Contributions to the study of shell shock : being an account of certain disorders of speech, with special reference to their causation and their relation to malingering / by Charles S. Myers.

CONTRIBUTIONS TO THE STUDY OF SHELL SHOCK (III): BEING AN ACCOUNT OF CERTAIN DISORDERS OF CUTANEOUS SENSIBILITY.

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In my first communication on this subject,[1] I described three of the earliest cases of severe shell shock I had seen, which were characterized especially by defects of memory, vision, smell and taste. Among the large number of cases which have since come under my observation, I have met (in about twenty-five per cent) with various disorders of cutaneous sensibility, some distinctive features of which form the subject of the present contribution.

Over-reaction and "Hyperæsthesia."

The following is a pronounced instance of general over-reaction :—

Case 9 (Case Number 227).—Stretcher-bearer, aged 19, with eighteen months' service, and six months' service in France, was seen by me the day after admission to a base hospital. Four days before admission he had been "blown up three times by aero-torpedo trench mortars" while attending to the wounded in the trenches during an enemy attack. He said that one had blown him in the air, that another had blown him into a dug-out, and that the third had knocked him down, but that nevertheless he continued his work of carrying away the wounded to the dressing station. Two or three hours later, after he had finished, he was resting in a dug-out when "everything seemed to go black" (probably he had a hysterical "fit") and he became "shaky," and had remained so ever since. He said that he had hardly slept for seven days before he "gave in."

He appeared an honest, courageous lad, but was obviously in a very "nervous" condition, making irregular spasmodic movements of the head, arms (especially the right) and legs (especially the left). There were well-marked coarse tremors and inco-ordination during voluntary movements of the arms. He touched his nose with far greater uncertainty when his eyes were closed. The lightest touch of cotton-wool on the limbs or head provoked very lively movements; obviously he dreaded the next touch. "I was

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[1] Published in the *Lancet*, February 13, 1915.

always ticklish," he explained, "but never like this. I can't stand it, sir." A pin-prick produced a series of most violent spasms, almost amounting to a convulsion. He sweated considerably during examination. There was much rigidity in the legs, and so much spasm that a knee-jerk was unobtainable until my second visit the sixth day after admission. Plantar stimulation gave a flexor response. He suffered from visual hallucinations of bursting shells; he also heard them when dozing.

He improved considerably with rest and treatment; but seventeen days after admission, lying asleep in bed outside his tent in the sunshine, he woke to find himself being carried back in his bed owing to a sudden shower of rain. This brought about a recurrence of such terror that a special nurse was considered necessary that night. The next day he was still very "jumpy" and alarmed, even at the sound of a footstep; he complained of severe headache. Three days later he had again improved and was transferred to England.

Cases like this, of general over-reaction, appear to be very rare after shell shock. But I believe that they may be regarded as an extreme form of the far commoner condition of unilateral or otherwise more restricted "hyperæsthesia"; and for this reason (based on considerations which will appear immediately) I place the word in inverted commas. Such local "hyperæsthesia" was specially apt to occur over areas which were the seat of spontaneous (subjective) painful sensations. Unilateral "hyperæsthesia" was combined in several cases with contralateral anæsthesia or hypæsthesia. In others it was sometimes difficult to be sure whether one side of the body was subnormally sensitive or whether the opposite side was supernormally sensitive, although, as a rule, the patient's "jumpiness" and muscular over-reaction afforded a sufficient clue to the latter condition.

The Nature of the "Hyperæsthesia."

Several cases of "hyperæsthesia" presented features recalling to my mind those which have been emphasized by Head and Holmes[2] in their observations on lesions of the optic thalamus, and which have been attributed by them to a loss of the inhibitory control normally exercised by the cerebral cortex over the activity of the thalamus. They compare this loss of cortical control over the thalamus with the loss of cortical control over the bulb and cord;

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[2] *Brain*, 1911-12, vol. xxxiv, pp. 102 to 253.

just as the latter manifests itself in muscular rigidity, increased reflexes, etc., so the former results in sensorimotor and effective over-reaction. In such thalamic over-reaction a cutaneous stimulus produces abnormal motor response, excessive tingling and diffuseness of sensation, and increased affective reaction of pain or pleasure.

