A CONTRIBUTION
TO THE
PATHOLOGY OF THE PONS VAROLII.

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Received April 22nd—Read May 14th, 1861.

As the following cases illustrate, to some degree, the physiology and pathology of the pons Varolii, their communication may not be altogether without interest. In two of them the focus of the disease was for some time small and circumscribed; there was no complication with affections of other portions of the cerebrum, nor was there any disturbance in the encephalic circulation. These two cases exhibited, therefore, if I may use the expression, experiments performed by nature with greater accuracy than we shall ever be able to practise in vivisections.

CASE 1.—*Summary*.—A tuberculous subject had first vertigo, then motor paralysis in the limbs of the right side, afterwards anæsthesia in the left side of the face; later, also diminished sensation in the limbs of the right, and diminished motion in those of the left side; contraction of both pupils, especially the right; eighteen hours before death

attack of convulsions, followed by loss of power of articulation and deglutition, perfect motor paralysis and anæsthesia in limbs of right, imperfect in those of left side; without loss of consciousness. Tubercle in left half of pons Varolii, with softening in circumference, and hæmorrhage in the latter.

P. S—, æt. 25, a journeyman baker, has been affected with tubercles of the lungs, probably since 1848; has been an in-patient of the German Hospital in 1852, when he suffered from hæmoptysis, with signs of tubercular deposit in the right apex. In the same year patient had typhoid fever. In 1853 he enjoyed good health, with the exception of a moderate cough, which never prevented him from working. In February, 1854, he felt repeatedly giddy, the right arm became weaker, and later, also the right leg, but not to the same degree as the arm, the cough and general health remaining unchanged.

On May 15th, 1854, I found patient in the following condition:—he is of middle stature, moderate muscular development; scarcely emaciated; feels himself well with the exception of the weakness in the right side; cough not troublesome, although the physical phenomena of pulmonary phthisis are quite distinct, especially in the upper portion of the right lung; the urine contains no albumen; the right arm is much weaker than the left, but not completely paralysed; the muscles are thinner than those of the left arm, rather flaccid; the right leg is likewise weaker than the left, but the difference is not so great; patient is able to walk without a stick; sensibility unchanged; intellectual faculties unimpaired; there is occasional vertigo, especially through sudden change of position.

Five grains of iodide of potassium were ordered three times a day.

June 10th.—General health unchanged; pulse 80 to 90, regular; paralysis in right arm and leg increased; sensibility unchanged; right side of face unaffected, as well with regard to motion as to sensation; left half of face rather

numb ; feels the points of the compass less distinctly on that side than on the corresponding places of the right ; vertigo more troublesome, frequently brought on by cough ; senses unchanged, but both pupils rather narrow, right more so than left.

The doses of iodide of potassium to be increased to six grains. Half an ounce of *Oleum Morrhuæ* twice a day.

30th.—General health and spirits so good that patient contemplates an early return to Germany. Paralysis of right arm and leg slightly increased ; right arm perceptibly thinner than left, flaccid ; difference in nutrition of lower limbs less marked ; numbness of left side of face increased ; sensibility of inner side of left cheek, of gums of left side, and of left half of tongue, diminished (tested by compasses, caustic ammonia, galvanism, and various degrees of temperature, viz., pieces of steel previously dipped alternately in rather hot and in iced water). Taste on both halves of the tongue equal ; hearing on both sides the same ; conjunctiva of left eye injected, with increased secretion in the morning ; sight good ; pupil as above.

July 10th.—Two days ago patient exerted himself much by walking, afterwards took some spirits, became soon intoxicated, although, as he says, he had taken only a small quantity of spirits compared with former times ; while drunk, he had a fall in the street, and was carried home, but was never quite unconscious. At present he looks weaker, and is much depressed in spirits ; has no pyrexia ; skin is cool ; pulse 95 to 98, weak, regular ; appetite less good ; bowels moved only through aperient medicines (*pilul. Rhei co.*) ; cough increased, disturbs sleep ; urine free from albumen and sugar. Paralysis of right arm and leg increased ; mastication impaired ; bites less hard on left side than on right ; tongue protruded in middle line ; anæsthesia in left side of face augmented ; feeling in right arm and leg less distinct than in left ; redness of conjunctiva of left eye rather increased ; pupils narrow, especially that of right eye—do not dilate completely under the influence of want of light.

The eighth of a grain of *Morphiæ Acetas* was ordered to be taken three times a day. Omit other medicines.

