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TRAUMATIC EPILEPSY AFTER GUNSHOT WOUNDS OF THE HEAD

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The object of this paper is to summarize the results of an inquiry into the fate of men who sustained gunshot wounds of the head in the war of 1914-18, with special reference to the development of epilepsy. Through the kindness of the Director-General of Medical Services, Ministry of Pensions, 540 case notes have been examined. These were taken from the files of the group known as "four-year cases"; that is to say, all the patients survived long enough to be re-examined with a view to final award of pension four years after they were first "boarded" for head injury by the Ministry of Pensions. The material thus does not include those who died from the results of head injury within the first few years, before their pension reached the stage of final award. It is possible also that certain cases of minor injury not severe enough to receive provisional award of pension may have escaped the survey; but a man bearing on his head a visible scar or a hole in his skull as a result of war service seldom failed to appeal and to obtain an award of 20% or more. With these reservations the group may be accepted as a fair sample of gunshot wounds of the head involving bone, and a somewhat selected sample of the severer scalp wounds.

Information Available

Relating to each case are four groups of documents. (1) There are the strictly medical papers—the field medical card, and corresponding medical cards completed at the base hospital in France or elsewhere and at the general hospital in the United Kingdom, and one or more Army Forms I 1237. (2) The medical board papers. Boards were held first, as a rule, when the patient was discharged from hospital, then at intervals of six months, and later of one or two years, until the final board, usually in the period of 1922-5. When a final award had not been granted because the case did not appear to be in a final and stationary condition, or when later appeals were lodged by the man, further medical board reports are available, perhaps as late as 1930, 1935, or more recently. (3) Long after the war many pensioners were admitted to Ministry of Pensions hospitals for observation, and hospital reports are often available. (4) In addition there are the man's non-medical military documents, a collection of papers relating to the non-medical side of pension arrangements, including any letters from the man himself or from his relatives or friends. Should the pensioner at any time come into conflict with the civil power a record of the crime and sentence is to be found.

The most serious omissions from the medical notes are the family history and the previous history of the patient.

Selection of Cases

Of the 540 case records examined 317 have been abstracted, the rest being discarded. Rejections were made solely on account of incomplete notes, especially an in-

complete operation note. All cases having adequate notes were accepted, no matter how trivial the injury. No injuries from causes other than gunshot wounds are included in the present series. Wounds of the cerebellum have been excluded.

Incidence of Epilepsy

Of these 317 cases, 107 (34%) had fits. Every patient whose notes record one or more fits is included, yet this figure is perhaps a little low. It has not always been easy to determine from the records whether or not a patient has had fits, but it is reasonably safe to assume the fits to be genuine when they are accepted as an attributable disability by medical boards. The majority of men complaining of fits were admitted to Ministry of Pensions hospitals for observation, often for long periods.

It is possible that an occasional patient was falsely accepted as epileptic. On the other hand, it is probable that a number of cases of genuine epilepsy without full-fledged convulsions were missed. In the records examined there is little or no reference to automatic states and to less outspoken forms of epilepsy. In some cases not regarded by medical boards as genuine epilepsy the description of attacks is nevertheless convincing, and these cases are included in the 107. But they are few, and it is therefore fair to conclude that the figure of 34% is at least not an over-estimate.

The following case reports illustrate the varieties of epilepsy encountered and indicate the sort of data on which the present survey is based.

Major Epilepsy without Obvious Focal Onset

Case No. 108.—Wounded on October 4, 1918, at the age of 17. While advancing the patient was struck by a shell splinter in the left temporal region and knocked down. He stated that he was able to get up immediately and walk to the dressing station, where he lost consciousness, and did not "come to" till three weeks later in England. On arrival at the base hospital he was found to be dysphasic and to have weakness of the right arm, leg, and face. Radiographs revealed a depressed fracture and two metallic fragments one centimetre within the skull, near the Sylvian point. At operation two days after the injury fragments of depressed bone were removed and there was found to be "some loss of brain substance"; the foreign bodies were not seen. Six days after the injury he had a convulsion with loss of consciousness. Occasional slight fits occurred during the rest of his prolonged stay in hospital (the wound did not heal for seven months). He remained hemiplegic, though his leg regained enough power to enable him to walk, and his memory and intelligence were said to be good. The fits grew more frequent; in 1919 they took place twice a month, and in 1921 two operations were performed. The first, in February, revealed the hole in the skull filled with fibrous tissue. Beneath it lay a "large subdural

