MULTIPLE SCLEROSIS

'. . . il n'est pas râre de voir des intermissions complêtes qui ont pu faire espérer une guérison définitive.'

(Charcot 1872)

'. . . it is not rare to observe complete remissions which show hope for a positive cure.'

(Charcot J M, (1872) *Leçons sur les Maladies du Système Nerveux*).

MULTIPLE SCLEROSIS

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To undertake research on the economic aspects of medical care.
To investigate other health and social problems.
To collect data from other countries.
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Introduction

The unequal geographical distribution of multiple sclerosis is one of its most striking and potentially significant characteristics. The disease occurs with much greater frequency in temperate latitudes and it is particularly prevalent on the island of Orkney, where the prevalence rate is about six times greater than the world average of 30 per 100,000 population (Donnelly 1974). In Great Britain as a whole it is estimated that between 40,000 and 50,000 individuals suffer from the illness, implying a rate of more than twice the world average figure.

Multiple sclerosis is a disease of early and middle adulthood and one which occurs more frequently in females. The disablement consequent upon the complaint varies considerably: from severe paralysis in a few cases to no visually apparent incapacity. It is virtually impossible, however, to estimate precisely the numbers suffering from specific degrees of disability. Similarly generalisations relating to the prognosis of the disease are often misleading because no two patients are affected in exactly the same manner. The majority experience a relapsing and remitting course and the frequently encountered assumption that multiple sclerosis inevitably leads to rapidly progressive deterioration in physical condition is inaccurate and has given rise to unnecessary pessimism.

Our understanding of multiple sclerosis is in a position today somewhat analogous to that of tuberculosis late last century. There are a number of specific similarities, such as the presence of precipitating influences in both diseases (e.g. pregnancy) and the intermittent nature of the two complaints. On a broader level, clues relating to the aetiology and epidemiology of the disease continue to emerge but the clearly identifiable cause or causes and an effective form of treatment which will prevent further relapses have yet to be discovered. Yet it seems probable that research work will, in the not too distant future, clarify the different aspects of multiple sclerosis which may well turn out to be a great deal less complex than is implied by the relatively confused state of our current knowledge of the disease.

This paper describes the nature and suspected causes of multiple sclerosis, its prevalence and the variety of therapeutic measures which have been employed. It also examines the social and personal problems generated by the complaint and the implications that they have for its management.

The nature of the disease

Credit for the first description of the clinical manifestations of multiple sclerosis is generally accorded to Charcot in the mid-nineteenth century, who became familiar with the disease through watching its gradual development in one of his servants. He was unable to identify the cause but suggested a relationship to an antecedent illness and cited cases that had developed following typhoid fever, cholera and smallpox. He also mentioned exposure to cold and emotional factors. By the turn of the century the condition had become well established in medical literature and knowledge was widening with regard to both its clinical manifestations and prevalence.

Multiple sclerosis is today one of the main chronic disorders of the central nervous system and its consequences can lead to the disruption of normal functioning of many other parts of the body. The complaint is characterised by episodes of dysfunction in the brain and spinal cord which have a tendency to remit, leaving the patient with no obvious signs of disability. With the passage of time, however, the severity of these attacks may increase, resulting in a less complete recovery of function after each exacerbation. Nevertheless, it must be emphasised that the disease can assume a multiplicity of unpredictable courses.

The term multiple sclerosis is derived from the fact that post mortems carried out on individuals who have suffered from the disease reveal areas, disseminated throughout the central nervous system, which have been sclerosed (scarred). This condition is the result of a reaction in the white matter of the brain and spinal cord through which run thousands of nerve fibres. The latter, which are effectively the lines of communication connecting the many co-ordinating centres with one another, are each protected by an insulating covering, known as the myelin sheath. A reaction occurs which causes patches of inflammation (plaques) to develop on the myelin covering. The damage to and the gradual loss of myelin frequently leads to a temporary interruption of impulses along the underlying nerve fibre, although the reserves of the nervous system are so considerable that the loss of nerve fibres in the early stages of the disease may not be outwardly apparent. It is only after repeated relapses that scar tissue forms, resulting in permanent damage to nerve fibres with a consequent loss of normal functioning.

The areas of damage are apparently scattered in a random manner and the symptoms experienced by the individual depend upon the location of the point of attack. However, there is evidence to suggest that there are distinct sites of predilection (the optic pathways, for example, are frequently involved) and that

lesions may present a symmetrical pattern, which is encountered sufficiently often to necessitate a more convincing explanation than chance alone (Lumsden 1970).

The process of demyelination (the removal of the protective myelin sheath) is known to both accelerate and decelerate and these changes are associated with the relapses and remissions which characterise the illness. Whether or not remyelination can occur has been the subject of much discussion. Bornstein (1968), using cultured central nervous system tissue, demonstrated that it was possible if the noxious multiple sclerosis serum was replaced by the tissue's normal nutrient. Yet the process is slow and the thickness of the reformed sheaths may not reach that found in unaffected areas. Furthermore, there may be a significant difference between the natural situation in man and the experimental one in cultures.

Aetiology

Many potential causes have been investigated and it is certainly possible to suggest that the solution may involve hitherto unsuspected disease processes.

Research work into the causes of the complaint has, to some extent, been constrained by the inability to reproduce the disease under laboratory conditions. However, experimental allergic encephalomyelitis has often been accepted as a partial model for multiple sclerosis although it is only of limited use because of its transient and non-recurrent nature.

Another research problem results from the fact that familial diseases like multiple sclerosis are often confused with those of a hereditary nature. Instances of the condition in two members of the same family may reflect common exposure to a similar environmental factor rather than a genetically determined aetiology. The more rigorous the ascertainment methods among relatives and the longer the period during which they are followed up, the higher will be the familial incidence figure. Bearing this in mind, a review of a number of studies would tend to indicate that familial cases (first degree living relatives) of multiple sclerosis are between 15 and 20 times as common as cases in the general population (McAlpine *et al* 1972) and that they are particularly prevalent amongst siblings.

Currently, there are two main schools of thought on causation although they are not necessarily mutually exclusive and the evidence available so far does not conclusively prove one theory or the other. One of these schools postulates that the disease is the result of an autoimmune response. Immunity refers to the process whereby the body recognises micro organisms and other foreign substances and then acts to destroy them by producing antibodies and cells that behave like antibodies (immunologi-

cally competent or sensitised cells). In a few naturally occurring autoimmune diseases, and in a number of experimentally induced disorders, antibodies are produced which specifically combine with and destroy normal constituents of the body and this may be the case in multiple sclerosis.

Evidence has been found to suggest the presence of circulating auto antibodies against myelin and myelin sensitised lymphocytes although the antigen(s) remain unidentified. This evidence consists of the finding of a selective elevation of gamma globulin in the cerebrospinal fluid of multiple sclerosis patients. Antibody globulin has been seen to be bound to myelin sheaths undergoing the actual process of destruction at the active edges of plaques in formation, i.e. there is visual evidence that these fixed immunoglobulins are anti-myelin antibodies (McAlpine *et al* 1972).

The second main school of thought proposes that infection is the likely causative agent in multiple sclerosis. The disease may stem from an inadequate immune response on the part of the individual to an infection, which is probably a virus. Furthermore, it has been shown that viruses can attack white matter directly. Pathological, epidemiological and immunological findings have been used to support the infection theory.

Pathological support depends on the observations of inflammatory cells around blood vessels in the region of active or recent plaques of demyelination, which can be interpreted as reaction to infection. Perhaps the most significant evidence for an infectious aetiology is provided by serological surveys. Adams and Imagawa (1962) were the first to report a slightly increased average titre of antibody against measles virus in the serum of patients with multiple sclerosis. Subsequent studies, using a variety of techniques, have confirmed this finding and have also found a higher prevalence of measles antibodies in cerebrospinal fluids from multiple sclerosis patients compared with individuals suffering from other neurological diseases. More recently a number of investigations have identified an increased incidence of specific antibodies against certain structural components of measles virus (Salmi *et al* 1974). Haire *et al* (1974) reported a prevalence of measles virus-specific IgG antibody in the cerebrospinal fluid of patients with multiple sclerosis of 58.1 per cent compared with other neurological diseases (24.1 per cent) and normal control subjects (zero). Such studies contribute additional clues about the role of measles virus in the pathogenesis of multiple sclerosis although the validity of the results is greatly dependent on the choice of suitable controls.

