The ecology of trauma

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According to the dictionary, ecology is 'that branch of biology which deals with the inter-relations of organisms and their environments' (Oxford English Dictionary). This aptly applies to four aspects of this protean human disease, trauma.

1 In the causation of trauma there are many interrelated factors.

2 In its pathology there are many general and local interacting aspects of what is one disease.

3 In treatment there is the essential team work.

4 In the prevention of injury and of disability, cooperation is needed by the many national and local agencies and by the great lay public themselves.

Causation and prevention involve the whole basis of life: genetics, tradition, education, physical and psychological development; environment (political, social, and domestic); architecture and engineering; industry, transport, communications, and recreation. It is here that ecology comes in. Because of the complexity of all these factors, my statistical presentation can only be an outline sketch.

Accidents are comparable with the coliform organisms: they exist everywhere all the time but pathological results require special circumstances within the individual. Accidents may cause no trauma or material damage: injuries may be slight, moderately severe, of multiple severity, or may lead to catastrophe and death. The same accident may lead to any of these results, and it is often chance that determines which though not chance that causes the accident: the difference between the subjective and the objective, in other words, personal action and material reaction. These rarely are 'equal and opposite'. Nevertheless, chance does enter largely into the causation of trauma to those people to whom we refer as 'third parties'; in other words, to the person who

happens to be at a certain place at a certain time in relation to a particular incident. The accidents without trauma have special lessons, as the following stories indicate.

A few years ago, I was driving my car through a small country town on a rather blustery day. A loose tile was blown from the roof of a rather shabby shop and crashed on to the bonnet of my car, causing severe damage. If this had occurred half a second later, the tile would have gone through the windscreen and I could have been a victim. This was a double chance happening, first in damaging my car, and then in not causing injury to me. The accident, however, was what caused the tile to break loose from its bedding. The insurers of the building tried to take refuge in an 'act of God' (which I told them was blasphemy). Enquiries into official local wind records and an inspection of the roof had proved that the ultimate cause was defective environmental maintenance.

In Exeter, a modern shop decided to provide a canopy over the pavement in front of its windows. The evening before it was opened this thoughtful provision was still protected by a wooden hoarding some 6 ft or so from the shop. The pavement was crowded with traffic, when the canopy collapsed without warning and without causing injury. It was chance that the hoarding was still there, but not chance that the canopy collapsed; this was due to the failure by the architects to design a proper cantilever construction. When tubular scaffoldings collapse, as they have done several times recently, it is surely defective craftsmanship which is the major cause. Both accidents are examples of human personal failure.

Many people live perilously poised between physiological normality and abnormality. In other words, the physiological defects of obser-

vation and perception, together with defects of intellectual response and motor function, may be the first steps on the slippery slope to disaster. The border lines of abnormality may, of course, be both moral and pathological. These everyday experiences are commonly referred to as mistakes. On the pathological side, these may lead to unhappiness and tragedy, destruction, and economic loss.

The industrial revolution and the automobile have led to the overthrow of 'pedestrian man'; he is now increasingly a mere cog in the machine-man, and as such his special vulnerabilities are those of weight and speed of impact when he allows the machine to take possession.

The clear pathological causes of accidents on the roads are of importance although relatively small statistically. One refers to the influence of cardiac disease, diabetes, epilepsy, and other neurological diseases, crippling, visual and auditory defects. Death at the wheel is rare. These matters have been discussed in a publication by the Medical Commission on Accident Prevention entitled *Medical Aspects of the Fitness to Drive Vehicles* (1968).

Statistics

It should be stressed that mortality figures are not a sufficient guide to the seriousness of our subject. In England and Wales the mortality

Road ²	6,349 (1967 = 7,168)
Industry	1,313
Poisonings (all types)	964
Suicides	4,584
All other accidents (including home)	9,533
Total	22,743

Table I *Accident mortality rates*¹

¹From Department of Health and Social Security report in 1968 for England and Wales.

²In 1968 the road mortality was the only one which was reduced probably due to the legislation relating to alcohol and driving.

Deaths	7,000
Serious injuries	84,000
Lesser injuries	250,000
Average daily bed occupancy (England and Wales)	13,000

Table II *Yearly road accidents for England and Wales in round figures*

Sickness benefit	200,000
Injury benefit (industrial)	19,000
Sickness absence	300 millions
Injury absence (non-industrial)	22 millions

Table III *Weekly claims for benefit and days of work lost to industry published by the Department of Health and Social Security (1968)*¹

¹All figures refer to England and Wales.

figures from all accidents are approximately 22,000 yearly, with 8,000 domestic, about 7,000 in transport, 1,200 in industry, 1,000 poisoning, 4,500 suicides, and the rest other unspecified causes (Table I). Concerning road accidents, mortality receives the greatest publicity, but we should realize that for every death there are approximately 12 cases of serious injury requiring admission to hospital, and 36 times as many minor injuries (Table II). A few years ago there was a daily bed occupancy in British hospitals of 13,000 dealing with trauma (the equivalent of 25 large district hospitals). A further guide to the economic loss (Table III) is contained in the figures of the Department of Health and Social Security for 1967 (the last available) (DHSS, 1969). This relates to claims for industrial injury benefit, which indicate that more than 21 million days are lost each year to industrial production from this cause, which, I am told, far exceeds those lost due to industrial strife (5 million days). In addition another 20 million man days are lost to employment from non-industrial accidents.