With the most careful avoidance of suggestion on my part, various patients suffering from "hyperæsthesia" after shell shock have given me the following observations—cotton-wool "tingles more" "tingles and runs right up," "is more tingling," "tickles more," "is more ticklish," "itches more," "is more itchy," "gives me an awful feeling, a tingling tickle with an after-itch," "I can't stand it, sir." A pin-prick is "like an electric current," "more like an electric shock," "stings like a bee," "shoots up the arm," "seems to run up more" (from foot to knee), "shoots more than usual up the leg and lasts longer as an after-tingling," "is sharper and itches more."[1]

As would be expected, such over-reaction when limited to one side of the body, usually made localization of the spots touched on that side distinctly more difficult and more inaccurate than on the normal side. No doubt the spatial threshold would have been raised, but I have not yet applied the compass tests to such cases.

Clearly, far closer inquiry is needed to establish more than the superficial resemblance which is here indicated. In view of the relation already recognized between emotion and, on the one hand, shock, and on the other, thalmic activity, such an inquiry would have especial interest. Unfortunately (or fortunately, in relation to freedom from prejudice) the relation was not in my mind when these observations were recorded.

As Head and Holmes observe, the paths of cortical control "come from all parts of the cortex to impinge on the thalamus" (p. 179). No doubt in unilateral lesions of the optic thalamus many of the striking features observed are due to the more or less complete and abrupt *structural* severance of the thalamus of that side from the sensory areas of the cortex. But, in the cases with which we are now dealing, the interruption, if it occurs, is of a *functional* character, and the cortical centres here deprived of their normal inhibitory action are situated far "higher" than those of which we have at present any topographical knowledge, acting,

[1] It was this kind of disturbance of sensibility which was alluded to in Case 5, described in my communication to the *Lancet* of January 8, 1916.

it may even be, not directly on the thalamus, but through intermediate levels. As they stand, the patient's replies indicate a sensory as much as an affective over-reaction. And in this connexion we may recall certain features of what Head and his fellow-workers have called "protopathic" sensibility, where one peripheral system of sensibility obtains full play—no longer controlled by the inhibitory influence of the higher ("epicritic") system—yet another instance of unleashed primitive sensibility.

In any event, then, we should not expect to meet with the *syndrome thalamique* of Roussy, with its hemi-anæsthesia, hemi-ataxia, slight transient hemiplegia, persistent paroxysmal pains on the affected side and irregular athetoid or choreic movements. It is, however, noteworthy that the last of these symptoms is said to occur in less than half of the observed cases, while the first may be so slight as only to be revealable when the stimulus strength is carefully measured; indeed, in thirteen of the twenty-two cases observed by Head and Holmes the pain threshold was equal on the two sides, and in five of their cases the threshold for the light touch of hairs was equal on the two sides. But *in no case* did these observers meet with a lowered threshold, i.e., a *true hyperæsthesia*, on the affected side, although the affective over-reaction was throughout a characteristic feature. The patient typically replied that a prick was less sharp and less plain over the affected side, although it hurt him more, and in several cases an actually higher threshold was found on that side.

We have therefore to consider whether the "hyperæsthesia" which is met with in certain cases of shell shock is the outcome of genuine increase in sensibility or whether it is not due to sensory diffuseness and increased affective response. At first sight, it would appear that this question could be settled by comparing, in hemi-hyperæsthetic patients, the thresholds to pain or touch of the two sides. But even had I had the opportunity of employing an algesimeter or von Frey's hairs in suitable cases, I am very doubtful if any accurate readings on the affected side would have been obtainable. For in the case of pain, at least, it would always have been difficult to ascertain whether the patients were responding to the minimal sensation of pain or of touch, or to the dreaded discomfort which they expected the stimulus to produce, so "jumpy" was their invariable condition. Moreover, it is quite conceivable that even if the *threshold* for pain and touch were found normal, the *sensation* might nevertheless be abnormally strong after once that threshold had been passed, that is to say, when the stimulus was powerful enough to give rise to any sensation at all.