15th.—Right arm and leg almost motionless, bent, rather rigid; increased weakness in left arm; mastication and deglutition difficult; feeling of numbness in right hand and foot; sensibility decidedly decreased, shown by compasses; redness of left eye more apparent; eyelids rather swollen, sticking together in the morning.

21st.—Expression of great anxiety in countenance; cough much diminished; pulse 110 to 112, very feeble; temperature scarcely altered; limbs of right side more contracted; left arm weaker than before; left leg, too, is weaker; deglutition of solids difficult; articulation rather indistinct; both pupils are narrow, and dilate only slightly under the influence of darkness.

14th.—While sitting up, patient was suddenly seized with vertigo and general convulsions. After a few minutes he seemed to have regained his consciousness, and to recognise those around him. An hour and a half after this paroxysm he was found by myself in the following condition:

Posture, on back, with expression of great anxiety; when asked how he feels, he answers only by moaning. Pulse 140, very feeble. Limbs of right side in state of flexion, rigid, perfectly motionless; those of left side scarcely ever, and then only slightly, moved. Articulation destroyed; the only sounds produced consist in a more or less loud moaning or screaming. When asked to show the tongue, patient only opens the mouth. Deglutition very defective. When any fluid is offered to drink, the countenance assumes an expression of horror, and patient screams in a pitiful manner; the attempt to swallow a few drops of wine causes a most distressing fit of coughing. When the right foot is slightly pinched, no movement takes place; when severely pinched, the great toe moves a little, no alteration whatever taking place in the expression. When the left foot is rather intensely pinched, the toes of the same foot manifest a slight movement, without there being any change in the expression

of the face; but when the left foot is severely pricked, this foot is distinctly drawn away, the face expresses pain, and the patient groans.

Patient is evidently conscious, and knows those around him. The pupils of both eyes are extremely narrow; seeing and hearing are undisturbed.

About twelve hours later dyspnœa and stertorous breathing commenced, and death ensued eighteen hours after the paroxysm of convulsions, patient having exhibited signs of consciousness only a short time before his death.

Post-mortem.—The examination of the head, twenty-eight hours after death, manifests nothing abnormal in the cerebrum and its ventricles. The pons Varolii, inspected from below, appears larger than usual; the left half is rounder and larger than the right; the left trigeminal nerve is about one fourth smaller than the right. A transverse incision into the pons, from the left to the right fifth nerve, exhibits in the lower or anterior¹ part of the left half, close to its periphery, a round, rather hard tumour, of yellowish-white colour, of about half an inch in diameter. The surrounding tissue is in a state of red softening, which extends posteriorly almost to the floor of the fourth ventricle, to the right considerably beyond the middle line, and in the direction from the medulla to the crura cerebri about two lines either way. In the softened tissue there is a recent effusion of blood loosely coagulated, amounting to about as much as finds room in a small hazel-nut. It has forced its way in various directions in the softened tissue, and also between the normal fibres beyond the middle line, viz., into the right half of the pons.

The cerebellum and the medulla oblongata appear normal.

No microscopic examination was performed, as we were not permitted to take away any portion of the body.

The inspection of the chest and abdomen was not allowed.

¹ The expressions "lower" or "anterior" are applied to the portion of the pons corresponding in situation to the anterior portion of the medulla.

Three periods may be distinguished in the history of this case—the first from the beginning of the head symptoms in February until July 8th; the second from that time until July 14th; the third comprising the last eighteen hours before death. The *first* period is characterised by attacks of giddiness, and by motor paralysis in the limbs of the right side, appearing first in the arm, afterwards in the leg; the right side of the face, as also the sensitive functions of the limbs remaining unaffected. The motor paralysis of the right arm and leg was soon followed by anæsthesia of the left side of the face and left half of the tongue, and by a contracted state of the pupils, especially the right. There was scarcely any disturbance of general health. These symptoms we consider as corresponding to the growth of the tubercle in the lower or anterior part of the left half of the pons Varolii, pressing on the peripheric origin of the left quintus. The *second* period exhibits the phenomena of the first in an increased manner; and besides these, contraction and rigidity of the paralysed limbs, as also commencing anæsthesia in the same; further, incipient motor paralysis in the limbs of the right side, and impeded mastication and deglutition. Rapidly increasing softening in the neighbourhood of the tubercle, extending to the tissue of the right half of the pons, and to the upper or posterior¹ layers of the left half, probably represents the anatomical condition of this period. Bodily over-exertion and intemperance seem to have hastened the development of this alteration. The *third* period sets in with a paroxysm of general convulsions, after which the consciousness and the senses of sight and hearing appear unimpaired, while the motor and sensitive paralysis of the limbs is much increased, the reflex function not being quite destroyed. The powers of articulation, deglutition, and protrusion of tongue, are totally lost. Death seems caused by suffocation. Hæmorrhage into the softened tissue, disturbing by pressure also

¹ The term “upper” or “posterior” layers of the pons is applied to those corresponding, in situation, to the posterior portions of the spinal marrow.

the function of the adjacent healthy parts, is the cause of the phenomena of this last period.