The findings relating to measles appear to be significant in the evidence for an infectious aetiology. It has been postulated that the failure of the body's defence mechanism to expel the virus

completely may enable the latter to remain 'dormant' for a period of time and then emerge, in those who are vulnerable, as multiple sclerosis. Yet one prominent characteristic of diseases known to be caused by slow-viral agents is an almost invariably progressive course with a fatal outcome. This is seen in visna (sheep), kuru (man) and scrapie (sheep or mice). However, only a small proportion of multiple sclerosis patients experience a chronic progression without exacerbations and remissions which might be expected if multiple sclerosis were an uncomplicated slow-virus disease (Adams and Dickinson 1974).

Considerations such as these imply that neither the autoimmune nor the viral infection theories, taken separately, can provide a satisfactory explanation of the disease and this has led to a number of attempts to combine the two approaches. Field (1973), for example, has suggested that multiple sclerosis may stem from the persistence of an initial viral infection (especially measles) with a consequent raised lymphocyte sensitivy to encephalitogenic factor[1] so that an autoimmune disease process results.

The possible significance of fatty acids in the disease process has received a great deal of attention ever since it was shown that some of these acids are probably essential dietary constituents for man. The body appears to be able to build up all the necessary polyunsaturated fatty acids provided it is supplied with linoleic acid and linolenic acid and these may be deficient in multiple sclerosis patients.

It has been suggested that the diet in the areas where the disease is particularly prevalent is not sufficient in these essential fatty acids. Subsequently, this contention has been modified, and it is claimed that the problem is an excessive intake of saturated fatty acids (derived from animal fat) which reduces the amount of essential fatty acids absorbed and used by the body. The mechanism by which a deficiency of linoleic acid may result in multiple sclerosis is not clearly understood. It may be that properly constituted myelin is prevented from developing or that the deficiency of polyunsaturated fatty acids may increase the susceptibility of myelin to the attack of some immunological or auto aggresive disease or to viral infection, either as a left-over from an acute infection or as a 'slow' infection (Field *et al* 1974). If any of these hypotheses can be confirmed, there are significant implications for the treatment of multiple sclerosis by dietary supplements.

A number of surveys have suggested a correlation between the incidence of the disease and the consumption of large quantities

1 Encephalitogenic factor is the putative antigen at work if multiple sclerosis is regarded as an autoimmune disease.

of animal fat. Similarly, Agranoff and Goldberg (1974) have identified a close relationship between a high prevalence of multiple sclerosis and a high intake of dairy produce. However, these hypotheses do not accord with the established fact that multiple sclerosis is uncommon among the Afrikaans-speaking White South Africans who consume a diet rich in animal fat and milk and butter (Dean 1967; 1974).

Precipitating factors

As is the case with both tuberculosis and poliomyelitis, a number of factors can be identified which appear to precipitate the onset of multiple sclerosis or an exacerbation of it. The following observations are based on case histories and although the actual proof of a causal relationship between these factors and multiple sclerosis is extremely difficult, it is possible that the knowledge of their existence may enable some individuals to influence partially the course of their illness.

Pregnancy, it is generally agreed, does not affect the course of the disease. Nevertheless, although the evidence is somewhat conflicting, it has been suggested that there is a small but significant increase in the frequency of exacerbations during the puerperium. A retrospective study (Millar *et al* 1959) found an average of 0.265 per pregnancy year (the nine months of pregnancy and the following three months) which was twice as high as the relapse rate in women without children. A relapse may be provoked sooner than it would otherwise have occurred by the stress of labour and the subsequent increase in work and responsibility. However, a number of reports, such as that by Schapira *et al* (1966), have been unable to confirm this observation, and claim that the risk of exacerbation, in any pregnancy year, is only 50 per cent greater than in a non-pregnancy year. Pregnancy therefore appears to constitute some degree of risk for the multiple sclerosis patient, the magnitude of which will obviously vary depending on the individual's condition.

Physical trauma may also occasionally precipitate the disease in predisposed individuals. As is the case with many illnesses, patients can frequently offer histories of minor bodily trauma preceding the onset of the symptoms. The injuries cited have been as often trivial as severe. Instances have also been quoted where the onset of the disease has followed tooth extractions and surgery; it has been claimed, for example, that the risk of acquiring multiple sclerosis is 1.7 times greater if the individual has had a tonsillectomy (Poskanzer 1965). McAlpine and Compston (1952) reported that 14 per cent of a series of 250 patients could recall having had an injury within three months of the onset of the first symptom, and that in 61 per cent of these cases the site of the injury and the initial plaque were related.

The possibility that emotional stress may stimulate the onset of symptoms and produce exacerbations in individuals with a susceptibility to the disease has been recognised for a long time. Anxiety and the loss of a key figure in the patient's environment have been identified as potentially important factors (Philippopoulos 1958). Similarly, symptoms may first appear in response to violent exertion and fatigue.

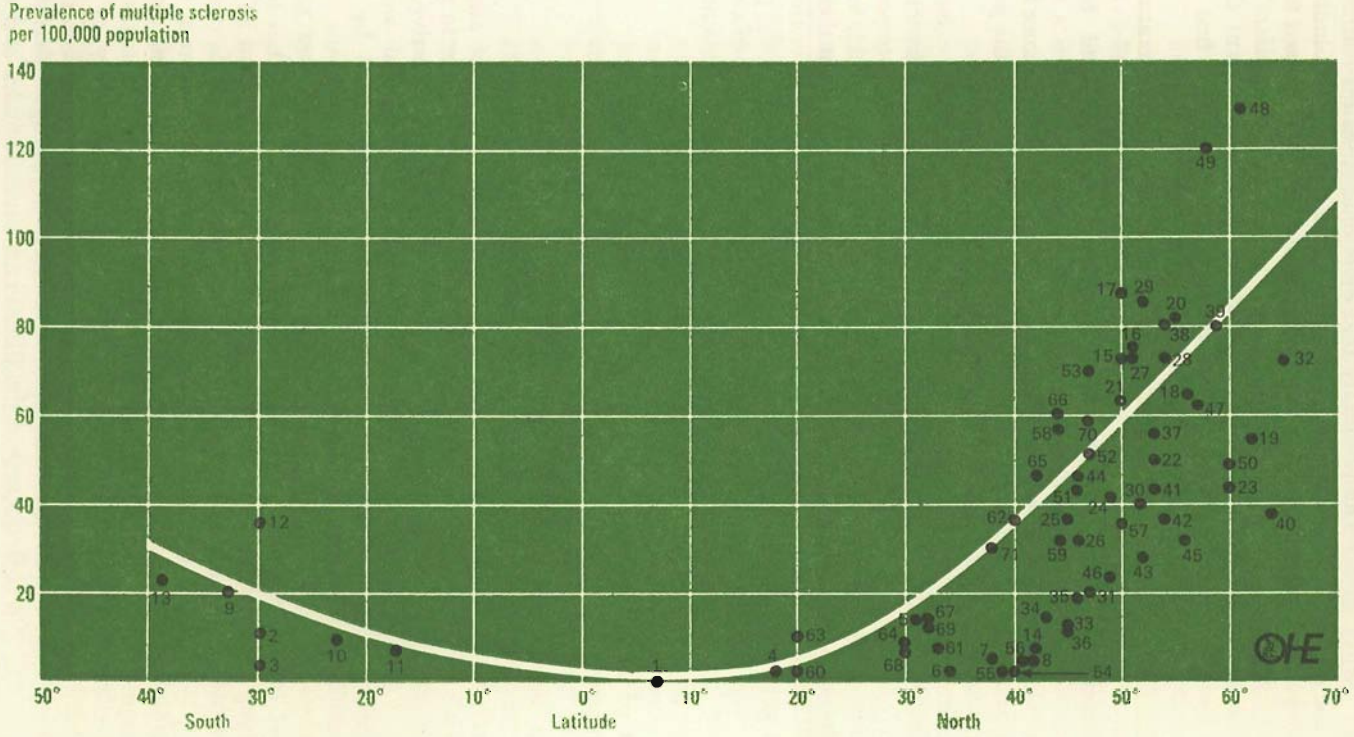
There have been several reports in the literature of apparent provocation of multiple sclerosis by protective inoculations against typhoid, tetanus, poliomyelitis and by vaccination against smallpox. The mechanism involved is a matter of conjecture; some inoculated materials might enhance immunological reactivity or may indeed share antigens with the putative antigen responsible for the disease.

Finally, it has been demonstrated that changes in body temperature can intensify or relieve the symptoms of multiple sclerosis. One of the most commonly found responses to heat is the loss of visual acuity, which recovers quickly with the reduction of body temperature. The suggestion that these observations could provide the basis of some form of test for the disease is not generally accepted because the mechanics of the process are not clearly understood. Furthermore, a number of cases have been cited where symptoms have unpredictably worsened on exposure to colder temperatures (Geller 1974).