In this connexion attention must be drawn to the fact that in several of my cases the condition of "hyperæsthesia," whatever may have been its nature, passed over into one of distinct hypæsthesia, without, however, losing all its features. Thus one patient, during a stage of mutism had shown unilateral (left) "hyperæsthesia," which twelve days later gave place to diminished sensibility; whereupon he complained that "the prick is more numb on this (left) side and seems like a blunt point, but I feel it more because it shoots more," and he averred that light touch "tingles up the left side, but it does not feel numb on the right as it does on the left."

In another case, the state of "hyperæsthesia" over an aching, tender, "jumpy" abdomen (across which sandbags had been blown through a shell explosion) was accompanied by "dulness" to cotton-wool over that area. In yet another, previous "hyperæsthesia" of the right leg and foot ("it seems to jab all over") was followed by a "sleepified pins-and-needles feeling" in the right calf, but the prick still seemed "to run up more" than on the left side.

Another case is noteworthy, of loss of sensibility on one side, on which patches were found giving a sensation to pin-prick of "tickling like a hair, more ticklish than usual, felt over a wider area" than on the opposite side.

Anæsthesia.

But whatever be the cause and nature of the disorders of sensibility already considered, there can be little doubt as to the origin of the far commoner (2 : 1) condition of simple anæsthesia or hypæsthesia. It is the outcome not of relaxed control but of dissociation or inhibition in the higher cortical regions. How far suggestion plays a part in this process may be deferred for the present; I need only now remark that I was alive to the possibility of the anæsthesia being produced by medical investigation and took every precaution to avoid it.

The loss of sensibility varied considerably in degree. In the slightest cases it could only be demonstrated by comparing normal with abnormal regions of the skin surface. Loss of pain was commonest, the prick of a pin being (*a*) merely dulled, or (*b*) recognized as the end of a match or pencil or as my finger or finger-nail, or (*c*) not even felt as a touch. Only in the severest cases was sensibility to deep pain lost.

Defective power of localization (because "I can't feel it so well") was often present over hypæsthetic areas. Thermal sensibility

was also found to be defective when there was pronounced loss of sensibility to light touch and pain, hot or cold stimuli appearing less hot or less cold over the affected areas. The surface temperature, especially of the extremities, was sometimes very cold; and in one case a bilateral difference of body temperature accompanied a bilateral difference of sensibility to light touch, to superficial and deep pain, yielding correspondingly different answers to moderately warm and cool stimuli on the two sides owing to the different "temperatures of adaptation" thus arising.

Sometimes such anæsthesia or hypæsthesia arose immediately, especially in patients who had been buried; and in several of these cases, as we shall see, the loss of sensation occurred in regions which had become painful or numb after being hit by sandbags or other objects. In other cases the onset occurred later, and was more widely distributed. It then appeared to be the result of emotional shock (terror, horror, or anxiety), often uncomplicated by initial bodily pain, but almost invariably subsequent to a period of amnesia.

Hemianæsthesia.

It was especially in such cases that the condition of hemi-anæsthesia, so well known among hysterical patients, occurred. The two following cases may be cited as instances of this condition. In the description of them, and henceforth in this article, the words anæsthesia and hypæsthesia will be used in their narrower sense of defective sinsibility to *touch*, while analgesia and hypalgesia will be employed for defective sensibility to *pain*.

Case 10 (Case Number 126).—Rifleman, aged 33, with twelve years' service, and five months' service in France, was admitted to a base hospital for inquiry into his mental condition, he having wandered from his post without permission five weeks previously. On admission he appeared to be in a state of semi-stupor typical of the state following shell shock, unable to say why he had been sent to hospital; replying, "I don't know," to nearly every question, and only slowly able to recall the names of his children, but able to give their ages. He later admitted to past abuse of alcohol. He complained of right frontal headache. His right arm was very tremulous even when at rest, and the grip of the right hand was distinctly weak. His knee-jerks were somewhat exaggerated; his plantar reflexes were flexor; his abdominal reflexes were not obtainable. He stood and walked naturally; no Rombergism. His pupils reacted normally to light; no nystagmus.