cyst," which was swabbed out with iodine and filled with a graft of fascia lata and muscle. The fits continued, but were fewer. In June of the same year the wound was reopened, a fruitless search made for the foreign bodies, and a second graft applied. For a time he had up to six fits a week, but the following year only one a fortnight. Improvement, however, was brief. In 1925 fits took him so often that he was unable to go out alone; in 1926 he had two a day, and in 1927 four. In 1930, fifteen years after the injury, fits were so frequent that he required constant attendance.

Case No. 124.—Wounded on July 6, 1915, at the age of 19. This man was struck in the posterior part of the left frontal region near the vertex, and was said to have been unconscious for seven days. He was trephined next day; bone fragments, hair, and dirt were removed from the surface of the brain, the wound drained, and the edges drawn together. Healing was complete in twenty-five days and no focal signs are recorded. Six to nine days later he had two attacks of loss of consciousness, preceded by trembling of both arms. He recovered and was able to carry on his pre-war work of farm labourer, and a year later was engaged in felling timber. In 1920, however, he had another fit, with generalized convulsions in which he bit his tongue and wet himself. For more than a year there was no further attack. In 1922 fits began again, and by 1924 took place every month. When last examined in 1926, eleven years after the injury, he was having fits every week.

Epilepsy with Focal Onset

Out of a total of 107 cases of epilepsy, 33 (31%) are recorded as having a focal onset. This group consists mostly of fits starting with jerking or some abnormal sensation in a limb. In addition there are two cases of occipital injury in which the fits began with flashes of light; three of occipital injury in which the fits began with or were characterized by dimness of vision and blindness; and one of injury to the left temporal lobe having minor fits in which speech was lost. No instances of uncinat fits are recorded. It is possible, therefore, that the focal features of attacks have been overlooked in some cases.

Case No. 175.—This man was wounded at Gallipoli on May 24, 1915, at the age of 31. A bullet glanced off the side of his head, causing a depressed fracture over the lower part of the left Rolandic area. He was unable to speak, and his right arm and leg were powerless and insensitive. Trephining was performed aboard a hospital ship, but the condition of the dura is not stated. Within a year he was able to walk well, but there was still severe sensory loss in his right hand, and speech was hesitant. Fourteen months after the wound he began to have fits. Before a fit he "only saw half a thing," and his right hand went numb; occasionally he lost consciousness and wet himself. At first fits were infrequent; by 1920 they occurred monthly, and in 1924 every week. He was, however, able to retain his job as a gateman. He died of heart failure due to mitral disease in March, 1937.

Case No. 268.—Wounded on July 27, 1917, at the age of 29. A bullet pierced this soldier's steel helmet and ploughed a furrow in his scalp from front to back, an inch to the right of the middle line. The wound was excised four days later, and the bone was seen to be grooved but not broken. The wound was septic, and he lay five months in hospital. The first fit took place a month after he left hospital. It began with pain in the left arm, and consciousness was lost. Similar attacks followed at intervals of about three months. In 1923, seven years after the injury, they ceased. For ten years he had no more. But in 1933 attacks occurred every week for a time, yet ceased once more four months before his last medical board examination (held the same year), at which his pension remained at 50%. There is no record of his ever having had focal signs.

Case No. 127.—Nine months previously this patient had sustained a slight scalp wound, but had remained on duty. On August 20, 1917, at the age of 21, he was struck on the right side of the head by shrapnel balls. One penetrated just in front of the ear, lodged in the bone, and drove a shower of bone fragments into the parietal lobe. On admission to hospital he was semiconscious and disorientated. His head and eyes were deviated to the right, but he could be induced