CASE 2.—*Summary*.—Boy, æt. 7, affected with chronic hydrocephalus and tuberculosis; six months before death attacks of convulsions in left arm and leg; pain in right side of face; later, motor paralysis in limbs of left side, anæsthesia in right half of face; consciousness undisturbed; contraction of pupils, especially left; paroxysms of general shaking; four weeks before death rigid contraction of paralysed limbs; death under symptoms of tubercular meningitis. Tubercle in right half of pons Varolii, near origin of right quintus, with atrophy of the latter; red softening round tubercle; phenomena of tubercular meningitis.

C. L—, a boy, æt. 7, came, towards the middle of June, 1856, under my treatment at the German Hospital. He belongs to a scrofulous family, and has lost several brothers from “hydrocephalus.” Patient himself has been affected with chronic hydrocephalus from his second year, has often been an out-patient at the hospital, twice with symptoms resembling tubercular meningitis, viz., headache, pyrexia, vomiting, constipation, and irregular and rather slow pulse. He has a large head, with small face, old features, and intelligent expression. Since the beginning of 1856 the child has been affected with occasional feverishness and cough, and has become considerably emaciated, in spite of the use of cod-liver oil. Towards the end of May he has had, for the first time, convulsions in the left arm during about two minutes, without loss of consciousness. A similar attack occurred several times in the course of the following weeks.

On June 12th, patient was ordered to resume the cod-liver oil, which had been left off for some weeks, and to take, in addition, three grains of iodide of potassium three times a day.

June 19th.—Has had five attacks of convulsions in left arm during the last seven days. In the intervals the phe-

nomena of motion and sensation in limbs and face are normal; the pupils are equal, and contract well. Pulse 80 to 85, regular.

July 1st.—Four fits of increased strength and duration, affecting also the left leg, though to a less degree than the arm. The boy cries during the fit, without losing his consciousness; the cause of the crying appears to be not so much pain as fright. Has repeatedly complained of giddiness, while walking. Both pupils are rather narrow. Cough has almost ceased. Bowels rather costive.

15th.—Has had six fits of convulsions in left arm and leg; the left side of face does not participate. Giddiness increased. Frequent pain in right side of face, especially in the lower teeth, sometimes, however, also in the upper ones; a chemist has extracted, without legitimate advice, two sound teeth, no abatement of pain having followed.

August 11th.—Fits more frequent, but less strong; left arm is distinctly thinner and weaker than right; left leg, too, is weaker, but not in the same degree. Pain in right half of face continues, and extends also over forehead. The pain is at times very great, at times almost absent. Cough has disappeared completely. Costiveness continues. Pulse 75 to 82.

September 8th.—Limbs of left side very weak, emaciated, flaccid. Sensation in limbs of both sides equal. The convulsions in left arm and leg are so slight that they resemble a kind of trembling, recurring in attacks. The pain in the right side of face has almost ceased, but the sensation in the same part of the face is perceptibly diminished. Both pupils are narrow, especially the left; they do not sufficiently dilate under the influence of darkness. Consciousness unaffected. Colour of face pale. Pulse 82 to 88, feeble.

A teaspoonful of steel wine with two teaspoonfuls of cod-liver oil was administered twice a day.

October 13th.—Motor paralysis and emaciation of left arm and leg increased; temperature in the same lower than in the limbs of the other side; frequent attacks of trembling

in the paralysed limbs. Patient has had several attacks of shaking of the whole body, lasting about eight or ten minutes, without loss of consciousness. Urine is free from albumen and sugar, often forming sediments of lithates.

November 18th.—Limbs of left side are now completely paralysed and flaccid. Both sides of the face are symmetrical, and move equally. Tongue protruded in middle line. The attacks of shaking are less violent, the paralysed limbs are moved less during the shaking than those of the right side. Sensation in right side of face and right half of tongue decidedly less delicate than in left; taste on both halves of tongue equal; sight and hearing normal; pupils very narrow. Respiration during sleep very irregular; articulation rather indistinct.