Two days later he seemed distinctly brighter. On investigation of his cutaneous sensibility, he proved to be totally insensitive to pain and light touch on the right side of the face, tongue and trunk, and on the right limbs. Sensibility to deep pressure, as tested by Cattell's algometer on the thumbs, was completely absent on the right thumb but was normal on the left. The compass test showed a normal spatial threshold on the left side; on the right side, of course, the threshold was unobtainable. With eyes closed, he distinguished a penny from a watch successfully held in the right hand, terming the former "sharp," the latter "a piece of glass"; he named them at once when held in the left hand. The vibration sense was wholly lost on the right side, save on the right temple, where it was feeble as compared with the normal left side. He failed to recognize in which direction his right hallux was moved, and failed to appreciate passive movements of his right arm; nevertheless, he was able to imitate with his right arm the position in which his left had been placed. Sensibility to temperature not examined. Tested for smell and taste, he showed complete right hemianosmia and hemiageusia to all smells and tastes; left side, normal.

The left ear heard normally, the right was almost completely deaf. The sound of a tuning-fork placed on the vertex was localized in the left ear. Otoscopic examination revealed no abnormality. The right visual field was limited to the fovea, the left was normal. The visual acuity of his right eye was $\frac{4}{18}$, of his left $\frac{4}{6}$. His right eye could only read Jaeger type No. 14, whereas his left read No. 2.

Case 11 (Case Number 94).—Serjeant, aged 32, with eleven years' service, and eight months' service in France, was admitted to a base hospital for inquiry into his mental condition, he having been charged with malingering. For seven years before the War he had been teaching in an Army school. On arrival in France he had at once found the heavy marching too much for him. He had fainted several times during the retreat from Mons, and during the fighting on the Aisne, where he had reported sick for dysentery. He stated that on that occasion he went to a field ambulance for two days and that, owing to the bursting of shells, one of which struck the ground and knocked him into a ditch, the ambulance was forced to move for shelter into a cave. Since then he had suffered from tremor which, he stated, was much worse when he moved his limbs, was addressed, or felt himself watched. After discharge from hospital, he had been employed for three months as

dispatch-rider on a motor cycle, but he lost his nerve for this work and was then given the duty of taking charge of fatigue parties. Again he had found the work, "long distances and long standing" too much for him. Finally, the charge of malingering was proferred against him. He had always been a total abstainer.

He was a very nervous, delicate-looking man, with widely dilated pupils, prominent eyeballs, a pronounced tremor of the right arm, and a pulse frequency of 102. No signs of goitre. The tremor was markedly diminished when he was left alone, and was increased, extending to the head, when he stood, and to the left arm when both arms were outstretched. He could control the tremor to a certain extent. He complained that he frequently woke at night, but said that he had no dreams. He had noticed that he forgot the names and faces of people he had known and the earlier parts of books he read. Memory tests demonstrated the defective state of his memory. He said that he felt very despondent and exhausted after the railway journey to this hospital.

Two days after admission he said that he had slept much better last night. Pupils much smaller this morning. Pulse-rate 75. Sensibility to light touch normal. Sensibility to pain distinctly reduced over the whole of the right side of the head and body and over the right limbs. He generally described a prick of the right arm or leg as the touch of my finger.

There was almost complete hemianosmia and complete hemiageusia on the right side; peppermint, eucalyptus and opium being only smelled by the left nostril, ammonia being termed "cold" to the right nostril, ether having a "faint" smell, while both were at once recognized by the left nostril. Visual acuity—right eye read two letters, left eye all letters at $\frac{5}{5}$. Right eye read only a few words of Jaeger No. 1, and then the print blurred; left eye read this type easily. Visual fields—general limitation in right eye; normal in left eye. Hearing not examined. Patient transferred to England.

The Influence of Past History.