Epidemiology

Estimates of the frequency of occurrence of any disease in a population are useful for two purposes, firstly to provide a base from which ideas about their causes may be derived and secondly to calculate the demand for curative and welfare services. However, the epidemiologist is confronted by a number of complications in the case of multiple sclerosis. The circularisation of practitioners and the examination of hospital records are the methods most frequently employed, but local variations in the standard and degree of organisation of medical care means that it is difficult to obtain an accurate overall picture of the prevalence of the condition. Furthermore, the prolonged interval between the onset of symptoms and diagnosis, which characterises many cases, creates problems in the dating of the commencement of the disease. Uncertainty of diagnosis has frequently resulted in the use of the terms 'probable' and 'possible' in the indentification of cases of multiple sclerosis. Finally, the frequency of the illness can be both under and over estimated

Figure 1 *The geographical distribution of multiple sclerosis*



Sources M Alter *et al* 1973 J Kurtzke *et al* 1973

Table 1 *The geographical distribution of multiple sclerosis*

Location	*Degrees of latitude*	*No in figure 1*	*Prevalence (a) per 100,000*
Africa			
Ethiopia	7 N	1	0
Republic of South Africa			
White English Speaking	30 S	2	11
White Afrikaaners	30 S	3	3
India			
Bombay	18 N	4	2
Israel	31 N	5	15
Japan			
Fukuoka	34 N	6	2
Niigata	38 N	7	4
Sapporo	43 N	8	2
Australia			
Newcastle	33 S	9	20
Queensland	23 S	10	9
Cairns	17 S	11	7
South Australia	30 S	12	38
New Zealand	39 S	13	23
Bulgaria	42 N	14	6
Czechoslovakia			
Kladno	50 N	15	73
Northern			
Bohemian Region	51 N	16	75
Prague	50 N	17	87
Denmark	56 N	18	64
Faroes	62 N	19	54
England			
Carlisle	55 N	20	82
Cornwall	50 N	21	63
Durham/Northumberland	53 N	22	50
Finland			
Turku	60 N	23	43
France			
Bas-Rhin	49 N	24	41
Montelimar	45 N	25	37
Vienne	46 N	26	32
Germany			
Cologne	51 N	27	74
Hamburg	54 N	28	73
West Berlin	52 N	29	85
Magdeburg	52 N	30	40
Hungary			
Budapest	47 N	31	20

Location	*Degrees of latitude*	*No in figure 1*	*Prevalence (a) per 100,000*
Iceland	65 N	32	72
Italy			
Ferrara	45 N	33	13
Perugia	43 N	34	15
Varese	46 N	35	19
Parma	45 N	36	12
Netherlands			
Groningen	53 N	37	56
Northern Ireland	54 N	38	80
Norway			
Vestfold	59 N	39	80
Western Norway	64 N	40	38
Poland			
Bydgoszcz	53 N	41	43
Slupsk	54 N	42	37
Warsaw	52 N	43	28
Romania			
Brasov	46 N	44	46
Russia			
Lithuania	56 N	45	32
Cherkassy	49 N	46	23
Scotland			
Northern mainland	57 N	47	62
Shetland	61 N	48	129
Sweden			
Goteborg	58 N	49	120
Uppsala	60 N	50	49
Switzerland			
Geneva	46 N	51	43
Lucerne	47 N	52	51
Zurich	47 N	53	70
Turkey			
Black Sea Region	40 N	54	2
Central Anatolia	39 N	55	2
Maramara Thrace	41 N	56	4
Canada			
Winnipeg	50 N	57	36
Kingston	44 N	58	57
Nova Scotia			
Halifax	44 N	59	32
Mexico			
Mexico City	20 N	60	2

Location	*Degrees of latitude*	*No in figure 1*	*Prevalence (a) per 100,000*
USA			
Alabama	33 N	61	8
Denver	40 N	62	37
Hawaii	20 N	63	10
New Orleans	30 N	64	9
Boston	42 N	65	46
Rochester	44 N	66	60
Charleston	32 N	67	14
Houston	30 N	68	7
Jackson	32 N	69	12
Missoula	47 N	70	59
San Francisco	38 N	71	30

(a) Prevalence rate includes cases of 'possible multiple sclerosis'
Source M Alter *et al* 1973 J Kurtzke *et al* 1973

as a result of inaccurate case ascertainment and erroneous classification or misdiagnosis of suspected cases.

Numerous investigations into the occurrence of the disease suggest, in very broad terms, that it becomes increasingly prevalent with greater geographical latitude, ranging from well over 100 cases per 100,000 population in some of the islands off northern Scotland to between 0 and 5 per 100,000 in countries near the equator. This relationship (see Figure 1 and Table 1) certainly holds true in the northern hemisphere (although Japan is an exception) but the evidence relating to the southern hemisphere is more fragmentary.

A number of other characteristics with potential aetiological significance have emerged from the epidemiological study of the condition. Age specific analyses reveal that the chances of acquiring the symptoms of multiple sclerosis increase rapidly with age until about 32 years when a peak is reached. Thereafter the risk declines rapidly, becoming trivial by the sixth decade. Local variations inevitably occur and it has been suggested that, in areas of low frequency, the average age of onset is later, although this contention has yet to be substantiated. With regard to discrimination between the sexes, there is evidence to indicate that multiple sclerosis attacks females more frequently than males, in the proportion of 1.9: 1.0 (McAlpine *et al* 1972).

Figures relating to the distribution of the disease in urban and rural areas are conflicting. A study of US Army Veterans suggested that the risk of multiple sclerosis was about four times greater in men who had lived in metropolitan centres with a population exceeding 1 million, than in those who had resided in towns with a population of less than 2,500 (Beebe *et al* 1967). Conversely, Swank *et al* (1952) undertook a survey in Norway and observed that the disease appeared to be more prevalent among

farming communities than in those dependent on fishing and industry. Similarly, the facts relating to the social and occupational characteristics of individuals suffering from the illness have not been firmly established. It has been claimed that multiple sclerosis is more frequent in the higher social groups, (Miller *et al* 1960; Russell 1971) but the examination of this proposition presents considerable methodological difficulties.[1]

Incidence studies of the complaint in particular countries illuminate further the geographical distribution and the results comply with the observed world-wide pattern. The catalogue of frequency surveys undertaken in North America is extensive and, although the methods employed have varied and become more sophisticated over time, the fundamental pattern to emerge demonstrates that multiple sclerosis is more common in the north than in the south. Limburg (1950) observed that the dividing line appeared to be the 40th parallel of latitude.

Morbidity surveys in selected communities have furnished additional evidence, corroborating the prevalence patterns revealed by the mortality data analyses. Westlund and Kurland (1953) studied three similar sized cities and found a three-fold increase in incidence and prevalence between New Orleans (30°N) and Boston (42°) and Winnipeg (50°) and a five-fold gradient in mortality rate. A similar pattern of distribution was revealed by a study in Charleston County (33°N) and Halifax County (45°N) (Alter *et al* 1960). The disease had a prevalence rate 2.4 times greater in Halifax than in Charleston, (the actual rates were 32.3 and 13.5 per 100,000 respectively).

Investigations in Europe, North Africa and the Near East present a similar pattern: a higher prevalence of the disease in northern and central Europe, which diminishes significantly in those countries surrounding the Mediterranean. In addition, the available information infers that the average prevalence is higher in Europe than in North America north of latitude 40°N.

It is almost impossible to draw any meaningful conclusions about the frequency of multiple sclerosis in Asia, as the information consists mainly of clinical impressions of regional frequencies. The disease appears to be rare in countries like India and China and it is only in Japan that formal frequency surveys have been undertaken. A number of cities, located at different latitudes, have been studied and from the results it has been ascertained that the disease is extremely rare in Japan and that there is no north-south gradient of frequency.

The evidence relating to the southern hemisphere is far less

1 As with a number of other diseases, notably diabetes, this higher frequency may be attributable to earlier identification of cases of multiple sclerosis amongst these social groups, resulting from a greater ability to articulate the symptoms and an increased willingness to consult a medical practitioner.

complete. Virtually nothing is known about the occurrence of multiple sclerosis in South America (Barlow 1971). Surveys conducted in Australia and New Zealand suggest that, for people of European stock, a small but measurable risk is encountered in the tropics but that this risk takes on northern and central European proportions for similar groups resident in Tasmania and the Southern Island of New Zealand. In South Africa there is now sufficient evidence to affirm that the disease is rare in the White population (11 per 100,000), although there are significant variations in prevalence within the White South Africa born population: the disease is more common in the English-speaking settler population (12.7 per 100,000) than in the longer established Afrikaans speaking (3.6 per 100,000) (Dean 1967).

