

Finally, the gradual accumulation of photocopies or reprints of classical contributions to the neurological sciences is nowadays possible. In this way a remarkably useful collection of primary source material for teaching or research is provided and this ready access to original historical writings can eliminate the slavish and laborious copying of other writer's citations from classical works, with all the attendant chances of error.

Here then is a survey of some of the work proceeding or needed in the history of the neurological sciences, a veritable research protocol for the future. The professional historian of medicine can tackle a proportion of the topics mentioned but when it comes to the technical details he must be joined by neurological experts, the persons practising the subject the historian is investigating. It seems therefore that there is a large amount of historical work available for all of us.

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Rehabilitation of the Brain-injured

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Head Injuries: An Analysis and Follow-up Study

The planning of facilities to care for head injuries demands the accurate definition of the problem facing medical services, in terms of both numbers and severity. Many series of head injuries have been published, most of which have dealt with selected populations. The series reported by Russell (1934) was studied at a time when hospital admission of head injuries was in itself a criterion of severity; that published by Russell & Smith (1961) was exclusively of Service personnel, and Miller & Stern's (1965) patients were all seen for medicolegal purposes. The present study was designed to state the problem presented to a teaching hospital in the course of one year, in terms of the immediate situation and of the situation five years later.

Material and Methods

Four hundred and eighty-four patients admitted to the Cardiff Royal Infirmary in 1958 were classified as head injuries in the diagnostic index. The case records of these 484 patients were studied and five years later, in 1963, a study of the current medical and social status of these patients was started. Data from both investigations, the study of inpatient records and the follow-up study, were transferred to punch cards and tabulated. Difficulties of selection arise in all series of this type but we have reason to believe that selection played a minimum part in this series. The patients were admitted almost exclusively via the Casualty Department, which is one of two such departments in the City of Cardiff and for several miles around. These departments are equidistant from the City Centre and are situated on the main route through the city. The selection of head injury as the diagnosis may have allowed the escape of some cases of head injury whose other injuries formed the dominant problem. The total may therefore be an underestimate.

Wherever possible information for the follow-up study was obtained by personal interview

Table 1

Head injuries – analysis and follow-up study of 484 cases admitted to Cardiff Royal Infirmary in 1958

	No. of cases
<i>At follow up 1963-4</i>	
Untraced	23
Dead – no information	2
Dead (treated separately)	44
Available for study	415
<i>Information from:</i>	
Patient	260
and relative	} 80%
Patient only	
Relative only	47
Questionnaire	32
Multiple sources	3

(J H S) with the patient – failing this, by questionnaire. It was considered desirable to interview a relative of the patient, and the patient was subjected to a neurological examination.

The main data are set out in Table 1. Nine (1.9%) patients died as a result of their head injury, and as usual in such series, their deaths occurred predominantly in the first forty-eight hours after admission. By the time of the follow-up study a further 37 patients in the original series of 484 had died. Analysis of this group by age, social class, severity of injury, and degree of disability and cause of death revealed no trends which might suggest that their head injury had influenced their death, and this group will not further be considered. Four hundred and fifteen patients were available for the follow-up study and the source of information is classified in the second part of Table 1.

Classification by Age and Social Status

The population of Cardiff City Borough in 1958 was 253,300. Of the original 484 patients, 390 resided within the City Borough at the time of

their accident. These 390 were classified by age and compared with the general population of the Borough similarly classified (Fig 1). The trend indicates predisposition to head injury in the younger age groups, which is reversed in middle age but which tends to reappear in senility. The same 390 patients are classified by Registrar General's Social Classes in Fig 2. There is little significant difference between the populations except in Social Class IV, where the percentage of head injuries was greater than the percentage of the general population. Tabulation of the sex and marital status of the series revealed no significant trends when related to type of accident or to the general population of the Borough. In the series as a whole there was the type of sex incidence reported in most other series, 348 males to 136 females (2.6:1).

Nature of Accident

Site of occurrence: Of all the head injuries 64% occurred in the street; these comprised 45% road traffic accidents and 19% others. Accidents in the home totalled 14%, including 4% who fell downstairs. Industrial injuries (9%) were classified as those which occurred during the course of employment irrespective of the geographical site; they form a remarkably small percentage of the total. Sports injuries (3%) and assault (7%) accounted for a significant 10% of the total.

