P.A.+ hemiplegia.	18 months.	Nov: 22 Jan:23	Stationary
28	F	44	Nov: 1918	Headache, Pains in chest. Paresis accomddation, lethargy.	P.A.	3 years and 9 months	Dec:22 Jan:23	Progressive.
29	F	14	June 1920	Headache insomnia, diplopia, lethargy.	P.A. + double pyramidal involvments.	2-3 months.	Aug 22 Nov:22.	Progressive.

Case No.	Sex	Age	Date acute attack.	Symptoms acute attack	Type of sequel	Interval between acute attacks and sequel.	Period under observation.	Course.
30	F	34	Dec: 1919	Headache, nausea, general pains.	Uni- lateral P.A.	1-2 months.	Dec 21. March 23.	Progressive.
31	F	45	Nov: 1921	Irritability tachypnœa paresis accomod: insomnia delirium.	Pseudo Bulbar palsy.	2 months	Sept: - Dec:22	Progressive.
32	F	29	Sept. 1920	Headache Vomiting depression diplopia.	Ocular palsies.	None	Oct:20 Feb:23	Improving.
33	M	36	March or April 1918.	Ptosis Diplopia. muscular twitching	Benedict's syndrome	None	April- August. 1920.	Stationary.
34	F	45	Dec: 1921	Headache pains general diplopia insomnia.	Partial Internal opthalmoplegia.	None.	Feb:- March 1922.	Improving
35	M	52	March 1919	Pain in neck lethargy diplopia chorea.	involuntary movements, head, tongue.	None	Nov:19 Jan;20	Improving.
36	M	48	Dec: 1920	Vertigo squint, left facial paresis.	involuntary movements, left leg: neurosis.	2-3 months	Nov:22 Feb:23	Improving.

Case No.	Sex	Age	Date acute attack.	Symptoms acute attack.	Type of sequel.	Interval between acute attacks and sequel.	Period under observation.	Course
37	F	34	Dec: 1920	Insomnia, diplopia, lethargy.	involuntary movements face and all four limbs.	None	Dec: 20 March 23	Improving.
38	M	15	Jan: 1921	Chorea, insomnia, diplopia, delirium, lethargy.	P.A.	5 months	June 22	Stationary.
39	F	16	June 1920	diplopia lethargy	Unilateral P.A. change in character.	1-2 months	Nov: 22	stationary.
40	M	9	Dec: 1920.	Epigastric pain, muscular twitchings Lethargy.	Change in character.	3-4 months.	Oct;22 Feb;23	Improving.
41	F	16	Nov: 1919	Diplopia lethargy.	Change in character.	2-3 months	Jan: Feb:22	Stationary
42	F	12	June 1920	Diplopia Lethargy.	Change in character	1-2 months	June 20 Nov:22	Stationary.
43	F	16	March 1919	Headache, diplopia, delirium, lethargy.	Neurosis	None	Feb-April 1922.	Improving.
44	M	17	Nov: 1919	Delirium, incontinence, Lethargy.	Neurosis.	None	May:22 Feb:23	Improving.

Case No.	Sex	Age	Date acute attack	Symptoms acute attack.	Type of sequel	Interval between acute attacks and sequel.	Period under observation.	Course.
45	M	31	June 1917	Pains, lethargy, paresis accomod: twitching face and limbs.	Epilepsy + change in character.	None	Nov:21 July 22	Stationary.
46	F	18	Aug: 1921	Headache, abdominal pains, diplopia, lethargy.	Neurosis	None.	Nov:21 March 23	Improving.
47	M	22	June 1920	Diplopia lethargy.	Neurosis.	None	June 20 Nov:21	Improving.
48	M	19	Jan: 1919	Delirium insomnia, dysphagia	Dementia præcox.	None	Jan: 1923.	Improving.
49	F	19	Oct: 1922	Pain between shoulder and in limbs. Insomnia paresis rt. arm, myoclonus.	Spinal form.	None	Jan-March 23	Improving.
50	F	15	Aug: 1921.	Headache rt.facial paresis, lethargy.	Rt. facial paresis, (peripheral)	None	Aug:21 Jan:23	Improving.
51	M	51	Dec: 1919.	Pain back of neck, lethargy, paresis accomod:	Involuntary movements face and left arm.	None	June 21 May 22.	Died July 1920.

Case No.	Sex	Age	Date acute attack	Symptoms acute attack.	Type of sequel.	Interval between acute attacks and sequel.	Period under observation.	Course.
52	M	50	April 1919.	Pain rt arm Insomnia.	P.A.	1-2 months	Oct:22 March 23	Progressive.
53	F	28	June 1920	General pains insomnia myoclonus	Adiposity.	12-18 months	June 20 March 23	Stationary.
54	F	32	June 1922	Vertigo, vomiting, diplopia, paresis accomod:	Internal opthalmoplegia.	None	July 22 Feb:23	Improving.
55	M	41	April 1922.	Pains in chest and between shoulders diplopia drowsiness.	Internal opthalmoplegia.	None	June 22 Jan 23	Improving
56	M	65	Aug: 1921	Pain back of neck, general lassitude.	P.A.	5-6 months	Aug: 22 Jan:23.	Stationary.
57	F	63	Aug: 1922.	Insomnia, delirium, headache, paresis accomod:	P.A. + dementia	None	July 22 Feb:23	Progressive.
58	F	68	March 1919.	General pains headache, insomnia, paresis accomod:	P.A.	2-3 months	Jan:- Feb:23	Died. Feb: 23.

ase No.	Sex	Age	Date acute attack.	Symptoms acute attack.	Type of sequel.	Interval between acute attacks and sequel.	Periodunder observation.	Course
59	M	45	Spring of 1918	Difficulty in speaking and swallowing great weakness in limbs.	Bulbar type.	None	Jan:- Feb:23	Progressive.
60	F	54	Dec: 1920	Pains diplopia diarrhoea.	P.A.	None	May- Sept:22.	Stationary.

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