The observed distribution of multiple sclerosis throughout the world has generated a great deal of interest in migration from high to low risk zones and the significance this may have for acquiring the disease. The results of Dean's (1967) survey in South Africa demonstrated that the prevalence rate for immigrants from Europe was considerably higher than that for all South African Whites. Adult migrants appear to have the same risk of developing multiple sclerosis as in their country of origin and thus movement to a low risk country does not appear to lessen the possibility of acquiring the illness. Dean therefore proposes that the condition is normally an infection of infancy, probably a virus infection, and that exposure to it, during childhood, conveys upon the individual a degree of immunity or protection against the disease. Those who miss early infection and are susceptible to the illness may contract multiple sclerosis in adult life. An alternative theory is that the disease is acquired in 'endemic' areas (e.g. northern Europe) at about the age of 15 and manifests itself years later, regardless of geography (Kurtzke and Dean 1971).

Israel is particularly well suited to an examination of the relationship between migration and multiple sclerosis as its inhabitants consist of immigrants from 70 different countries. The prevalence rate in Israel was calculated to be 15 per 100,000 population and a breakdown of this figure, giving prevalence rates by area of origin, is presented in Table 2. The prevalence curve derived from these statistics (Figure 2) adds further confirmation to the basic assertion that the disease occurs with diminishing frequency with progression from temperate to tropical zones.

A further study (Alter *et al* 1966) demonstrated that Europeans who migrated whilst between 15 and 29 years of age had an incidence almost nine times higher than Afro-Asians; for the age group 30 to 44 years, the corresponding proportion was five times higher. Europeans who had migrated to Israel before the

Table 2 *The prevalence of multiple sclerosis among national groups in Israel*

Area of origin	*Population*	*Mean latitude, °N*	*Number of cases (a)*	*Prevalence per 100,000*
Central Europe				
Germany-Austria	53,000	50	27	51
Hungary	31,000	47	14	45
North-East Europe				
Czechoslovakia	30,000	50	13	43
Romania	149,000	46	46	31
Russo-Poland	310,000	52	94	30
North-West Europe				
Holland	20,000	52	6	30
South-East Europe				
Greece	11,000	40	2	18
Yugoslavia	9,000	44	1	11
Bulgaria	43,000	43	4	9
Eastern Mediterranean				
Turkey	41,000	40	3	7
Iraq	130,000	34	9	7
Iran	31,000	33	2	7
North Africa				
Morocco	226,000	31	14	6
Native Israelis	588,000	32	25	4
Arabian Peninsula				
Yemen-Aden	63,000	14	2	3
Others	—	—	20	—
Total	1,735,000	—	282	15

(a) Includes probable and possible cases of multiple sclerosis

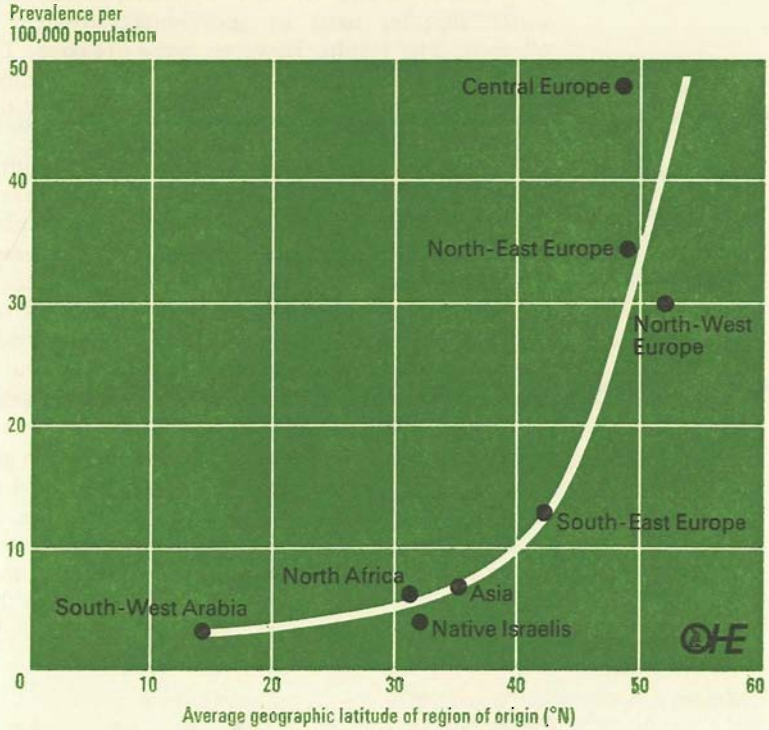
Source M Alter *et al* 1962

age of 15 had an incidence rate which was only 1.7 times greater than among Afro-Asians. These results can be interpreted to suggest that migration at an early age from a temperate to subtropical climate confers a reduced risk of developing multiple sclerosis.

Studies of migration in the opposite direction, from low to high risk regions, would be of great value in determining whether the causative agent is prominent in high risk areas or if some protective phenomenon is at work in the low risk zones. Unfortunately, primarily as a consequence of the dearth of populations suitable for study in the low risk areas, the evidence relating to this direction of movement is only fragmentary.[1]

1 A study of the significance of migration from low to high risk regions is currently being conducted by Dr J G K Dean of Dublin.

Figure 2 *The prevalence of multiple sclerosis in Israel among natives and immigrants, related to latitude of region of origin*



Source M Alter *et al* 1962

The geographical distribution of multiple sclerosis has inspired the examination of a variety of physical factors in the environment in the search for the cause of the disease. Climate may be a significant variable, either through the direct effect of heat, cold and sunshine on the human body or through its influence on human customs, sanitation and on the plant and animal environments. However, it is clear that no single type of climate is characteristic of the high or low risk zones. A rough, negative correlation can be established between mean annual temperature and the prevalence of multiple sclerosis, although Japan and northern Italy are exceptions to this observation.

Suggestions that a deficiency of an essential trace element in the soil or water, or deposits of some toxic mineral may be aetiologically significant have generally been refuted because such factors are focal in nature and not, therefore, compatible with the very wide distributional limits exhibited by the disease.

The occurrence of swayback (a demyelinating disease in lambs) can be prevented by administering copper supplements to pregnant ewes and this led to studies of the copper content of water supplies used by individuals suffering from multiple sclerosis. The results, however, were negative. The lead content of the soil has also been investigated but studies have failed to confirm any association between this or other trace metals and the disease.

The necessity of investigating every possibility in the search for the cause or causes of multiple sclerosis has resulted in the formulation of a variety of hypotheses. Explanations of the observed world-wide distribution of the disease, for example, have been sought in terms of a protective effect of some part of the solar spectrum (Acheson *et al* 1960) and cosmic radiation (Barlow 1960). Environmental carbon monoxide (Cook 1974) and the consumption of sheep's brains (Legg and Thomson 1972) are further examples of the many potential aetiological factors which have been examined and finally rejected as insignificant.

Epidemiological surveys lend support to the general theory of infection and they indicate that if an infectious agent is responsible, it is contracted many years before the disease becomes clinically manifest. However, the source of the infection, its mode of transmission and man's susceptibility to it are probably determined by environmental factors which have yet to be identified.

The approach to the disease

The findings revealed by the examination of an individual with multiple sclerosis will depend on the stage of the illness, the severity of involvement and the criteria for diagnosis. A confident diagnosis of the disease can usually be made in cases which present the characteristic combination of pyramidal, cerebellar and eye signs, see Table 3, with a history of well defined remissions. However, the diagnosis of the early or atypical case may be much more difficult. The absence of a generally accepted specific laboratory test for the disease means that the diagnosis is based upon an initial suspicion, provoked by a case history of remissions and relapses and a wide variety of signs and symptoms, which is then confirmed, as far as possible, by performing tests to exclude other diagnoses. The diagnosis can be further obscured by the failure of an individual to report any symptoms, e.g. an episode of tingling or numbness, or blurring of vision, until a definite disability occurs. In addition, general practitioners may overlook the significance of minor neurological symptoms

Table 3 *The main signs and symptoms of disorders of the central nervous system*

Sign/symptom	*Characteristics*
1. Pyramidal signs and motor symptoms	Stiffness, heaviness, weakness, even paralysis of one or more limbs, in whole or in part. Excessive tiring.
2 Cerebellar signs and coordination symptoms	Inability to arrest a muscular movement at the desired point. Intention tremor. Loss of muscular tonicity. Muscular movement carried out in a series of separate motions – not smoothly. Abnormalities found in any limbs.
3 Brainstem signs and symptoms	Nystagmus (rhythmical oscillation of the eyeballs, either horizontal, vertical or rotary). Facial weakness. Vertigo – often accompanied by nausea.
4 Sensory signs and symptoms	Sensations such as numbness, tingling, deadness.
5 Bowel and bladder signs and symptoms	Urinary urgency or retention are evident in the milder stages of the disease. Incontinence in the latter stages. Bowel retention more common than incontinence – but less severe and occurs later than urinary problems.
6 Visual or optic signs	Blurring of vision – may be preceded by pain. Double vision. In most cases the signs and symptoms abate and often there is a full restitution of visual function.