to look to the left, this movement being accompanied by nystagmus. There was left hemiplegia, complete in the arm and almost complete in the leg. Sensory tests were unreliable. He was operated on about twelve hours after injury by Harvey Cushing (1918, Case 36).^{*} The wounds were excised and sutured. The shrapnel ball in the petrous bone was removed, together with many fragments of petrous bone and pieces of helmet lining. In the parietal region the bone and the shrapnel ball in it were removed *en bloc*. From the brain itself fragments of bone, much clot, and disorganized brain were removed to a depth of 5 cm. The wounds healed by first intention. A month later his left leg was nearly normal, and within four months of injury his left hand had a fairly good grasp and was still improving. He was deaf in the right ear. In January, 1918, after he was evacuated from France, an aluminium plate was inserted. A week later he had an attack of twitching of the left side of the face and left arm. He remained fully conscious, the fit was slight, and there was no further attack for a year. Thereafter other attacks followed with increasing frequency, and in 1924, seven years after the wound, they took place two or three times a month. Consciousness was never lost, but whereas twitching had been confined to his arm and face, in later years it spread to his foot.

Petit Mal

Case No. 100.—Wounded on June 24, 1917, at the age of 42. A shell splinter glanced off this man's skull in the left fronto-parietal region, causing an extensive scalp wound but not injuring the bone. His right arm and leg were found to be weak. Power soon returned, and he was able to serve at home till demobilization. He complained that his right hand was still numb, and he was found to have astereognosis, impairment of postural sense in the right hand and right foot, and a right extensor plantar response. Nevertheless he was able for a time to take up his old employment as a blacksmith's striker. When last examined in 1931, fourteen years after the injury, he reported that he had been obliged to relinquish that particular work as he had suffered for some four years from attacks "in which he lost himself for a few minutes."

Case No. 148.—This man sustained a severe penetrating wound of the left lower parieto-occipital region through which the brain fungated. Four months later he began to have attacks which he described as follows: "I feel something inside my head which feels altogether strange. Something goes like a flash through my head and I feel unsteady. At times when I wish to speak my speech goes twisted."

Depth of Wounds and Fits

The incidence of fits in relation to the depth of wound is shown in Table I.

TABLE I.—*Relation between Epilepsy and Depth of Wound, Foreign Bodies, etc.*

Group	Site	No. of Cases	No. with Fits	% with Fits
1 ..	Scalp ..	66	16	24
2 ..	Fractured skull; dura intact ..	104	24	23
3 ..	Metal in brain ..	42	16	38
4 ..	Metal removed from brain ..	30	16	53
5 ..	Dura torn; brain injury; bone fragments removed or <i>in situ</i> (exclusive of Groups 3 and 4) ..	57	26	46
1 & 2	Dura intact; all cases ..	170	40	23
3, 4, 5	Dura penetrated; all cases ..	129	58	45

Fits are twice as frequent when the dura is penetrated. Nearly half (45%) of such cases are affected.

Metallic Foreign Bodies and Fits

It is remarkable to find that patients who retain fragments of metal in the brain are less liable to fits than those from whose brain metal has been removed (Table I). There are several possible explanations. Surgical removal of the missile may greatly increase the damage to the

^{*} Dr. Cushing's case report describes the head wounds as being on the left side, but the Ministry of Pensions records leave no doubt that they were on the right side.

brain or, under conditions often obtaining in war, increase the sepsis. Another and more acceptable explanation is that most of these retained missiles are small splinters, often less than a centimetre in diameter and often with a small entrance wound. When a man is struck by a large lump of metal it kills him if it penetrates far; if it remains near the surface, though it can be readily removed, it causes much destruction. Consequently, of men surviving penetrating splinter wound of the head, those in whom the metal is retained may well have less cerebral damage and therefore less liability to fits.

The surmise that the cases in which metal was removed from the brain often have more serious brain damage than those in which metal remains *in situ* is supported by the fact that 12 of the 30 from whom metal was removed developed brain fungus, whereas only 3 of the 40 from whom the metal was not removed had fungus. Furthermore, included in the "metal removed" group are 13 through-and-through wounds, and these are usually severe injuries.

The important fact that emerges is that in penetrating wounds the mere presence of a small piece of metal in the brain does not increase the risk of epilepsy.