December 5th.—Limbs of left side rather rigid, in semi-flexion; voice more thick; occasional difficulty in swallowing. Consciousness undisturbed.

16th.—During the last days great irritability of temper; headache; occasional vomiting; increased constipation, with sunken stomach; pulse 75, not quite regular; pupils narrow, as before.

Four grains of iodide of potassium were now given four times a day. Calomel gr. iss, with jalap gr. vj, at bedtime.

24th.—The child has been in a comatose condition since 22nd; he can be roused for a moment; looks then like one awaking from a dream; occasionally gives a reasonable answer, but immediately falls into his former state of coma, when left to himself. Frequent twitchings of small fascicles of muscles are perceptible to the eye and the touch; pupils larger than before, almost motionless; pulse 62 to 66, unequal in strength and rhythm.

27th.—Has had an attack of general convulsions, more in the right side than in the left; is unconscious; pulse very frequent and feeble; pupils much dilated, without any reaction.

Death on December 31st.

Post-mortem.—Numerous tubercular granulations in pia mater, especially in fossa Sylvii, most abundant along the course of the blood-vessels. The lateral ventricles much enlarged, filled with almost transparent fluid; the walls of the ventricles and the septum softened. The substance of the hemispheres rather soft, otherwise normal; the aquæductus Sylvii enlarged, as also the fourth ventricle and the upper part of the central canal of the spinal marrow. On the upper surface of the cerebellum, in the pia mater, many granulations; the substance of the cerebellum itself normal. The right half of the pons Varolii, viewed from below, is decidedly larger than the left, especially near the peripheric root of the right trigeminus, which nerve itself is considerably thinner than the left. A transverse incision, from the origin of one trigeminus to that of the other, manifests a round tubercle, with a diameter of about half an inch, situated in the lower or anterior portion of the right half, commencing about a line from the lower periphery, near the origin of the right trigeminus. In the circumference of the tubercle the nerve-substance is softened, of a yellowish-red colour; the softening extends from half a line to about a line in the various directions; towards the middle line it does not quite reach the centre. The cut surface of the tubercle is of yellowish-gray colour; the consistence is softer in the centre than in the circumference. The microscopic examination of the tubercle itself manifests the well-known constituents of such growths; that of the surrounding softened tissue exhibits a large number of granule-cells (Körnerzellen), together with broken nerve-fibres, numerous fat-globules of various size, many isolated granules, and amorphous matter. The fibres of the sensitive root of the right quintus appear thinner than those of the left; in many of them rows of granules and minute fat-globules are seen.

The bronchial glands are much enlarged, with scrofulous infiltration. Both lungs contain many isolated tubercles; the pleura and the peritoneal covering of the liver, spleen, and intestinal canal, are studded with tubercular granulations, similar to those in the pia mater.

In this case, again, we may, for the sake of conveniently analysing the phenomena, adopt three periods, viz., the first, from the beginning of the cerebral phenomena in May until to the second half of November; the second, from that time to the middle of December; the third, from that time until death. In the *first* period we remark attacks of convulsions, first in the left arm, then also in the left leg, without loss of consciousness, and without alteration of sensation in the limbs; we, further, find pain in the right side of the face, of varying intensity; occasional giddiness; contraction of pupils, especially the left; wasting of limbs of left side; paroxysms of general shaking. The anatomical alteration existing and developing itself during this period was the small tubercle in the right half of the pons, near the root of the right trigeminus. In the *second* period we observe, in addition to most of the preceding symptoms, contraction of the paralysed limbs, anæsthesia of the right side of the face, slight difficulty in articulation and deglutition, and irregularity of breathing, principally during sleep. In this period we may suppose the red softening in the circumference of the tubercle to have been developed, together with some degree of atrophy of the right trigeminus. The phenomena of the *third* period are those of the tubercular meningitis, on which we will not now dwell.