Source J F Kurtzke 1970

because they do not encounter cases of multiple sclerosis very often.

The guise in which the disease shows itself varies considerably from case to case. In addition to this, the fact that the diagnostic criteria adopted by specialists in the field have not always demonstrated complete uniformity, has led to a number of attempts to formulate a set of standardised criteria, one of the most useful of which resulted from the work of Schumacher and his colleagues in 1965 (Appendix 1). Considerable progress has, however, been made by Field *et al* (1974) with their investigations into the significance of a deficiency of polyunsaturated fatty acids in multiple sclerosis. It has been shown that lymphocytes (white blood cells) from patients with the illness are much more sus-

ceptible to the inhibitory activity of linoleic acid in their recognition of antigen (91 per cent inhibition) than those from normal subjects (57 per cent). Cells from patients with a variety of other neurologic diseases give 47 per cent inhibition with linoleic acid. These differences, it is claimed, are specific for multiple sclerosis and can be used as a laboratory test for the disease. Field then studied the families of multiple sclerosis patients and found that 60 per cent of near relatives showed the 'normal reaction' (57 per cent) while 40 per cent showed a mean reduction of 77 per cent. This 'anomalous' figure, which was generally found to be more common in female relatives than in males, is not incompatible with life-long freedom from multiple sclerosis but is indicative of a familial background to the disease. These observations have been both confirmed (Jenssen *et al* 1974) and questioned (Mertin *et al* 1974) and so further research is necessary before an accurate assessment can be made of the implications for the diagnosis and treatment of the disease.

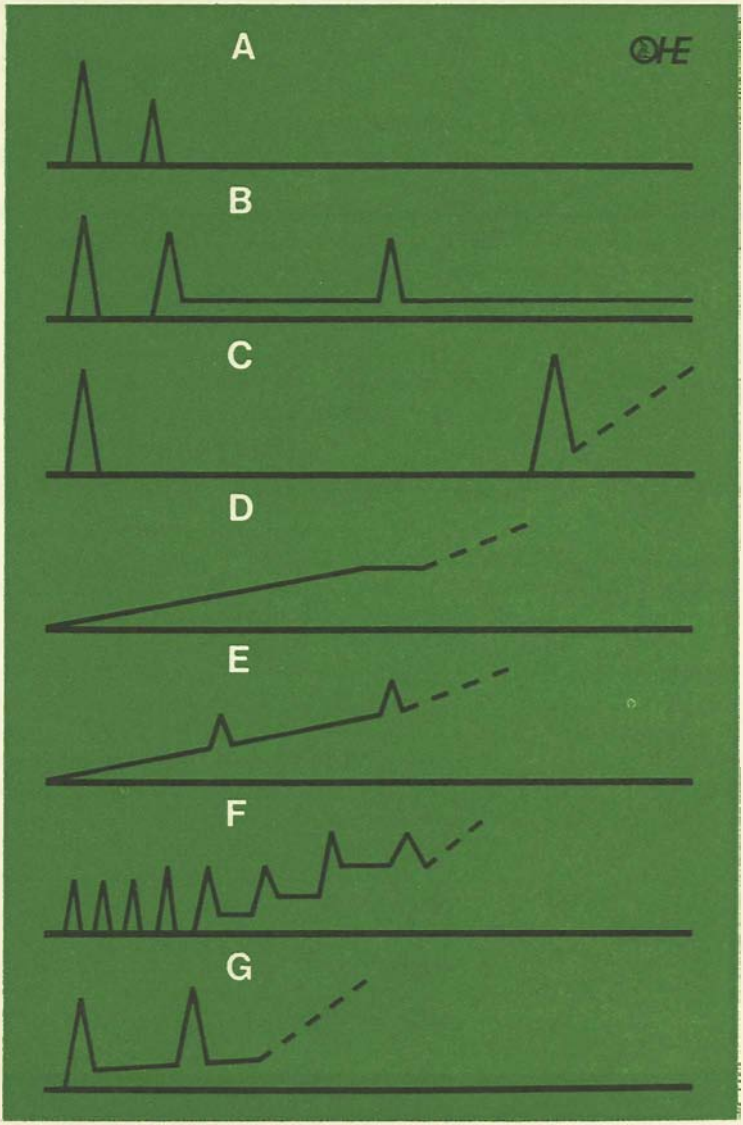
Prospects

The prognosis of multiple sclerosis is notoriously uncertain (see Figure 3). The popular conception is too often one of a chronic crippling disease, characterised in the early stages by relapses and remissions, followed by a chronic progression to a bed-bound, incontinent, paralysed state, after which death ensues as a result of pneumonia, urinary infection or bed sores (*BMJ* 1972). However, this gloomy picture represents only one extreme of the spectrum, which relatively few people experience. Much more common is the benign form of the disease, in which relapses are mild and infrequent, permitting active life for many years. It is extremely difficult, therefore, to construct an accurate picture of the general course of the disease. This is further hindered by the fact that it would be necessary to follow up an adequate number of cases from onset to death even though many individuals are not referred to hospital within the first two or three years and the average duration of the disease may be prolonged.

The initial symptoms presented may provide clues to the course the disease is going to follow. In general, symptoms which appear acutely have a better prognosis than those which present insidiously. The nature of the symptoms may also provide clues: visual and sensory symptoms, for example, show a greater tendency to remit than motor disturbances. Also, isolated symptoms diminish more than those occuring in groups and remission is experienced more frequently in the initial stages of the disease than after subsequent relapses.

An examination of the factors which may exert an influence on the course of the disease reveals that the age of an individual at the time of onset is particularly significant. Disability has been

Figure 3 *The course of multiple sclerosis*



A. Abrupt onset; few if any relapses after first year; no residual disability.
B. Relapses of diminishing frequency and severity; slight residual disability.
C. Abrupt onset with good remission followed by long latent phase.
D. Slow progression from onset without relapses.
E. Slow progression from onset, superimposed relapses, and increasing disability.
F. Many short attacks, tending to increase in duration and severity.
G. Severe relapses, increasing disability and early death.

Source McAlpine *et al* 1972

found to develop more rapidly in patients who experience the onset of multiple sclerosis later on in life (Liebowitz and Alter 1970). In addition, there is some evidence to suggest that males who are first attacked by the illness in middle age are more susceptible to disability than females.

Accepting the fact that there are wide variations, a number of additional observations have been made. In the incipient stages, the disease runs a relapsing and remitting course in about 90 per cent of cases. Relapses are inclined to greater frequency in this stage and they are generally of shorter duration than those experienced subsequently (these characteristics do not appear to be significantly related to sex and the age of onset). The average duration of life after the onset of symptoms is at least 25 years, and only a very small proportion die within five years (about 5 per cent). Death occurring in the early stages is usually due to involvement of vital centres, whereas the most prominent causes in later years are complications arising from bronchopneumonia and infections of the urinary tract.

The more benign forms of multiple sclerosis, involving comparatively slight incapacity, are more common than is frequently supposed and a severe progression of the disease is experienced in only a minority of cases. The inability to predict accurately the course of the illness creates problems in informing the patient of a diagnosis. If the patient presents symptoms which lead only to a suspicion of multiple sclerosis and which then vanish again, it is quite reasonable to suppose that they will not reappear for a number of years. It is, therefore, wrong to burden an individual with the fear of multiple sclerosis when it may not develop at all. Alternatively, when the diagnosis is beyond all reasonable doubt, making the patient fully aware of the facts enables him to help himself as much as possible and prevents him from having to find out about the disease for himself, which can lead to great emotional stress.

Treatment

In the absence of a consistently successful therapy for multiple sclerosis the desire for positive action has often led to the administration of placebo agents. These have occasionally been associated with a subsequent improvement in the condition, although why they should appear to be effective has remained unclear.

Attempts to identify the cause or causes of multiple sclerosis have occasionally been coupled with the recommendation of a new form of treatment. The theory that the small, early lesions in the disease probably resulted from the occlusion of venules by thrombi inspired the use of anticoagulant drugs, with conflicting results. The use of blood transfusions to confer passive

immunity to possible but unproven viruses and to correct speculated deficiencies, failed to offer sufficient promise or possess adequate rationale to justify the risks (e.g. incompatibility reactions), inconvenience and expense involved (Sibley 1970).