Mechanism of injury: Falls predominated as a cause of injury. No fewer than 262 (54%) of the entire series were caused in this way: 106 fell from a bicycle or motor bicycle, 13 from a vehicle, 25 fell down stairs, 46 fell from a height and 72 fell to the ground. When the mechanism was tabulated in relation to age no striking trends emerged. Old people and children tended to be knocked

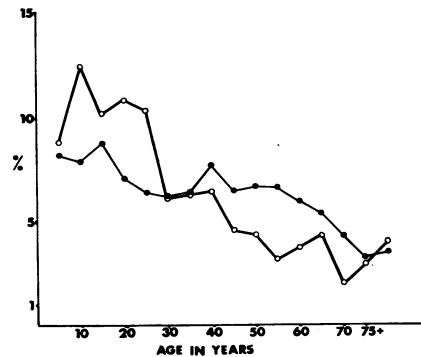


Fig 1 Comparison of 390 head injury patients with general population of Cardiff City Borough. ○—○, head injuries by age as percentage of all head injuries. ●—●, number of persons in age group as percentage of total population (1961 census)

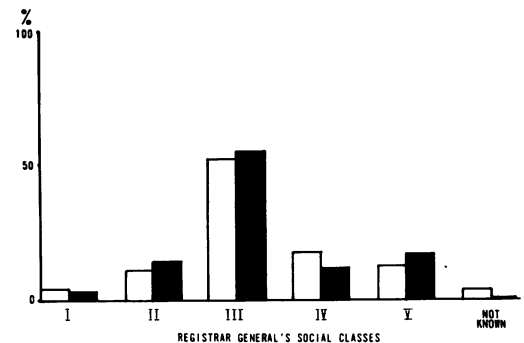


Fig 2 Classification of 390 head injury patients by Social Class, compared with general population of Cardiff City Borough (CCB). □=percentage of 390 head injuries. ■=percentage of population of Cardiff City Borough

Table 2

Duration of disability		Percentage of cases
<i>Duration of hospital stay (484 cases)</i>		
Less than 48 hours (264 cases)	54	
More than 1 month	4	
<i>Duration of convalescence (415 cases)</i>		
At 1 month:		
Recovered	69	
Returned to work	51	
At 3 months:		
Recovered	81	
Returned to work	74	
At 5 years:		
Felt recovery incomplete	13	
Not back at work	1	

Table 3

Complications during admission (484 cases)

Complication	No.	%
Cerebrospinal fluid leak	10	2.1
Subdural hæmatoma	7	1.4
Extradural hæmatoma	4	0.8
Anosmia	6	1.2
Epilepsy	10	2.1
Hemiparesis	10	2.1
Cranial nerve palsy	15	3.1
Dementia	3	0.6

down on the roads, bicycle accidents tended to occur in the 5–15 age group, and motor cycle accidents and assaults in the 15–30 age group.

Hospital Care and Convalescence

Four hundred and forty-nine patients were admitted as an emergency, the remaining 35 being transferred from other hospitals. The nature of the emergency services in 1958 was such that 69% of the total were under the care of general or orthopaedic surgeons and 23% under pædiatric care. All children under 14 were admitted to pædiatric wards irrespective of the nature of their illness. The situation in 1969 is probably not substantially different, except that the orthopaedic surgeons have taken over from the general surgeons in the care of head injuries. Table 2 shows the duration of convalescence as estimated from the follow-up data: the trend at one month, and to a lesser extent at three months, is for some patients to be off work at a time when in their own estimation they had recovered. This trend is sharply reversed at five years, when 13% felt recovery incomplete, but only 5 (1%) were not back at work.

The incidence of fracture in the 363 patients in whom the information was recorded in the notes was 23%. This may be an over-estimate since it is likely that failure to record the results of skull radiography implies that there was no fracture. The types of fracture were: linear 49, stellate 4, depressed 5, compound 9, compound plus depressed 19; total 86. The surprisingly high incidence of serious fractures is almost certainly a

result of selection since the neurosurgical service for the region is sited in the hospital and such cases frequently entered the series as transfers from other hospitals.

Complications arose during admission in 65 patients (13%); some patients had more than one complication (Table 3).