In comparing these two cases, in which the anatomical alterations were, to all appearance, in the beginning almost the same, we remark that in both, motor affection, first of the arm, and afterwards also of the leg of the opposite side, together with attacks of vertigo, were the first phenomena to attract our attention; in both cases the sensibility of the affected limbs remained for a long period unchanged, and the side of the face opposite to the lesion was altogether unaffected; in both cases contraction of the pupils of either side, especially of the opposite, was an early phenomenon; in both sensitive affection of the corresponding half of the face and mucous membrane of the mouth and tongue; in both, at a later period, wasting of the paralysed limbs, and still later, rigidity of the same, impaired articulation, deglutition, and

respiration. The intellectual functions and those of the special senses appeared throughout uninfluenced. Striking, but probably not essential, differences were, in the commencement, the convulsions in the opposite arm and leg, preceding the paralysis in the second case; the pain in the corresponding side of the face preceding the anæsthesia, and later, the paroxysms of trembling in the affected limbs, and of general, rather violent, shaking. In the first case we have, during the second period, anæsthesia coming on in the limbs of the opposite side, and incipient paralysis in those of the corresponding side, while these conditions are absent in the second case. The symptoms of both cases were very different in the last period, but this requires no explanation, considering the palpable differences in the anatomical conditions.

Much might be said with regard to the conditions causing the appearance of certain symptoms in one case which are absent in another, in spite of the similarity of the anatomical alterations; but we will, at present, refrain from such surmises, mentioning only that we cannot consider those symptoms which were present during the first period (tubercle, without softening in circumference) only in one of the two cases as necessary effects of the local alteration in all cases, but must ascribe them to a peculiar disposition in the case in which they occur. We often see in brain diseases, and in affections of the nervous system in general, that the seat of the organic lesion is not the seat of the functional disturbance, and that the same organic lesion may, according to individual differences of disposition, cause disturbance in different portions of the nervous centre, and thus cause different symptoms in different cases. Lesions of different nature, and situated in different localities, may, on the other side, cause functional disturbance of the same portions of the brain, and thus produce the same symptoms. The fits of shaking, for instance, were certainly not necessarily due to the anatomical alteration of one side of the pons, as they were absent in the first case and in many others of similar nature; they are occasionally present, on the

contrary, in diseases of the cerebellum without any alteration in the pons Varolii.

Respecting the differences in the second period, we may, with good reason, explain some of them by the anatomical conditions. Thus, in the first case, the softening extended to the upper or posterior part of the pons; in the second, scarcely beyond the middle of its antero-posterior diameter; in the first case we have anæsthesia of the limbs of the opposite side, in the second sensation remained unimpaired. In the first case the softening extended beyond the middle line into the other half of the pons, in the second it did not reach the middle line; in the former we have, towards the end, incipient paralysis of limbs of the side of the original disease, in the latter no such phenomenon has been observed.

With regard to the diagnosis, it was in both cases quite possible to arrive, at all events, at an approximative one long before death. The manner in which we argued was this:—the motor paralysis of the limbs of the right side, in Case 1, unattended with any disturbance of the intellect, made the existence of an alteration in or near the left half of the basis of the brain probable; the numbness in the left half of the face appearing soon after the paralysis of the limbs, suggested that the alteration in question was in close connexion with the root of the left quintus; the fact that the second, third, fourth, sixth, and seventh nerves were unaffected, showed that this alteration was of a very limited circumference; the further considerations that the lesion was gradually but slowly increasing, and that it occurred in a tubercular individual, made us surmise that it consisted in a tubercle, either in the substance of the left half of the pons Varolii or in close apposition to it, pressing on the left quintus. The affection of both pupils might have rendered the existence of the tumour within the substance of the pons rather more plausible, but this fact was, at the time, not sufficiently taken into account. The reasoning in the second case was very similar to that in the first.

Among the physiological inferences which may be drawn from these two cases we remark especially—1. That the conducting fibres for the limbs passing through the pons, as well the motor as the sensitive, decussate below the pons. 2. That there are no sensitive fibres for the limbs in the lower or anterior part of the pons. 3. That the upper or posterior part of the pons contains sensitive fibres for the limbs. 4. That the intellectual functions of the brain are independent of the pons Varolii. 5. That the nerves regulating the state of the pupils seem to be in close connexion with the pons Varolii. As well in the two cases just related as also in two others which I have observed, there was a marked contraction of both pupils, and more so on the side opposite to the lesion. 6. Extensive lesion of the pons seems to be associated with disturbance of deglutition, articulation, and also respiration; but it is possible that these phenomena do not depend so much on the alteration in the pons itself as on the influence exercised through it on the adjacent parts of the medulla oblongata.

Several of these inferences are corroborated by the following case, which I attended at the German Hospital, together with Dr. Frommann, the late resident physician, to whom I am indebted for the greater part of the notes.