Examinations of the effectiveness of steroid therapy (especially adrenocorticotrophic hormone) have produced disparate results. Initially it was hoped that such drugs would be beneficial in the treatment of multiple sclerosis because of their ability to suppress both allergic reactions and the inflammatory responses of tissue. It is now generally thought that medium or large doses of ACTH, used as short-term treatment, tend to have a favourable effect on recent relapses, although side effects may be provoked in some patients. However, as a form of long-term treatment, regular corticotrophin therapy fails to prevent deterioration or reduce the number of relapses (Millar *et al* 1967).

The observation that multiple sclerosis may be related to the amount of fat in the diet, and in particular to a deficiency of polyunsaturated fatty acids, has led to treatments involving diet supplementation. Linoleic acid, which is an important polyunsaturated fatty acid, was administered to multiple sclerosis patients in the form of sunflower seed oil in a double blind trial over a period of two years (Millar *et al* 1973), with the result that relapses tended to be less frequent, significantly less severe and of shorter duration.[1] It has been postulated that linoleic acid may be of some benefit because it reduces the lymphocyte attack on the brain antigen, although clear evidence that this treatment affected the overall rate of deterioration was not obtained.

It has been suggested that if children related to multiple sclerosis patients, and who are perhaps more susceptible to the disease, are given unsaturated fatty acids, it is possible that they may develop properly constituted myelin and so acquire a nervous system unsuitable for the development of the condition (Field *et al* 1974). However, this is a hypothesis which some workers have not been able to confirm and so it is important to avoid generating parental anxiety and potentially false expectations at this stage.

A number of dietary régimes have been followed in the hope of ameliorating the course of the disease. Diets involving a low intake of animal fats have appeared to benefit some patients. Similarly, an immuno-suppresive gluten-free diet, supplemented by an intake of vitamins, has been associated with remarkable improvements in a number of well-publicised cases. There is no

1 Gammalinoleate, which is converted to linoleic acid in the body, is currently being used by some multiple sclerosis patients as a form of treatment. It is available under the brand name of Naudicelle (but not on prescription) and a double blind clinical trial is being conducted to evaluate its usefulness.

valid scientific evidence to support the use of such a diet in the management of the disease and, indeed, some patients have reported a set-back in their condition following its use (Jellinek 1974).

The cost of multiple sclerosis

The economic significance of an illness to a community can only be calculated approximately and it is therefore misleading to attribute undue importance to these estimates. Whilst they are undoubtedly useful for comparative purposes, their relevance as an indicator in the determination of policy priorities is severely limited.

The cost of multiple sclerosis, like other diseases, can be divided into three categories: the direct cost to health and welfare services, the incomes foregone by victims of the disease and the cost of personal hardships which are unquantifiable in monetary terms. However, the accuracy of these calculations is inhibited by the fact that the number of persons suffering from the disease is not known with any certainty and because individuals rely upon the health and welfare services to widely varying degrees, depending on personal circumstances and the extent of physical handicap.

Multiple sclerosis does not show its effects at least until early adult life so that only the adult population need be considered. From the survey of the handicapped and impaired in Great Britain (Harris 1971) it is estimated that there are 18,450 individuals living at home who are appreciably or severely handicapped as a result of multiple sclerosis (Table 4). An estimate of 1,400 patients in hospital and 1,000 in other institutions, at any one time, brings the total to 20,850 of which 18,650 are of working age (Table 5). This figure is consistent with the generally quoted one of 50,000 which includes those individuals who suffer from disabilities of a much milder nature.

It is calculated that the annual cost of multiple sclerosis to the economy is approximately £31 million (Figure 4). The cost of hospital care is mainly the result of the provision of long-term accommodation and short stays for diagnostic tests as there is no effective treatment for the condition which requires hospitalisation. The frequency of visits by multiple sclerosis patients to out-patient departments in order to obtain physiotherapy and advice varies considerably, depending on the degree of disability. Similarly, the frequency of general practitioner consultations will be determined by the individual's assessment of his needs and the doctor's perception of his role in the 'treatment' of multiple sclerosis.

Table 4 *Multiple sclerosis patients living at home*

	Degree of handicap				
	Very severe (Groups 1–3)	*Severe (Group 4)*	*Severe (Group 5)*	*Appreciable (Group 6)*	*Total (Groups 1–6)*
Male	2,430	1,770	1,540	660	6,400
Female	5,311	720	3,640	2,376	12,047
	7,741	2,490	5,180	3,036	18,447

Source Harris (1971) *Handicapped and Impaired in Britain*

Table 5 *Population of disabled multiple sclerosis patients in Britain*

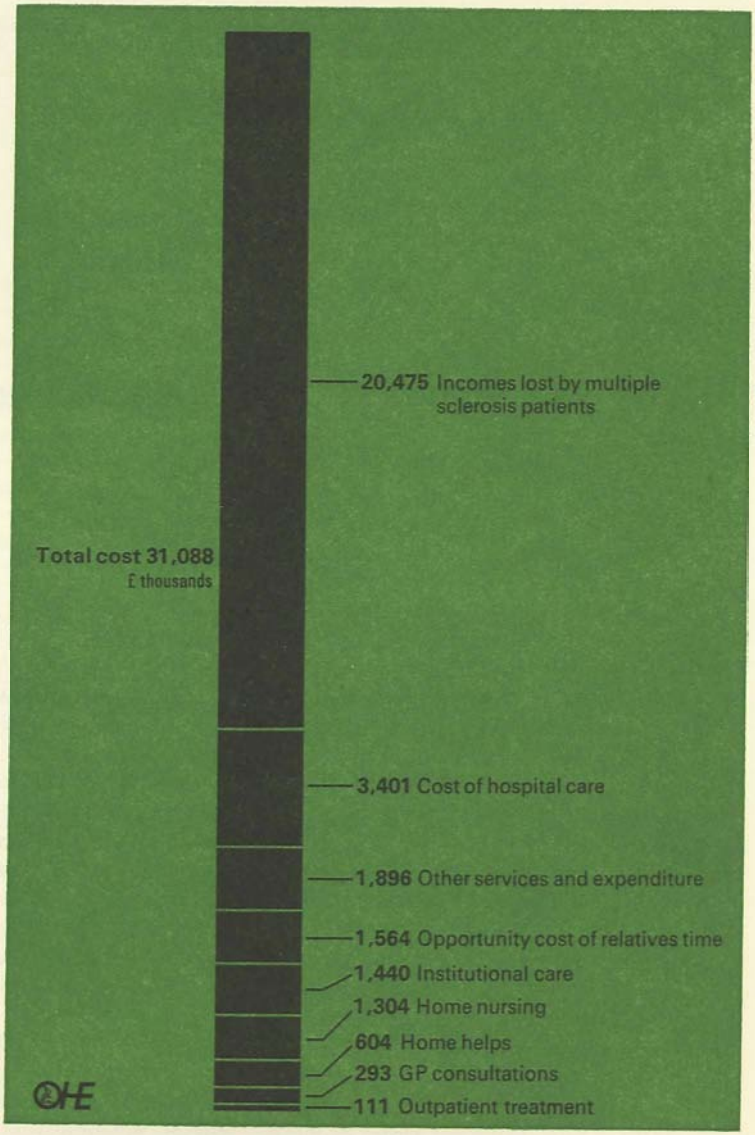
	Male	*Female*	*Total*
In hospital (i)	446	949	1,395
In other institutions (ii)	300	700	1,000
At home (iii)	6,400	12,047	18,447
	7,146	13,696	20,842
Number under 65 (iv)	7,146	11,505	18,651

Sources
(i) Hospital In-Patient Enquiry, 1972. Proportion of males to females is extrapolated from past trends.
(ii) Economist Intelligence Unit estimate.
(iii) Table 4 above.
(iv) The total is produced on the national survey basis: 16 per cent of women over 65, no men.

The availability of home nurses and home helps is particularly important in the case of multiple sclerosis as it enables many patients to live in their own accommodation. This is further facilitated by the provision of other welfare services such as the availability of wheelchairs, hoists, gadgets and aids to daily living, assistance with home adaptations, laundry and meals services. The extent to which these services are utilised is virtually impossible to estimate accurately as each individual has different requirements.

Individuals with exceptionally severe disabilities and those without relatives to look after them at home generally have no alternative to being cared for in an institution. A number of different types of home provide accommodation but there are considerable variations in the expenditure incurred and the quality of service. Consequently only a crude estimate can be made of the total cost. Finally, account has to be taken of the incomes that are lost by patients who are forced to relinquish

Figure 4 The cost of multiple sclerosis to the economy, 1973 (£ thousands)



Source OHE Estimates (See Appendix 2)

their jobs and by the relatives caring for them. Although only a few relatives have to abandon full-time employment, many may find that there are fewer opportunities to work overtime and to undertake economically significant but unrecorded activities (e.g. house maintenance).