About two-thirds of the cases of disturbed sensibility were accompanied by spontaneous (subjective) disorders of sensation, or by disorders of movement. Local aching, tenderness, muscular over-reaction, rigidity and spasms were common accompaniments of "increase" of sensibility; similarly, local numbness and tremor, paresis or palsy often went with loss of sensibility. Into the details of these disorders it is hoped to enter on another occasion.

Such disorders could often be successfully traced to actual blows upon the region in question due to the impact of sandbags or other objects, or to the patient's fall after being lifted or pushed by the force of the concussion.

But in a considerable number of cases the site of the sensory disorder caused by the shock was determined by a previous history of pain in that region. For example, one patient who had suffered four years previously from " ruptured kidney with blood in the urine " after a football match, complained of pain in his " back and kidneys " after being buried by a shell. Another who, on admission, complained of pains in the back when he breathed, gave a history of severe pleurisy from which he had suffered twelve months previously. Yet another who, after being lifted by a shell began to suffer from such pains in the left lower costal region and of pain in the left leg, recalled that he had had pleurisy on that side many years ago, and that a piece of glass once entered his left leg from which, he believed, it had never been removed.

In relation to the natural question as to how far the earlier experience may be actually revived in consciousness the following case deserves mention :—

Case 12 (Case Number 452).—Private, aged 26, with eleven months' service and one month's service in France, was admitted the day after shock to a base hospital. The concussion produced by a shell had caused the dug-out in which he was standing to collapse. The props gave way and a beam hit him on the left side of his face (he pointed to a bruise on the face). It forced him forwards to the ground on his right side, and pinned him there; at the same time a piece of corrugated iron fell on the left side of his back, and his right leg became pinned by a cross-beam which fell on the back of his thigh. He did not lose consciousness, but was merely dazed. " I had about three tons on top of me," he explained; " one of my mates had both legs broken and the others were badly shook up. The rest of the platoon dug us out. Two men helped me to the dressing station." He had been able to walk since, but complained that he had a pain in the right groin, and that his right knee gave way.

He was quite certain that about fifteen minutes after the accident he told "one of the other fellows" that he had " no feeling " in his right thigh. His medical officer did not arrive until about half an hour later. This feeling of " numbness " (as he calls it) " increased," he says, " until the day before my first visit, when the right thigh was found to be totally analgesic, to the level of the

upper margin of the patella, save for a narrow strip in the mid-line on its posterior aspect. Since then the 'numbness' feeling" of the thigh had improved, and correspondingly I found that whereas the thigh was now generally hypæsthetic and hypalgesic over its anterior surface, the only area of complete anæsthesia and analgesia was on the outer side of the lower half, the posterior surface having regained its normal sensibility.

He explained that three years ago he had been buried four feet deep in a brick-yard beneath a heap of clay which fell upon him. "I felt it most," he said, "in the right leg. I fell face downwards, like this time. My thigh was stiff and sore, not numb as it is this time. The back of it got black and blue." He admitted that the present accident *immediately* reminded him of his previous experience.

There was slight weakness of the lower facial muscle on the left side, of the left orbicularis palpebrarum, and of the arms, but no tremors nor any disturbance of sensibility on the face, arms, chest, back, or abdomen. The left buttock, across which a plank fell, showed diminished sensibility to cotton-wool. ("It feels number"), while a prick felt "like a match," until the point was inserted deeply, when it was recognized as a prick, but the pain was "duller" than over the right buttock.

Sensibility to warmth and coolness and to the vibrations of a tuning-fork was diminished over the right thigh, especially over the anæsthetic and analgesic area, where sensibility to deep pressure and to deep pain was also very markedly diminished. No threshold could be obtained over this area with the compass tests. Visual fields and taste and smell seemed unaffected. The corneal and conjunctival reflexes were diminished. No jaw-jerk was obtainable; the palatal, pupillary, abdominal and plantar reflexes were normal. A knee-jerk was just obtainable with the aid of reinforcement on the left side, but not on the right.