Severity of Injury

This was assessed by three methods, state of consciousness on admission (Table 4), duration of unconsciousness (Table 5), and duration of post-traumatic amnesia (PTA) (Table 6). There was a striking lack of information in the hospital notes but it was found possible to remedy this deficiency in the case of PTA from the follow-up study. As expected, the duration of unconsciousness was less than 1 hour in 85% of cases, and only 9% were definitely unconscious at the time of admission, although information is lacking in 23% of the total.

PTA is generally accepted as a major index of severity in head injuries, yet its occurrence and duration were recorded in the hospital notes of only 40% of cases. The patients in the follow-up series were graded according to the duration of the gap in their memory; 13% of the 415 patients had a severe injury as judged by PTA of more than 24 hours.

Table 4

State of consciousness on admission (484 cases)

State on admission	No.	%
Conscious	271	56
Drowsy	59	12
Unconscious	43	9
Not recorded	111	23

Table 5

Duration of unconsciousness (484 cases)

Duration of unconsciousness	No.	%
Not recorded	193	292 } 60
Not unconscious	99	
Less than 1 hour	163	100 } 85
1 hour - 1 day	19	
1-7 days	3	
More than 7 days	7	

Table 6

Duration of post-traumatic amnesia (PTA) (415 follow-up cases)

Grade	Duration of PTA	No.	%
0	0	36	9
1	<1 hour	182	44
2	<1 day	89	21
3	<7 days	34	8
4	>7 days	19	5
Too young		48	11
Not known		7	2

Table 7

Effects of injury noted at follow up (415 cases)

	No.	%
<i>State of health</i>		
Well	339	82
Symptoms only	50	12
Physical signs	17	4
Epilepsy	9	2
<i>Occupational downgrading</i>		
No change	401	97
Temporary downgrading	3	0.4
Permanent downgrading	6	1.3
Unemployed	5	1.1

Effects of Injury

The physical and social effects of injury are listed in Table 7. Five years after their injury 18% of 415 patients demonstrated some physical sequelæ, and 2% of the total had had epileptic fits which were judged to be a consequence of their injury.

Occupational downgrading was selected as the most relevant yardstick of disability. In the case of housewives and children, ability to perform their former routine of housework and school performance respectively were the criteria adopted. Only 11 of 415 patients (2.6%) were unemployed or permanently downgraded as a result of their injury, and the occupational status of 97% remained unchanged.

Personality change has always been a difficult factor to assess because of the inability to quantify a subjective complaint, and because of changes which are so subtle in nature as to escape clinical identification. The complaint was made by 42 patients (10%) and confirmation was obtained from a relative in 35 of these. The mean duration of PTA was estimated in those cases in whom personality change was recorded and in those in whom personality change was not present. The difference between the means was highly significant. The relationship of personality change to the presence or absence of PTA in a qualitative sense could not be established statistically, but the incidence of personality change rose with increasing duration of PTA. Conversely the number of patients with no personality change fell with increasing duration of PTA. When personality change was related to age and duration of PTA it was found that for a given duration of PTA the incidence of personality change increased with age.

The relationship between PTA and time to recovery (in the patient's estimation) and between PTA and time to return to work is demonstrated in Fig 3. The patients were grouped according to the duration of their PTA, and the mean length of time to recovery and return to work were calculated for each group. The means were compared by the *t* test: in the figure illustrating recovery the difference between the means is not significant although the trend is clear; in the figure illustrating

the interval to return to work, the differences between PTA groups up to 24 hours are not significant but the differences between the other means are significant, and the trend is even more marked. An alternative analysis using median rather than mean values showed that the median times to return to work for PTA Grades 0-4 were, respectively, 18 days, 12 days, 19 days, 15 weeks and 44 weeks. Little significance can be placed on the fact that the group with no amnesia took longer to return to work than those in Grade 1, because the periods are so short that associated injuries and the differing routines of general practitioners must play a part.