The discovery of an effective preventive treatment would therefore result in a saving of about £31 million, although this would not accrue for a number of years. It would be erroneous, however, to create the impression that economic considerations provide the main inducement to the attempt to discover a cure for the disease. Sufficient incentive is afforded by the distress and hardship associated with multiple sclerosis. The personal costs, such as the loss of independence and potential and those relating to the specific problems of disablement (for example, the necessity for special clothing that does not irritate a person who is immobile or incontinent) are highly significant and the fact that they are to some extent incalculable should not be allowed to obscure their existence. It is particularly noteworthy that 66 per cent of the total cost of multiple sclerosis can be attributed to income lost by victims of the disease. This is a direct result of the fact that multiple sclerosis is a disabling disease of early middle age, when personal and family commitments are at a peak.

A final aspect of the cost of the disease is the amount spent on research. It is estimated that, in 1973/74, the expenditure by the Medical Research Council on disorders of the nervous system, which include the demyelinating diseases, was in the region of £240,000. The main clearly identifiable source of funds is the Multiple Sclerosis Society of Great Britain and Northern Ireland which provided £92,500 in 1973 for research into the causes and cures of the disease. (It should be noted that these funds may be allocated amongst as many as thirty recipients. It is the opinion of some members of the society that a more selective approach would prove beneficial and this possibility is being investigated by a working party.)

The total amount spent on research into multiple sclerosis is small at the present time but we can expect these expenditures to be raised to much higher levels as soon as some firmly established facts about the disease emerge.

Social aspects

Disablement, irrespective of cause, creates a variety of clearly identifiable problems but generalisations about the social and personal consequences of acquiring multiple sclerosis are extremely hazardous because the disease follows an unpredictable and

different course in each patient. Although an appreciable disability should not be regarded as the inevitable outcome of the illness, incapacity is experienced by a sufficient number of people to necessitate a careful consideration of their needs and problems, especially as this has crucial relevance to their social care.

The role usually performed by the individual, whether male or female, is seriously challenged and may involve a complete reorganisation of family life. Incapacity of the breadwinner, in particular, may lead to a reduction of the family's standard of living. The feelings of inadequacy generated by disablement and the problems inherent in caring for a disabled person can often lead to emotional stress which younger and less well established marriages may not be able to survive. A study of the social problems of multiple sclerosis victims, (Stevens 1974), revealed that about one-third of married patients were dissatisfied regarding the amount of affection shown to them by their partners, although the small sample size of this survey reduced the validity of the results obtained.

Intellectual effects

Our knowledge of the prevalence and nature of the psychiatric changes in patients suffering from multiple sclerosis is still somewhat confused. Intellectual deterioration, euphoria and personality changes have been seen to occur in some patients in the more advanced stages of the disease but it is not clear to what extent these changes are attributable either to damage to the central nervous system or to the psychological effects of progressive disability. Comparative studies with muscular dystrophy indicate, however, that the former is probably the more prominent factor involved.

Surridge (1969) and Jambor (1969) found evidence of intellectual deterioration in almost two-thirds of the cases they studied. Prominent features of this discovery were a loss of memory for recent events and an impairment of conceptual thinking. They also observed a variety of personality changes in about one-third of their patients and noted that there was a significant tendency to irritability and some to apathy. Anxiety and irritability may result from the necessity to adapt to an occasionally progressive but largely unpredictable course of events in spite of a diminishing capability to make such adjustments.

The frequency of depression in individuals suffering from multiple sclerosis has also been the subject of a number of studies. The evidence indicates that between one-quarter (Surridge 1969) and one-third (Stevens 1974) experience depression and that the symptoms of anxiety and depression are more prominent in the early stages of the illness, when disability is generally only slight, as patients often predict that the disease will assume a pro-

gressively deteriorating course. Once a patient becomes very dependent and accepts that he will probably not have a remission there is a tendency to adjust to the situation, with a consequent diminution in the prevalence of depression.

It has yet to be shown at what stage in the disease these changes might occur and whether or not they might fluctuate with time, as do the physical symptoms in some cases. Although it may sometimes be felt that it is unnecessarily pessimistic to emphasise that intellectual deterioration may occur amongst a minority of severe multiple sclerosis cases, such an awareness may help relatives and individuals to combat the problems they face. The main psychological problem is likely to be depression stemming from physical disability or feared disability and this can be alleviated by the use of modern medicines and psychotherapy.

Rehabilitation

The absence of any reliable curative treatment means that the management of disabilities resulting from multiple sclerosis is largely the responsibility of the rehabilitation team, with the objective of assisting the individual to live as full a life as possible, within the limitations circumscribed by his disability.

Physiotherapy can provide considerable help to some disabled multiple sclerosis patients by strengthening weakened muscles and training compensatory functions. In particular it may assist individuals to take full advantage of periods of remission in the disease and so minimise the degenerative effects of multiple sclerosis. It has, however, been claimed that physiotherapy is often used as a placebo treatment for those who are lonely, inadequately housed or have domestic, financial or marital problems. Such treatment fails to alleviate the fundamental problems involved and represents a misuse of resources.

The importance of the occupational therapist will be determined by the degree of disability experienced by the individual. Nevertheless, advice concerning the use of gadgets and aids to daily living and the recommendation of a variety of interests that can be pursued, may significantly increase the patient's mobility and reduce the amount of unoccupied time during which anxiety about personal circumstances and the possible future development of the disease frequently results in depression.

The apparent inadequacy of advice given to patients and their relatives with regard to coping with unpredictable alterations in the course of the disease and the associated emotional and personal problems may represent a significant obstacle to the management of multiple sclerosis. Most patients attend a hospital once in three to six months and, at this time, there are medical social workers available for them but there is often little contact between hospital attendances.

The provision of occupational therapists and health visitors to deal with an individual's physical needs generally does not help to tackle his psychological problems. These difficulties could perhaps be resolved by increasing the number of social workers dealing specifically with the problems of the disabled. 'Further research is necessary to estimate more reliably the prevalence of their psychological problems in relation to physical dependence, and to develop schemes of emotional support' (Stevens 1974).

It is apparent that teamwork, with each member fulfilling a particular function, can be of great importance in the successful rehabilitation of the disabled, although the key figure is the patient himself and without his active support any kind of rehabilitation programme is usually of no meaning. A realistic attitude towards disablement, whereby the individual comes to terms with his physical incapacity, will therefore further the maintenance of as much independence as possible. However, the nature of multiple sclerosis is such that a continuous process of adjustment may be involved. Furthermore, individuals possess the capacity to adopt such a philosophy to widely differing degrees.

The extent to which an adjustment to domestic life is necessary is naturally dependent upon the particular individual's condition. The availability of meals, laundry and home help services along with increasingly sophisticated aids to daily living and adaptations to premises, for which financial assistance can be obtained, enables many disabled multiple sclerosis patients to live at home with greater comfort, safety and convenience. It has long been recognised that institutional life can exert a negative effect on an individual because of the loss of personal friends and possessions, the enforced idleness and the cessation of much contact with the outside world. The congeniality of a familiar environment at home is obviously much more conducive to the maintenance of an individual's morale and independence but the burden of care imposed upon relatives and the existence of poor housing conditions in some instances are two particular considerations which should not be overlooked.

In general, the services theoretically available to the disabled may be considered fairly satisfactory, although inequalities do exist between local authorities because of the discretionary nature of their powers and demographic variations. Furthermore, the need, in some instances, for persistent pressure by individuals in order to obtain assistance (for example, with adaptations to the home) and the length of time involved between such a request and action, may serve as a deterrent against making use of these services. It is also apparent that some disabled people are unaware of their entitlement to various forms of assistance and this can

only be rectified by an improved information service. It has been suggested that a permanent register of all multiple sclerosis patients would provide a better insight into the degree of disability experienced by different individuals, the possibilities of rehabilitation and the need for facilities (Dassel 1973). However, it is to be hoped that the problems referred to above will be resolved as local authorities continue to investigate and plan for the needs of their disabled residents.

The fact that multiple sclerosis patients tire quickly and may have to work restricted hours, the possibility of unexpected relapses leading to further disablement and the existence of other unemployed manpower resources in the economy may induce a reluctance on the part of some firms to employ individuals suffering from this disease. Generally, however, if an employee of some years standing contracts multiple sclerosis most employers are willing to retain his services, if only on a restricted basis, providing it is advisable from a medical point of view. For an individual who cannot return to his previous employment because of his disability there is the possibility of retraining for a new and more appropriate job. Alternatively, work can be obtained under sheltered conditions although the suitability of the jobs available to multiple sclerosis patients and the characteristics of this type of working environment are open to question.