Other Late Complications, and Deaths

It may be added that so far as the late course is concerned the presence of metal in the brain does not seem to affect the outlook in any way. In fact, apart from epilepsy, late complications are astonishingly rare in the whole series, even in the severest wounds. It is to be remembered that the present study affords no information concerning fatal complications arising within the first four or five years after injury, nor are the records complete enough to give information concerning minor degrees of mental deterioration. No cases in the series were still receiving active treatment, so that the material gives no information about patients requiring permanent institutional treatment on account of psychosis.

Up to the end of 1940 14 patients (4.4%) have died. In only one case (No. 126) can death be attributed with certainty to the injury; in two others (Nos. 79 and 265) there is a probable direct connexion.

Case No. 126.—Wounded on November 1, 1916, at the age of 22. A shell splinter entered the brain in the left Rolandic region, causing a right hemiparesis. The patient was not operated on till the fifth day, when a cerebral abscess was drained. Considerable recovery of power took place, and he was able to work as an auxiliary postman till 1930, when minor attacks of epilepsy began. Major fits developed a year later, ending in a fatal status epilepticus in September, 1934, eighteen years after the wound. Necropsy revealed a "cyst" on the surface of the brain, but there was no trace of abscess or other septic complication.

Case No. 79.—Wounded on September 4, 1917, at the age of 20. There was a small wound of entrance in the left temporal region, and the patient was dysphasic and weak in the right arm. Operation next day revealed much pulped brain, which was removed, along with several fragments of bone. The wound healed in twenty days, and the dysphasia and weakness improved rapidly. X-ray examination showed a piece of metal, 1 by 0.5 by 0.4 cm. in diameter, 1 cm. to the left of the middle line and 1.5 cm. above the sella turcica. Fits began in the following year and grew more frequent. In 1933 glycosuria was discovered, and the patient died in diabetic coma in July, 1937, twenty years after his wound.

Case No. 265.—This man was wounded on February 27, 1917, at the age of 23. A scalp wound was sustained in the right parietal region. At operation three days later the wound was excised and the bone was found to be intact. Major fits began in June, 1922, causing him to lose his job as stage-door keeper. By 1929 fits were frequent and prolonged. He died in October, 1938, of "acute bronchitis and chronic epilepsy," twenty-one years after being wounded.

The cause of death in the remaining 11 cases is recorded as: heart disease (5), malignant disease (2), perforated gastric ulcer (1), bronchopneumonia (1), phthisis (1), influenza (1).

In-driven Bone Fragments and Fits

With regard to the significance of in-driven bone fragments and the risk of fits it has not been possible to extract satisfactory data. Judging by our experience at the Military Hospital for Head Injuries and by the reports of members of the Society of British Neurological Surgeons, bone fragments are driven into the brain in almost all penetrating injuries. Good radiographs are needed to detect them, and it is clear from the samples of old x-ray plates included in the Ministry of Pensions files that reports of negative radiological findings are unreliable. Many operation notes state that in-driven bone fragments were removed, but there is no guarantee that all of them were. Pieces of buried bone may be overlooked at operation, even with the help of modern radiography; with poor radiographs, or none, fragments will often be left.

Non-penetrating Wounds and Fits

It is surprising to find the incidence of fits in scalp wounds as high as 24% (Table I)—no less, actually, than in wounds fracturing the skull and often depressing bone. The fact that this series of scalp wounds is to some extent selected may account for the high incidence of fits. Many a scalp wound will in itself cause no disability, and the patient may only appeal for a pension should epilepsy follow. But there are other points to be considered. Scalp wounds due to projectiles are by no means the same as those seen in civil practice and due to a fall on the pavement or a blow with a brick. The outward effect on the scalp in the shape of a more or less linear cut is the same, that on the brain beneath quite different. The brick imparts its momentum to a wide area of the skull and brain, or, rather, to the whole head, and usually stuns the victim. The bullet or splinter pierces the scalp and strikes the skull, a very small area of which absorbs its momentum, and often the patient is not concussed. Should the bone be broken it is remarkable how localized the fracture is—often no larger than the missile—showing how concentrated and focal is the blow. It is the exception to see widely radiating cracks which indicate diffusion of force. There is also ample clinical evidence to show that a concentrated impact can injure the underlying brain without breaking the bone, for in these cases focal signs are common (Jefferson, 1919; Cairns, 1941). In this series of 170 cases in which the dura was intact 51 (30%) had focal signs of cerebral damage. Of 104 cases in which there is a note on the state of consciousness 25 are known not to have been unconscious, yet 7 of these developed fits, and in 4 the skull as well as the dura was intact.