Three days later the left buttock had regained its sensibility, and the small area of total cutaneous anæsthesia and analgesia on the right thigh had become one of hypæsthesia and hypalgesia, with corresponding improvement in the sensibility of the rest of the thigh. He was now up and feeling very much stronger. He was sent to a convalescent camp.

Even in cases where there could have been no actual hurt from the effect of the shock, the subjective disorders produced could occasionally be elucidated by recourse to the previous history of the patient. For example :—

Case 13 (Case Number 330).—Private, aged 22, with thirteen months' service, three months' service in France, seen by me in a casualty clearing station the day after admission. Two nights before my visit, he had been out in a wood getting timber, when a shell came falling at some distance, about a hundred yards from him. He said he would not have minded it, had it not been for the dead lying in the wood, he having just picked up a human head which in the dark he had mistaken for a piece of wood. The shell did not knock him down. He fell among the dead, and remembered no more until he found himself running out of the wood, whereupon he again lost consciousness, on recovering which he found two stretcher-bearers helping him, with whom he returned. He was a big, burly fellow, complaining of pains in the back. On questioning him, he told me that he had had exactly the same pain eighteen months previously, when he was hit in the back while at work in a coal-mine, and had been obliged to rest for fourteen days.

It is clear, then, that such past injuries and diseases had not passed away without leaving a "memory" behind them, ready to be awakened, not necessarily with recognition, on a subsequent shock to the mental system. I may add that I have met with similar revivals of other past disorders after shell shock.

Spontaneous Spread of the Disorder.

In many cases (e.g., Case 12), the anæsthesia spontaneously cleared up without any suggestion and despite occasional examination. But in a few instances evidence was forthcoming of a gradual spread of the subjective sensory disorder and an increase of the insensibility to pain after its first onset. For example:—

Case 14 (Case Number 129).—Stretcher-bearer, aged 44, with eleven years' service, and two months' service in France, was admitted into a base hospital and seen by me there eight days after reporting sick. He stated that three days before this, while sheltering in a cellar, a shell jammed the door and that poisonous fumes from it entered the cellar. Later in the day, in another cellar, he was blown off his seat by a shell, and his "surgeon and five men got laid out." That day and the two following days he was continuously shelled and he "worked at the wounded without any rest," afterwards returning to his regiment. Then he lay down, but on waking found himself useless in the left arm as if there was "something wrong with the circulation," it "feeling numb and

cold." This persisted, but *the numbness had since spread* to the legs, especially the left. He complained of continual tingling in the terminal joints of the fingers of the left hand.

There was distinct *hypalgesia* over both forearms and hands, especially on the left limb; over the dorsum of the left hand there was total analgesia.

Two days later he said, "I can now feel articles I am touching. I could not before. They are only numb now in the early morning. The tingling comes on when the numbness is passing off. But to-day the hands and forearms showed a *total loss of sensibility* to pain everywhere, save over a small area on the flexor surface just below the elbow-joint."

The Effects of Protracted Examination.

Improvement.—In this case the second occasion of examination showed a more severe loss of sensibility to pain than had been found on the first. Often, however, especially in those cases in which a spread of defective sensibility had occurred, a distinct improvement could be brought about by examination, provided that it was long enough continued at any one sitting.

Thus one patient, after being blown over by a shell and, later, frightened by another, developed hypæsthesia and hypalgesia over the left side of the chest down to the nipple line, over the left arm down to the elbow, and over the forehead, especially on the left side. The first few pin-pricks applied to the face were unfelt, the next were described as my finger-nail, but finally they produced a definite sensation of pricking pain. On the following day he felt far less shaky, his hands had almost lost their previous tremulousness, his pupils were less dilated, and no difference in sensibility could be distinguished between the two sides of the chest and the two arms.

Other cases showed similar recovery during examination. One patient, for example, who by his bravery had won the Distinguished Conduct Medal, showed very marked hypalgesia and slight hypæsthesia over the left arm and slight hypalgesia over the right arm; but after a series of deep pricks which were felt the arms regained their normal sensibility. In another case, light touches over the right thigh and buttock tingled more, and pricks over the right legs stung more than on the left side, and the skin over the lumbar spines was almost totally anæsthetic to light touch and stung more to prick; but after an

examination of the normal surface of the skin higher up on the back the lumbar region recovered its sensibility.