Financial aid for the disabled is currently receiving attention with a view to both raising the value of benefits and increasing their availability. The new Non-contributory Invalidity Pension, to be paid at about 60 per cent of the Retirement Pension, will extend cover to disabled people of working age who are not eligible for any National Insurance benefits because insufficient contributions have been made. A mobility allowance is to be phased in over a three-year period from 1975/6 and will provide cash for taxi-fares, a wheelchair, holidays or anything else which will help the disabled person to increase his mobility. Under the present system only those who can drive receive an allowance. Finally, the present system of attendance allowances is to be supplemented by the introduction of an Invalidity Care Allowance (at the NCIP rate) which will provide financial assistance for people who are prevented from working by caring for a handicapped relative.

The termination of employment and the consequent loss of income can create severe financial problems for the disabled and their families. Any additional assistance is thus to be welcomed but it must be ensured that these benefits are taken up by those entitled to them.

The implementation of the 1970 Chronically Sick and Disabled Persons Act, the appointment of a Minister for the Disabled and

a greater awareness of the financial implications of disablement are all measures indicating an increasingly sympathetic attitude towards the plight of the disabled and a desire to reduce their isolation from the rest of the community. Nevertheless, the limited availability of resources may mean that a reappraisal of policy in terms of the long-term objectives of community services is necessary before further provisions are made. With specific reference to those disabled by multiple sclerosis, the aim of society is to assist them in adjusting to their disabilities, so permitting as full a life as possible. In the long term, however, greater emphasis may be more profitably placed upon the discovery of a preventive treatment for the disease rather than the acceptance of inevitable disablement requiring social help.

The role of voluntary bodies

Many organisations assist the disabled and 'campaign' on their behalf. Benefit therefore accrues to multiple sclerosis patients from this indirect source. The principal organisation involved in their welfare is the Multiple Sclerosis Society of Great Britain and Northern Ireland, which was founded in 1953. The Society has expanded considerably since its establishment and now has about 30,000 members distributed throughout more than 230 branches. One of its main functions is to encourage and sponsor research projects into the cause or causes of and possible cures for multiple sclerosis; by the end of 1974 a total of £820,000 had been allocated for grants. The second objective is concerned with the help and welfare of people with multiple sclerosis and this is accomplished by means of home visiting, the arrangement of social functions, assistance with holidays and by the provision of information.

During 1974 the Multiple Sclerosis Action Group (now known as Action for Research into Multiple Sclerosis) was formed with the intention of promoting further research as directly and quickly as possible and to provide a counselling and information service. With regard to the latter function, the group is administered by people suffering from the complaint and it is anticipated that the exchange of personal experiences will help individuals overcome the difficulties forced upon them by the disease.

The work of the Multiple Sclerosis Society and the Action Group can be of great comfort and assistance to the victims of the disease, and it is to be hoped that their respective activities and policies will supplement each other's efforts.

Conclusions

The popular misconception of multiple sclerosis as a disease which invariably involves progressive paralysis and the absence of any effective medical treatment has resulted in much distress amongst individuals acquiring the illness. However the prognosis, although uncertain, is frequently more favourable than is generally assumed.

The protracted search for the cause or causes of and possible cures for the condition inevitably means that any new developments will be accorded a cautious reception. Nevertheless, a degree of optimism can be drawn from the current research work into the significance of fatty acids and measles virus in multiple sclerosis, the fact that many individuals have remissions for no apparent reason and the occasional successes in supressing the disease's activity that have been associated with particular dietary régimes. It is still important, however, to ensure that new forms of treatment are critically examined before they receive widespread publicity, in order to avoid raising false hopes in people suffering from the disease.

The suffering caused by multiple sclerosis and its cost to the economy emphasise the benefits to be derived from the discovery of an effective form of preventive treatment and hence the need to promote efficient research to the fullest possible extent. Until preventive or curative measures are found, however, social care must assume the dominant role in the management of the disease. But the wide range of disabilities experienced by different multiple sclerosis patients means that each individual must be seen in the context of his particular physical limitations as well as his social and economic environment.

The increasingly positive attitude of society towards the physically handicapped, the gradual improvement of the welfare services and the development of more sophisticated aids should help to make the lives of the disabled more comfortable and reduce their isolation from the rest of the community. Furthermore, the disabled individual, provided he is given as much information as possible about his prospects, may help himself by building a series of objectives and expectations which are compatible with his physical limitations. Although the nature of multiple sclerosis is such that these aspirations may have to be modified over time, the ability to come to terms with incapacity in this manner can help to create a satisfactory life for many individuals suffering from the disease.

Appendix 1

Diagnostic criteria for multiple sclerosis as formulated by Schumacher *et al* (1965).

1 There must be objective abnormalities on neurologic examination attributable to dysfunction of the central nervous system.
2 On neurologic examination or by history there must be evidence of involvement of two or more separate parts of the central nervous system.
3 The objective neurologic evidence of central nervous system disease must reflect predominantly white matter involvement, i.e. fibre tract damage.
4 The involvement of the neuraxis must have occurred temporarily in one or the other of the following patterns:
(i) In two or more episodes of worsening, separated by a period of one month or more, each episode lasting at least 24 hours.
(ii) Slow or stepwise progression of signs and symptoms over a period of at least six months.
5 Onset between 10 and 50 years of age inclusive.
6 The patient's signs and symptoms cannot be explained better by some other disease process, a decision which must be made by a physician competent in clinical neurology.
Patients who fulfil all of these conditions are 'Multiple Sclerotic'.

Appendix 2

(1) *Costs of hospital care*

Number in hospital = 1,395 (Hospital In-Patient Enquiry, 1972). It is assumed that the cost of 5 per cent of the total bed-days is incurred in partly acute non-teaching hospitals.

	Number of patients	*Patient weeks*	*Cost per week (a)* £	*Total cost (£)*
Partly acute	70	3,640	65·97	240,131
Long stay	1,325	68,900	40·25	2,773,225
	1,395	72,540		3,013,356

(a) Hospital Costing Returns, year ended 31st March 1973.
Two amendments are made to the above figures:
(i) £5 per week per long-stay patient is deducted to take account of the value of accommodation released (Economist Intelligence Unit estimate).
(ii) An addition is made for capital charges: £1,000 per year per bed occupied in partly acute hospitals and £500 for long-stay beds (EIU estimate).

	Acute (£)	*Long stay (£)*	*All patients (£)*
Direct cost	240,131	2,773,225	3,013,356
Capital cost	70,000	662,500	732,500
	310,131	3,435,725	3,745,856
Less value of accommodation released		344,500	344,500
	310,131	3,091,225	3,401,356

(2) *Out-patient treatment*

There is no source of information. It is assumed that the 18,447 multiple sclerosis patients living at home make two visits per year, at an average cost of £3.00 per visit (Hospital Costing Returns, 1972/3).

(3) *General practitioner consultations*

The number of consultations for multiple sclerosis (Second National Morbidity Survey, HMSO 1974) is expressed as a proportion of the total cost of general medical services (OHE Information Sheet, No. 24).

(4) *Home nursing*

It is estimated that the 7,741 very severely disabled multiple sclerosis patients living at home require four visits per week (EIU estimate) at a cost of £0.81 per visit (Institute of Municipal Treasurers and Accountants, Local Health Services Statistics, 1971/2).

(5) *Home helps*

It is assumed that half of the very severely handicapped living at home require a home help for six hours each week (EIU estimate) at a cost of £0.50 per hour (OHE estimate).

(6) *Other services and expenditure*

It is estimated that for the very severely disabled living at home there is an additional expenditure of £115 per annum plus an extra £2.50 per week (EIU and OHE estimates).

(7) *Institutional care*

There are 1,000 patients cared for in institutions (EIU estimate) at a cost of £25 per week. The total cost is modified by the addition of a capital charge of £400 per place per annum and the deduction of £5 per week per patient to take account of the value of accommodation released (EIU estimate).

(8) *Incomes lost by multiple sclerosis patients*

	Number aged under 65	*Activity rate*	*Number not working*	*Average yearly earnings (a) (£)*	*Incomes lost (£)*
Male	7,146	96%	6,860	£2,179	14,947,940
Female	11,505	40%	4,602	£1,201	5,527,002
					£20,474,942

(a) Based on average weekly earnings, for all industries, in April 1973 of £41.9 for full-time males and £23.10 for full-time females (Department of Employment Gazette, September 1974).

(9) *Opportunity cost of relatives' time*

It is estimated that the care of the 18,447 multiple sclerosis patients at home reduces the effective earning capacity of the relatives concerned by 5 per cent per annum (EIU estimate). An average yearly income of £1,690 is used (see (8) above).

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