Though one cannot readily accept the high figure of 24% as the true incidence of epilepsy in wounds no deeper than the scalp, it is clear that scalp wounds due to projectiles are more likely to be accompanied by local damage to the brain, and therefore epilepsy, than scalp wounds seen in civil practice.

Sepsis and the Incidence of Fits

An important aspect of the problem of traumatic epilepsy is the incidence of fits in relation to sepsis. This is shown in Table II.

TABLE II.—*Relation between Epilepsy and Wound Sepsis*

	No. of Cases	No. with Fits	% of Fits
Wound healed in 15 days ..	59	13	22
" " 15-60 days ..	59	22	37
" " unhealed after 60 days ..	58	26	45

In this series fits developed twice as often in cases of severe and prolonged sepsis as in those healing by first intention. To obtain a truer estimate of the influence of sepsis the figures must be analysed further. Since both fits and sepsis are commonest when the wounds are deep and severe, the causal relation between sepsis and fits suggested by these figures might be fictitious. In Table III, therefore, the cases are grouped according to the integrity of the dura mater, and we see that the same relation holds for scalp wounds as for penetrating wounds—namely, that fits are commoner when wounds are septic.

TABLE III.—*Relation between Epilepsy and Wound Sepsis*

		% with Fits
Dura intact	Healed in 15 days	12
	" " 15-60 days	30
	Unhealed in 60 days	32
	Healed in 15 days	36
Dura penetrated	" " 15-60 days	50
	Unhealed in 60 days	57

Site of Wound in Relation to Incidence of Epilepsy

Too much reliance should not be placed on these figures (Table IV) nor on those previously published. It is often stated that fits are commonest in parietal lesions, but it is not always clear if "parietal" refers to the bone or to the lobe. There is also a tendency, seen in the records of this series, to describe as parietal any wound not frankly frontal, temporal, or occipital. Furthermore, the damage to the brain giving rise to the fits is not necessarily directly beneath the site of bone injury. For what they are worth the figures (Table IV) show that wounds in and about the Rolandic area are most often followed by fits, and polar wounds least often.

TABLE IV.—*Site of Wound in Relation to Incidence of Epilepsy*

Site	No. of Cases	No. with Fits	% with Fits	% with Fits, All Cases; assuming Equal Proportion of Penetrating and Non-penetrating Wounds
Frontal*	Dura intact ..	49	11	22
	Dura penetrated	35	11	31
Rolandic	Dura intact ..	26	10	38.5
	Dura penetrated	28	15	54
Parietal*	Dura intact ..	52	13	25
	Dura penetrated	23	12	52
Temporal*	Dura intact ..	19	5	26
	Dura penetrated	17	10	59
Occipital*	Dura intact ..	22	3	14
	Dura penetrated	22	9	41

* Refers to the lobe, not the bone.

As a rough approximation it may be said that the further a wound lies from those portions of the cortex where sensori-motor function is predominantly represented, the less chance is there of subsequent epilepsy. Though it is legitimate to conclude that lesions near the sensori-motor cortex more often lead to epilepsy than do those at the poles of the cerebral hemisphere, the figures make it clear that the influence of the site of the wound on the liability to epilepsy is not great.

Concussion and the Incidence of Fits

The importance of local brain damage as the essential factor causing epilepsy in gunshot wounds of the head is emphasized in another way. In 104 cases the effect of the wound on consciousness is recorded. In 55 the dura was intact. In these the incidence of fits was practically as high in those remaining conscious as in those concussed (Table V).