Compensation

Sixty-three patients (15%) claimed compensation for their head injury; 54 were successful and 9 unsuccessful. Twelve patients received over £1,000, three of these receiving more than £5,000. Twenty claims (37%) were settled in less than one year and a further 32% were settled within two years; 31% of claims remained unsettled more than two years after the injury, but at five years all had been settled. An attempt was made to relate the amount awarded to the time to recovery and return to work, but no significant trend was demonstrated. In general the larger the sum awarded the longer the patient took to recover and return to work; the numbers in each category were small and several individual cases upset any trends. For example, one man who received £3,000 stated he had recovered in less than one week, while two who received £100 stated they had not recovered five years later. The patients whose claims were rejected took a long time to recover or to return to work, and it is tempting to invoke neurotic resentment in explanation of this. Of the 9 patients in this category, 4 had a PTA of more than 24 hours, and 4 of less than 1 hour. Any conclusions as to the

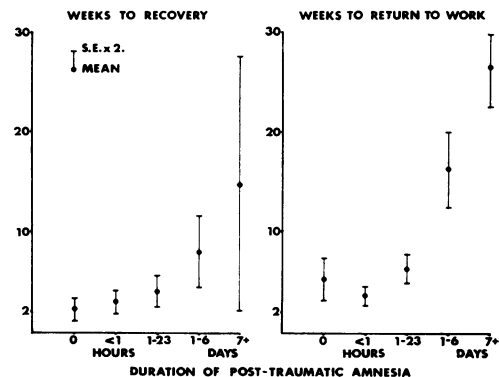


Fig 3 Relationship between PTA and time to recovery, and between PTA and time to return to work

Table 8
Relationship of post-traumatic amnesia to compensation

Incidence of claims (%)	Post-traumatic amnesia				
	Grade 0 25	Grade 1 6-4	Grade 2 19	Grade 3 35	Grade 4 74
<i>Amount awarded (£)</i>					
<100	2	5	5	-	1
100+	3	3	8	6	1
500+	-	-	2	3	2
1,000+	1	-	-	1	4
2,000+	-	-	-	-	1
3,000+	1	1	-	-	-
5,000+	-	-	-	1	2

effects of rejection of a claim are impossible because the rejection can result from failure to prove liability as well as from failure to establish serious injury. When the duration of PTA was related to the amount awarded, a striking trend towards higher awards for longer durations of PTA was demonstrated, but numbers were too small for statistical analysis. In the series of 415 patients there were 19 with more than 7 days' PTA, 14 of whom were involved in claims for compensation. The relationship of PTA to the amount awarded is shown in Table 8, with the incidence of claims for compensation in each grade of amnesia.

One-quarter of patients without PTA claimed compensation; this figure seems remarkably high and out of step with the trend of increasing incidence of claims with increasing PTA.

Discussion

The results of this study in terms of sex and age incidence, Social Class, nature of accident and hospital stay do not differ significantly from other series published (e.g. Selecki *et al.* 1967). Many series are not truly comparable for reasons of selection, as a result either of the population available or of the purpose of the study.

The studies of Miller (1961) and Miller & Stern (1965) were concerned with medicolegal cases only. Miller & Stern studied only severe injuries with PTA longer than 24 hours, and the mean duration of time off work was much longer than the means for Grades 3 and 4 PTA in our series. Although their cases contained a higher proportion of very severe injuries, the discrepancy may reflect some influence of litigation. Death during the follow-up period was attributable to the injury in one case in their series and in none in the present series. This contrasts with the opinion of Fahy *et al.* (1967), who concluded that there was an increased risk of premature death in their study of 275 severe head injuries. In this series again the high incidence of unemployment or occupational downgrading reflects the selection of severe cases.

The positive correlation of PTA with the incidence of organic sequelæ to head injuries has been repeatedly confirmed since Russell (1931) first emphasized the meaning and importance of 'return to full consciousness'. Selecting medical discharge as their criterion of disability in a series of service men, Russell & Smith (1961) found increasing disability with increasing duration of PTA and illustrated the value of PTA in distinguishing malingering from organic post-concussional syndromes. Service conditions are not wholly comparable with those obtaining in civilian practice and Russell (1966) commented on the desirability of using an unselected series to assess post-concussional symptoms. The criterion of disability in the present series is return to work, and Lewin's (1966) generalization that PTA of less than one hour favours return to work in less than one month is borne out by our figures.