In 1963 Beckingsale reckoned the total cost to the nation of all accidents to be about £500 million. Today it must be nearer to £1,000 million.

The road accident variables are well enough known. Here, apart from the particular problems of the young child and the elderly person, who both seem particularly vulnerable, there are differences to be detected between the pedestrian, bicycle, motor-cycle and other vehicle users. For the bicycle it is the older children who suffer, but the really serious vulnerability is in young adults between the ages of 16 and 25 on motor-cycles. This is clearly psychologically dominated, for it is at a time of life when physical fitness and reactions are at their peak of excellence and, at the same time, when alcohol as a vice is less significant and the influences of the aging processes are minimal, both of which appear to be major factors in the aetiology of all accidents. Figures 1 to 5 are from the authoritative review by Göglér (1965) of Heidelberg and can be regarded as typical for all western European countries, the chief variable being in the intensity of the accident situation from one country to another as illustrated by Norman (1962) in Figure 6.

In domestic accidents the infant and the elderly person are equally vulnerable, the former probably related to some extent to overcrowded conditions but also to the deficiencies of experience and training and to the conflicting social interests. In the old we are predominantly concerned with the aging process and the accompanying defects of locomotion, as well as with other pathological contributory features (Figs. 7 and 8).

In the American figures for domestic injuries an interesting increase is seen amongst women

Fig. 1 Distribution by age of persons killed or seriously injured per 10,000 persons of the same age in 1955 (Gögler, 1965).

Fig. 2 Age groups per 1,000 population compared with distribution of road casualties (Gögler, 1965).

the 45-year age group. This recalls the work of Dr Patricia Lees, in the Midlands of England, who studied the accident proneness of women in industry during the childbearing period. She was able to show that women in this period of life are significantly more susceptible to accidents

and she was able to pinpoint this liability to the preluteal phase of the menstrual cycle (Lees, 1966). Industrial accidents account for many millions of days lost to work. In factories the main causes are in the handling and lifting of goods and

Fig. 3 Comparison of accident deaths with mortality in other diseases between ages of 15 and 24 (Gögler, 1965).

Fig. 4 Causes of death in fatal accidents (Gögler, 1965).

Fig. 5 Body zones at risk and distribution of injuries in motor-car occupants (Göglér, 1965).

Fig. 6 Road accident mortality in three highly motorized and three less motorized countries (modified from Norman, 1962 with figures for England and Wales superimposed).

Fig. 7 United States figures for domestic accidents: age and incidence per 1,000 population (from Backett, 1965).

materials, defective machinery or its use, being struck by falling objects, or striking against objects and falling. The spine and hands are particularly at risk. While fatalities are in the neighbourhood of 1,200, the building and engineering industries have the worst reputation. In the young workers faulty training is a big factor but in all workers faulty design of, or failure to use, protective equipment, breach of instructions, unsafe attitudes, poor judgment, and inadequate supervision are all contributory. We should not forget that certain toxic processes are also hazardous.

For sport and other leisure-time activities, there are no accurate data, but it is probable that it is in this area that more injuries occur than in any other environment. Nevertheless, it must be accepted that injuries at sport are rarely lethal. Perhaps the disciplines of sport, which have to be accepted by the individual for his own safety and pleasure in an environment which is organized and restricted for this sole purpose, provides a basic model. In the arena of unorganized sport and leisure, however, the story is different, particularly in those situations where individuals, singly or in small groups, explore the natural environment without adequate training and study of the environment and without proper clothing and other equipment. Here are frequently found, as Pugh (1966) has described, the severe and even fatal results of exhaustion and exposure, particularly of collapse under wet, cold condi-

Fig. 8 British figures of percentage domestic accident deaths in age groups (from Backett, 1965).

tions. Even in the home where so many leisure-time activities are pursued, the training and protective measures, in an increasingly mechanized environment, are often grossly defective; the hazards include garden and carpentry tools, weed killers and other poisons, faulty electrical circuits, quite apart from the more customary domestic hazards.

The prevention of accidents must depend on education, properly directed, from an early age. It must go hand in hand with a moral regard for accurate perception and efficiency of performance in the jobs to be undertaken. Nevertheless, it would be foreign to human progress to prevent enterprise in youth for the sake of 'safety first'. Awareness of hazards and adequate preparation for them is the solution. The prevention of injury will depend on the application of the same principles and in the modern world it is increasingly a matter of engineering.

To summarize: underlying physical disease and disability play a small part in accident causation. Behavioural aspects aggravated by sub-clinical features, such as alcohol and drugs, play a larger part. Antisocial aggressiveness, bad citizenship, and sheer lack of skill are dominant features.

Environment determines the severity of accidents. Until the last 50 years, life was essentially pedestrian. Now in the age of the automobile and jet propulsion, acceleration and so also deceleration factors have been multiplied many

times. The spontaneous repair mechanisms designed for the pedestrian human being cannot cope with the speeds of impact involved today. The disruptive involvements of the body in multiple injuries are more than the total of their several elements. Even a so-called minor injury produces disorders of general physiological activity.

This is a community problem in mental and physical health, as well as an administrative one in organization, and a medical one in the team work for the reception of injured people, communications, transport, the measurement of the elements of the widespread involvements of the pathological processes of injury, of resuscitation and support of vital processes. The care of damaged parts takes place within that of the whole person (physically and psychologically) requiring the whole range of medical and ancillary specialists, backed by all the resources that the State can devote to a problem which, dispersed as it is throughout the whole population, is of catastrophic proportions.

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