TABLE V.—*Concussion and Incidence of Epilepsy*

	No. of Cases with Dura Intact	No. with Fits	% with Fits
Not unconscious	19	5	26
Unconscious	36	10	18

Time of Onset of Fits

The first fit may take place within a few hours of injury or may be delayed as long as twenty years. In this series information of the time of onset of epilepsy is available in 84 of the 107 cases, and is given in Table VI. When fits began while the patient was still in hospital the precise date of onset was usually available; but when fits began after discharge from hospital, which usually took place about three months after injury, the exact time of onset is often not recorded. The accompanying chart is

Chart showing monthly incidence of onset of epilepsy.

a graphical expression of Table VI, and shows the monthly incidence of onset of fits. For the reasons just stated the monthly incidence after the first three months is expressed on the chart as an average of three-monthly periods for

TABLE VI.—*Time of Onset of First Fit*

	Months						Years					
	1	2	3	4-6	7-9	10-12	2	3	4	5	6-10	11-15
No. of new cases of epilepsy	19	4	5	13	7	8	10	4	4	1	6	1

the remainder of the year, and as an average of each period of twelve months from the second to fifth year.

It will be observed that the rate of onset of fits during the first month exceeds by more than four times that of any subsequent month. After the initial fall it remains stationary till the sixth month, then falls again, till at the end of the second year a very low figure is reached. During the next three years the rate of onset declines further, and after four years is barely above the base-line. Only about one patient in twenty-seven developed epilepsy between the fifth and twentieth years.

Course of the Epilepsy

Information concerning the course of the epilepsy is available in 96 of the 107 cases.* In 30 of these, fits ceased some years before the final examination. The cases may thus be separated into two groups: those with persistent epilepsy and those with temporary epilepsy. By *persistent epilepsy* is meant that in which attacks were known to continue when the patient was last examined. By *temporary epilepsy* is meant that which is known to have ceased some years before the final award of pension.

The cases of temporary epilepsy fall into two distinct categories. In 11 of the 19 patients who had fits within the first fortnight, not to return (Category I). It is to be noted that there were no cases in which fits began in the

* These 96 cases comprise the 84 cases of which the time of onset is known and an additional 12 cases in which the later history but not the time of onset was available.

third and fourth weeks. This prevalence of epilepsy within the first fortnight after injury is doubtless connected with the presence of recent cortical damage due to haemorrhage or infection, and it accords with the not uncommon experience of fits in the first days after operations upon the brain, or after spontaneous subarachnoid haemorrhage. As in these conditions, fits occurring soon after injury are of little prognostic significance for the occurrence of late epilepsy.

There are a further 19 cases in which fits eventually ceased, but after a much longer interval (Category II). In 3 of these, fits began within the first two weeks and continued for two and a half, three, and four years respectively. The other 16 cases of temporary epilepsy began three months to two years after the wound, to disappear one to four years later. The average interval between the last fit recorded and the final examination is five years, the shortest two, and the longest eleven years.

Examples of prolonged temporary fits are afforded by the following cases.

Case No. 82.—Wounded on March 24, 1918, at the age of 24, by a shell splinter in the right lower anterior parietal region. Four days later at a base hospital the patient was trephined, and many fragments of bone were removed from the brain. Seven days after the wound he is described as being very dull but without paralysis. A week later a large fungus developed, and with it complete hemiplegia. He was doubly incontinent and remained critically ill for many weeks. Nine weeks after injury much of the fungus was cut away, and after a further three months the wound eventually healed. Very little power or sensation returned in the paralysed limbs. About a year after the wound he began to have fits every month, in which he lost consciousness and was incontinent. When last examined in 1934, sixteen years after the wound, he had had no fits for over ten years.

Case No. 210.—This man was wounded on June 23, 1916, at the age of 29, by trench-mortar fire. He was struck in the right frontal region. He was not unconscious, and the wound was trivial. Radiographs revealed neither foreign body nor fracture. No operation was performed, and he was back on duty at the end of the week. The next day he had an attack of twitching of the left hand, spreading to the whole of the left side, and he was sent to England. While under observation in hospital he had two more Jacksonian attacks. After leaving hospital in August he returned to duty and was sent to Salonika in April, 1917. He remained well until January, 1918, eighteen months after his wound, when the fits recurred and he had as many as fourteen in one day. On January 22 a trephine opening was made over the arm area of the motor cortex, some distance posterior to the site of the wound. Nothing abnormal was found. Fits continued on and off till June, then grew less frequent and ceased. At the time of his last attendance before the medical board he had had no fits for five years; his sole complaint was of giddiness on stooping at his work as a farm labourer, and he was awarded a pension of 30%, mostly on the basis of the trephine hole in his skull. He had never appealed for more pension.