Deterioration.—On the other hand, certain cases, in the course of prolonged examination showed deterioration in sensibility. Thus in one patient the bilateral differences became more marked, a state of hypalgesia becoming apparently one of analgesia, the subject being at length unable to distinguish (almost solely on the affected side) between the head and the point of a pin. This deterioration often appeared to result from the onset of a "jumpy," "nervous" condition, a state of mental confusion occasioned by the examination.

Perseveration.—Yet another change in the answers obtained during investigation was the outcome of perseveration—i.e., of persistence of response. In one patient, for example, who had suffered from stupor and mutism consequent on shell shock, the flexor surface of the left forearm and palm were "hyperæsthetic" and "hyperalgesic" and the left side of the forehead and *chest* were "*hyperalgesic,*" while over the back of the neck and over both scapulæ (where the patient complained of pain) a state of complete anæsthesia prevailed. This order was that in which the examination was at first carried out. Yet when later the applications of cotton-wool and pin were begun over the back of the neck and shoulders and extended on to the chest, the condition of *anæsthesia* was found to spread over *both sides of the chest* down to the nipples, the left arm remaining in its former condition.

These three features, of improvement through experience, of deterioration through mental confusion, and of perseveration, are well exemplified in the two following cases.

Case 15 (Case Number 332).—Private, aged 23, with five years' service, and five months' service in France, was seen by me the morning after admission to a casualty clearing station, having been buried a few hours before admission by a shell while he was in a dug-out. He said that he had come to himself shortly before my visit, and had no recollection of being moved here. He was alone in the dug-out when it was shelled. He admitted to having "felt very bad lately" owing to the depth of water in the trenches, and was recently kept back for two or three days for observation by his regimental medical officer before being sent back to the trenches. His general appearance, I find recorded in my notes, was that of one "who has control over a stormy sub-surface which might at any time get the upper hand and result in a hysterical attack." He complained of headache and of buzzing noises

in the ears. His pulse-rate was 96. His visual fields were distinctly restricted. His palatal reflex was absent. A jaw-jerk was present. His patellar and plantar reflexes were normal. He stood unsteadily, especially swaying when his eyes were shut. He showed no tremor of the hands or tongue. His left arm was anæsthetic to light touch. He could not distinguish the point from the head of a pin applied to his left arm. When it was pricked he said that my finger was pressing. The right arm showed normal sensibility; but at first, over the right biceps, he momentarily carried over the immediately preceding answers of the opposite side, unable, but only for a few seconds, to distinguish the head from the point of a pin. On subsequent re-examination of the left arm, continual pricking resulted in a recovery of sensibility to pain over the flexor surface of the forearm, and at length the back of the hand became sensitive to light touch; but on the extensor surface of the forearm and elsewhere on the limb nothing whatever was felt. His forehead and cheeks were rather more sensitive to light touch on the left side, but pain was felt equally on the two sides.

At first he said that the left side of the chest was more sensitive to prick than the right, and then he carried this difference over to the upper arm until the forearm was reached. Whereupon the difference of sensibility became reversed, the right forearm alone feeling the pain as before. This reversal to his previous answers persisted as the pricks were continued upwards over the upper arm, until on re-examination of the chest he declared that there was no difference between the two sides either for light touch or for prick. The rest of the body showed no disturbance of sensibility.

Case 16 (Case Number 46).—Corporal, aged 39, admitted in a very depressed condition into a base hospital after working under shell fire at barbed-wire entanglements, complaining of noises in the head, pricking pains in the body, unsteadiness of the legs, general fatigue, irritability and loss of confidence, and want of interest in his work. He was a big, robust-looking man, showing very tremulous movements of the arms and legs, especially during movement. His gait appeared normal, but he stood very unsteadily with his eyes closed. "I'm strong enough," he explained, "but only a bit shaky. My legs have been very unsteady, especially when someone is looking at me. They must have thought me drunk at times." He showed a pronounced inability to touch any prescribed part of the body with his eyes shut. His head and tongue were

very tremulous. His pupils were equal and reacted normally. His knee-jerks were exaggerated; no ankle clonus; plantar responses flexor.