CASE 3.—*Summary*.—A middle-aged woman was affected fourteen weeks before death, with motor paralysis of left side, with only transitory disturbance of sensation; gradual, but imperfect, recovery during the ten following months. On seventh day before death loss of articulation and deglutition, almost complete paralysis of all the limbs, contraction of pupils; death from the lungs. Remains of hæmorrhage on outer side of right corpus striatum; softening of the centre of the pons.

E. S.—, æt. 49, a married woman, during the last ten years subject to privation and cold, during the last six years

often affected with bronchitis, was in September, 1858, suddenly deprived of the use of the left side of the body, without loss of consciousness ; the left arm and leg were completely motionless and flaccid, the left side of the face nearly so ; the uvula was slightly drawn to the right ; the tongue, when protruded, pointed to the left ; the larynx just appreciably moved to the right ; sensibility in left arm and leg diminished (as tested by Sieveking's æsthesiometer) ; there were some sores, as from rupia, on various parts of the limbs, making us suspect complication with tertiary syphilis, the presence of which was, however, not distinctly proved. Under the influence of rest, nourishing diet, and iodide of potassium, the patient gradually recovered the use of her leg almost completely, that of her arm to a less degree ; the anæsthesia had disappeared already after four or five days, the paralysis of the face and tongue after two or three weeks.

On December 30th, 1858, patient lost, according to the report of the relatives, almost suddenly, the power of speaking and swallowing, and the use of all her limbs. On January 1st, 1859, she was again admitted into the German Hospital, where the following notes were taken. Posture, on back. Expression of face as in pain and alarmed, sometimes to the extreme, especially when she is offered something to drink. The attempt to swallow, even as little as half a teaspoonful of wine or beef-tea, causes the most distressing fits of coughing ; face slightly drawn to the right, but muscles of both sides can be moved ; tongue cannot be protruded ; when asked to show it, patient opens the mouth wide, but the tongue is scarcely seen to move ; power of articulation destroyed, the only sounds uttered consisting in more or less loud moaning ; right arm completely paralysed to motion and sensation ; left arm nearly so, both being flaccid ; the lower limbs can be moved only to a very limited degree ; moderate pricking and pinching of the toes causes a distinct movement of the toes, but does not seem to be perceived by the patient, to judge from the expression of the face ; severe pinching or pricking causes a change in the expression of

the face and moaning, the whole foot, at the same time, being slightly moved away ; both legs are flaccid ; patient is evidently conscious, knows those around her, hears and sees ; both pupils are rather narrow, and do not fully dilate. Urine and stool passed in bed, apparently without being perceived by the patient ; skin rather cool ; pulse 125 to 130, very weak.

On January 5th dyspnœa and irregularity of breathing were first observed, followed, after some hours, by stertorous breathing and death, without accession of convulsion, the patient having remained conscious to the last.

Post-mortem.—The examination of the brain manifests the remains of an old clot of blood, not yet quite absorbed, close to the anterior and exterior portion of the right corpus striatum. The remainder of the hemispheres is normal, as also the cerebellum ; the pons Varolii, when merely looked at, appears likewise normal, but by making vertical sections it is seen that in the centre of the superior part, viz., that nearest to the crura cerebri, a portion of the size of a small hazel-nut is softened. The colour of the softened spot is yellowish-gray, slightly darker in the middle, where the softening is most complete, while in the circumference, where the consistency approaches the normal, the colour is scarcely different from that of the unsoftened portion. The surrounding tissue appears unaffected, as well as the whole of the inferior (nearest to the medulla) and posterior or upper part (floor of the fourth ventricle), and the medulla oblongata. Thin slices of the softened tissue become, when a stream of pure oil of turpentine is passed over them, almost transparent ; the tissue, however, is so much softened that it is impossible, even after hardening it with absolute alcohol, to cut slices thin enough for microscopic examination in larger pieces. The use of higher powers shows in the centre of the softening scarcely any fragments of nerve-fibres, a great many oil-globules, small granules, and amorphous matter, but no granule-corpuscles (Körnerzellen). In the circumference of the softened spot the nerve-fibres become prevalent, the

oil-globules and amorphous matter are seen in smaller proportion, but likewise no granule-corpuscles.

Both lungs are emphysematous. The lower lobe of the right lung is in the condition of red hepatization, that of the left is likewise much congested. The heart is flaccid, but otherwise normal, without signs of fatty degeneration or valvular disease. The kidneys, too, are normal.