In the 19 cases categorized as prolonged temporary epilepsy there may be some that have had unrecorded attacks since the last examination, but in view of the fact that some of the patients have been free from fits for as long as eleven years it is not possible to explain away the impermanence of the epilepsy on this basis. What part may have been played by sedative drugs cannot be determined from the information available. In two of the cases the delayed onset of septic complications in the wound may have contributed to the presence of the temporary epilepsy.

In all the cases in which fits began more than two years after receipt of the wound the epilepsy was of a persistent character, attacks continuing up to the time of the last examination (Table VII).

TABLE VII.—*Time of Onset of First Fit in Relation to the Course*

	Weeks			Months					Years	
	1	2	3 & 4	2	3	4-6	7-9	10-12	2	3-20
Temporary	12	2	0	0	2	3	0	1	3	0
Persistent..	3	2	0	4	3	10	7	7	7	18

Epilepsy is more likely to be of a persistent character in those cases in which the dura was penetrated by the wound (Table VIII).

TABLE VIII.—*Relation of Integrity of Dura to Temporary and Persistent Epilepsy*

	Temporary Fits	Persistent Fits
Dura intact	41% (7 of 16 ceased in first 2 weeks)	59%
Dura penetrated	26% (3 of 14 ceased in first 2 weeks)	74%

When the focal signs clear up the prospect of the epilepsy also clearing up is enhanced (Table IX).

TABLE IX.—*Influence of Recovery of Focal Signs on the Course of the Epilepsy*

	Temporary Fits	Persistent Fits
Transient focal signs	37%	12%
Permanent focal signs	26%	46%

These late follow-up results thus show that in about one-third of the patients having fits after gunshot wound of the head epilepsy may be of a more or less transient character. The earlier the fits begin the less likely are they to become persistent. In the first week after injury, if we may judge from this series, the risk of a man having fits is about 5% (15 of 317 cases), but the risk of the fits becoming persistent is only 1 in 5. Fits starting in the second week stand an equal chance of being temporary or of becoming persistent. As the weeks pass the odds against the fits being of a temporary character rapidly increase. From the sixth month to the end of the second year the risk of developing epilepsy is about 10%, but the odds favour the epilepsy becoming persistent as 5 to 1. If the onset of fits is delayed beyond two years the epilepsy will be persistent.*

Summary

The Ministry of Pensions records of 317 cases of gunshot wound of the head of the 1914-18 war have been examined with regard to the occurrence of epilepsy. The series represents a fair sample of head injuries that were severe enough to receive an award of pension yet not so severe as to cause death in the first four years after injury. The period of follow-up varies from about seven to twenty years. Blunt injuries and wounds of the cerebellum have been excluded.

Of the 317 cases 107 (34%) developed epilepsy.

Up to the end of 1940, 14 (4.4%) of the patients had died. One, and probably two others, died of complications of the brain wound, the remaining 11 of intercurrent conditions.

In cases in which the dura had been penetrated fits were twice as frequent (45%) as in the scalp and skull wounds in which the dura was intact (23%).

Scalp wounds due to missiles are more likely to be followed by epilepsy than are scalp wounds due to blunt injury.

There was no evidence that removal of metallic foreign bodies from the brain diminished the liability to epilepsy.

* In this connexion it is necessary to add that the series gives no information about the effect of operative excision of brain scars upon the course of the epilepsy.

Prolonged wound sepsis, as indicated by delayed healing, favours the subsequent onset of epilepsy both in cases in which the dura has been penetrated and in those in which the integrity of the dura has been preserved.

Epilepsy is more common after wounds affecting the sensorimotor cortex than after wounds of the polar regions of the cerebral hemisphere.

The presence or absence of concussion (immediate unconsciousness) after gunshot wound does not influence the subsequent liability to epilepsy.

The first fit may occur within a few hours after injury or may be delayed at least as long as twenty years. Epilepsy begins more often in the first two weeks, and thereafter the liability to develop epilepsy progressively diminishes.

In 30 of the 96 cases in which the course of the epilepsy is known fits ceased some years before the patient was last examined. This subsidence of epilepsy occurred most often in cases in which fits began in the first fortnight after injury, less frequently when fits began within the first two years, and never when the first fit occurred more than two years after the injury.