The study cannot define the nature of the symptoms grouped under the title of 'post-concussional syndrome'. Miller (1961, 1966) considers many examples are frank malingerers. Symonds (1962) considered that neuronal damage may be responsible, a view supported by intensive application of modern investigative techniques (*Lancet* 1968). Rowbotham (1964) considered that the syndrome 'probably results from a combination of neuronal commotion, anxiety, exaggeration and the desire for retribution or gain'.

In our series 50 of 415 patients had symptoms without physical signs or disability five years after their injury. The incidence of such symptoms as headache, dizziness and loss of concentration in Barr & Ralston's (1964) series was similar, and they commented that when analysed in succeeding years the incidence did not seem to fall.

The beneficial effects of financial settlement on the syndrome (Miller 1961) cannot be confirmed from the present series owing to lack of essential data, but it is hoped that this may be possible in the future. The incidence of claims for compensation in each grade of PTA shows a striking similarity to the figures of Russell (1934). In both studies there is a high incidence of claims in the groups with PTA of less than one hour. Against a background of previous studies of the influence of PTA this would suggest that these claims are tainted by malingering, and the patients concerned may well represent the essence of Miller's (1961) argument.

The study confirms that PTA remains the best yardstick of organic brain injury. If such injuries are to receive proper care and assessment it is essential that the necessary information be recorded. In 60% of cases in this study there was no information in the hospital records to indicate the duration of PTA. Records of duration of unconsciousness demonstrated a lack of under-

standing of the definition of PTA and records of skull radiography were inadequate. Experience suggests that only in a centre specially designed to care for head injuries will adequate standards be attained, and the information published from the military unit in Oxford illustrates the point (Russell 1951).

Although the number of patients in this study left permanently disabled five years after their injury is small (2.4%), so is the unit studied compared with national medical services as a whole. Preservation of life has been shown repeatedly to be a question settled within hours or even minutes of injury, but permanent disability leaves a cumulative national pool of disability annually which must present a preventive challenge to medical services.

Summary

A survey has been made of 484 patients admitted to a provincial teaching hospital in one year with head injury. Four hundred and fifteen of these patients were followed up five years later and the long-term results in social and medical terms recorded. The results illustrate the necessity of keeping accurate and full clinical records of such patients, which would be best performed in a specialized centre. Post-traumatic amnesia remains the best yardstick of severity when related to the long-term results of the injury. The incidence of claims for compensation and the amount awarded was related to the severity as judged by PTA, with the exception of a remarkably large incidence of claims in those who had suffered no amnesia.

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Rehabilitation Needs of the Brain-injured Patient

From the point of view of rehabilitation, patients after head injury may be divided into three groups depending on the severity of the injury, each requiring some special need: (1) Mild and moderate head injury. (2) Major head injury. (3) A group of patients with prolonged unconsciousness. Before discussing these groups in greater detail, it is wise to keep the matter in perspective by reminding ourselves that the majority of head-injured patients require no special arrangements to be made. With general guidance they proceed to make a complete and uneventful recovery. For the minority, however, at all degrees of severity, it has become apparent that the lack of provision for their after-care leads to unnecessary invalidism, economic loss to the country and a management problem for the hospital services.

The numbers involved are difficult to gauge accurately but some help may be gained by analysing the figures obtained from the Department of Neurological Surgery and Neurology, and from the Accident Service, at Cambridge. All head injuries admitted come under neurosurgical care. An average of 750 are admitted annually with a mortality rate of about 3%. The great majority sustain minor or moderate head injuries with a post-traumatic amnesia (PTA) of less than 24 hours. A follow up over the country of this large group is notoriously difficult and how many fail to make the recovery they should from lack of adequate after-care is not known. What is certain is that within this group unnecessary invalidism results where recovery should be the rule. More is known of the patients in the second group who have sustained major head injuries with a PTA of more than 24 hours. Taking our own figures and translating them into terms of the country as a whole it is estimated that some 7,500 patients sustain such major injuries annually. In this group the permanent disability, both mental and physical, is more obvious and indeed some 20% of the survivors or about 1,500 patients a year are left unemployable or, after a long period of rehabilitation, are working at a simpler level. Among these are a smaller number of patients comprising a third group who sustain injuries of such severity that they remain unconscious for a month or longer, some for months or even years. These patients with 'prolonged unconsciousness'