He volunteered the statement that "When I stand, it feels like standing on cotton-wool." His soles proved to be totally insensitive to light touch and to pain; sensibility to deep pressure was retained. But further trials, especially when aided by comparison with the effects of stimuli applied to the dorsum of the feet, resulted in the gradual return of right answers. Tested with warm and cool tubes, he at first called both the tubes "cold" when applied to the soles, and he gave generally wrong answers over the dorsum of the feet, often wrong answers over the legs and occasionally wrong answers over the thighs. Yet over the arms he was invariably correct, and when stimulated to attend by such injunctions as "Now, O——, attend well, you know what this is," he gave correct answers over the legs and dorsum of the feet and usually over the soles. But in the course of further examination his legs became very markedly tremulous, "A silly childish fear came over me" (as he explained it); his hands began to "feel cold and clammy" and, at the height of this "attack," he replied "Hot" or "Cold" even when the tubes were not being applied at all to his skin, evidently suffering from hallucination.

So, too, a few hours later, during re-investigation of the sensibility of the soles of the feet to pain, he finally repeated, "You're pricking me," when the pin's head was applied instead of its point.

When the compasses were applied to the dorsum of the left foot (sometimes two points, sometimes one point, being presented in irregular order) his answers to the two-point touches, when separated by 4 centimetres, were all correct. At 3·5 centimetres he made one error in ten two-point touches. At 3 centimetres, his answers became very incorrect. Returning now to the distances of 3·5 centimetres and of 4 centimetres, I obtained extremely incorrect replies for the two-point touches. At 5 centimetres his replies were correct for the two-point touches, but he made occasional mistakes in the one-point touches, as he had done at the outset when the two points were separated by 4 centimetres, whereas he had made none for the one-point touches when the two points were separated by distances of 3·5 centimetres and 3 centimetres.

I have seen several other cases showing the effects of perseve-

ration, improvement with practice, and deterioration through confusion, inattention, or fatigue. In all the cases showing perseveration and in all showing improvement with practice, there was evidence of exhaustion preceding the shock. Now it is especially in such cases that we should expect to find a state of instability in portions of the central areas which have been functionally affected by the shock, the inhibition or the loss of control being at one moment manifest, at another quiescent, according to the conditions of examination. In these and in other cases it is conceivable that certain cutaneous areas are hence in a state of "hesitating" sensibility, on a knife-edge, as it were, ready to be influenced in one or other direction by the past replies given to stimuli applied elsewhere, by the summation effects of stimuli, by unconscious suggestion on the part of the investigator or by express counter suggestion on his part. Thus we may account for the occasionally wide variability of replies, with which I have met, made by the same patient (1) at any one sitting (one apparently honest fellow, for example, when brought to book for his inconsistent replies, retorting, "All I can say is what I feel,") (2) at different sittings with the same or (3) with a different investigator.

None of the cases showing deterioration in replies through confusion, hallucination, inattention, or fatigue was under treatment for purely the immediate effects of shell shock. Two of the cases have been already described (Cases 11 and 16), another was that of a serjeant who had previously been invalided for overwork to England, three months after his return from which he fell to the ground during a bombardment when two guns close to him were blown out of action; since then his legs had been feeling weak, but he had "managed to keep going on light duty" for two months before he finally reported sick and came under my observation.

Such phenomena are especially apt to occur when to the effects of shock conditions of previous long-continued anxiety and nervous exhaustion are superadded. That is to say, they imply a certain instability of cerebral activity, and in this connexion it is noteworthy that the liability to mental confusion, inattention, fatigue and hallucination and the tendency to perseveration occurring in the above-mentioned cases, are the very symptoms observed by Head and Holmes (*op. cit.*) as the effects of cortical injuries.

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