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RECENT MORTALITY FROM BRONCHITIS IN LONDON

BY

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Until the Registrar-General's Annual Statistical Review appears there is no information as to the main causes of death throughout the whole country in any period of time. Such records were last published for the year 1938, but figures are given for the administrative county of London under "short list" headings in the weekly returns, which have continued to be published since the outbreak of war. It is possible, therefore, to compare the experience of the years 1939 and 1940 with that of previous years for this area. The fifty-two weeks covered by the weekly returns do not coincide exactly with calendar years, but the slight error in taking the sum of the figures contained in them as a year's experience is unimportant. When this is done the very great increase in the number of deaths classed in 1940 as being due to bronchitis immediately hits the eye. Stocks (1940) has shown that the greatest single cause contributing to a general excess of deaths at ages over 45 in London between January 7 and February 17, 1940, was bronchitis. During this short period deaths from all causes exceeded the number expected on the basis of the same weeks in 1939 by 1,900, or nearly 33%; those from bronchitis were 800 (106%) in excess. With all the information of the Registrar-General's office at his disposal he was in a position to eliminate the several fallacies of comparison which will be discussed later, and the great increase in mortality from bronchitis he reveals must be accepted as real. The period of time was, however, very short, and a lesser but substantial excess in the deaths from some other causes, such as influenza, pneumonia, and

heart diseases, which he demonstrated then would probably not have been sustained if the figures for a longer period had been examined by the same methods. He drew attention to the fact that these rises coincided with the exceptionally cold spell of weather in January and February. The point is important, for any change of mortality which is contemporaneous with the war is apt to be regarded as one of its results. The experience of the whole year therefore deserves as careful examination as possible.

Statistical Discontinuities

At the outset we are faced with certain difficulties. We know that the population of the administrative county of London has been falling steadily for some time. Between 1921 and 1931 it fell from 4,484,523 to 4,396,821—i.e., by nearly 2%. The mid-year estimate for 1938 was 4,062,800, representing a rapid decline of more than 8% during the seven years since 1931. So long as comparisons of death rates, not merely of deaths, are made this fall does not matter. In 1939 the population was estimated at 4,013,400, but this figure was adjusted for death-rate purposes to 3,780,700 in order to allow for evacuation movements and the exclusion from the death returns of non-civilian deaths since the outbreak of war (L.C.C. Report, 1939). Estimates for 1940 have not yet been published and are beyond the competence of anyone without access to official records, but it would not be unreasonable to suppose that the deaths in 1940 occurred among a population not exceeding, on the average, three and a half millions. If this is so we should expect a reduction in the number of deaths from all causes, as compared with the average of the previous ten years, of at least 16%, in the absence of factors inhibiting such a decline. Further, since the outbreak of war deaths have been assigned to the place of occurrence and not to residence. This may seriously affect comparability. In the circumstances of 1940 it would probably reduce the recorded deaths from natural causes in London. A still more serious interference with continuity is the change made by the Registrar-General in the method of classifying causes of death since the beginning of 1940. Whereas formerly the selection of one cause for the purpose of classification from more than one stated in a death certificate was made according to arbitrary rules, it is now determined so far as is possible by the order of preference indicated by the certifying practitioner. It is easy to see that this change (which was bound to come sooner or later) gravely affects comparison with the statistics of previous years. The adoption at the same time of the 1938 revision of the International List of Causes of Death is less likely to affect the comparability of figures relating to those causes with which this paper is concerned. It is, at least, clear that, for the present, the large number of deaths from bronchitis in 1940 has to be examined without any attempt to express it as a death rate, and that we must make sure that it is not an artificial result of changes in statistical procedure.

In a normal year nearly 90% of the deaths classed as due to bronchitis in London occur at ages over 45. It is therefore a cause mainly affecting those who have passed middle age, and it rapidly increases in old age. In 1939 92% were over 45, and in 1940 the proportion rose to 95%. The reasons for this rise may be disregarded for our present purpose. The point is that we are considering for 1940 a condition affecting the usual elderly age group of the population. It kills especially those whose cardiovascular and renal systems, as well as the respiratory, are degenerating. When death occurs it must often be hard