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Relationship of Schizophrenia to the Environment

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Attention was first drawn to the importance of this topic by Schneider (1957) when he proposed that some of his first-rank symptoms could be grouped together under the concept of 'permeability' of the barrier between the individual and his/her environment – the 'loss of ego boundaries'. Similarly, in a recent series of papers (Strauss *et al*, 1987), the essence of schizophrenia was conceptualised in the processes of interaction between biology, behaviour, and environment. The two main syndromes – acute and chronic – can each be precipitated or made worse by environmental factors, and although most patients with the negative syndrome appear to show some irreducible impairment, poverty of the social environment has been found to worsen their condition, while on the other hand, a moderate degree of social stimulation promotes relative improvement (Wing, 1987).

Zubin (1987) has proposed a Vulnerability Model, whereby the affected individual is always liable to episodes of illness, or to the development of chronicity, under the impact of environmental stresses. However, three protective factors may result in a relatively favourable outcome, if they are positive; these are social network, the ecological setting, and individual qualities such as personality and intelligence. This is a generally optimistic model; however, it still requires to be empirically tested, and although Zubin proposed that studies of outcome should require control groups which were equated on all these psycho-social variables, it is not clear how that matching could be achieved.

Ciompi (1987) drew attention to our lack of knowledge of the continuous interactions which are occurring between vulnerable individuals and stabilising or destabilising environmental influences. This three-phase model proposed that in acute psychoses, vulnerable nervous systems are critically over-taxed by unfavourable psycho-social influences from the environment – especially stressful interpersonal situations and life events. Chronic states were said to appear predominantly under unfavourable psycho-social circumstances such as intrusive relationships, which result in over-compensatory avoidance behaviour. Therapeutic consequences include the need to simplify incoming information and to maintain environmental stimulation at an optimal level; it was also suggested that pharmacotherapy and psycho-social measures might substitute for each other in this, but numerous findings from studies of Expressed Emotion (EE) indicate that these two approaches are synergistic, and not alternatives. The evidence is not clear for a view that the outcome of schizophrenic illness depends mainly on psycho-social factors, or that an individual patient's constitution, including genetic inheritance, is not significant in relation to the developing chronicity.

Finally, Brenner (1987) emphasised that proposals for environmental management of schizophrenics so far remain rather non-specific; these may facilitate information-processing, but probably do not directly influence the underlying disorder. More sophisticated assessment of single cases might produce testable hypotheses, which could eventually lead to more specific intervention programmes: his own attempts to reduce illness-related cognitive deficits indicate how this might eventually be done (Stramhe & Brenner, 1983). These and other thoughtful contributions have provided the basis for examining here, from several directions, the evidence on the relationship of schizophrenia to the environment.

Psychological and structural approaches

Cognitive theory assumes that schizophrenic illness results from persistent overburdening of the information-processing functions of the central nervous system, due to defective ability to regulate and select amongst stimuli entering from the environment. Psychosis would therefore derive from the resulting perplexity and disorganisation. This theory provides a model whereby particular family or social environments (e.g. those providing inconsistent, confusing messages) could have pathogenic effects. However, as Gallagher (1980) points out, this is more of a description of processes than an aetiological explanation.

Warner (1985) has summarised the results of investigations which suggest that withdrawal into an isolated, inner world may be an adaptive manoeuvre, counteracting the effects of an individual's excessive vigilance or over-arousal towards irrelevant environmental information. Evoked potentials show that there is an abnormal response to such stimuli, both in those with overt schizophrenia and in some

relatives who are presumed to be at high risk. Possibly as a result of abnormal function in the limbic system, such individuals become overwhelmed by high arousal, even with only moderate levels of environmental input, amongst which they cannot discriminate the stimuli which most need attention. However, the arousal model still remains largely theoretical, since the evidence for it has not so far been well-established empirically.

Dinan (1987) refers to the hypothesis of Broadbent (e.g. 1971) that schizophrenia involves a defect in the perceptual filter mechanism, resulting in the individual being bombarded by environmental stimuli, and thus overloading his cognitive processing capacity. Supporting this view of specific defects in the filtering phase of information-processing, Broen & Nakamura (1972) found that chronic non-paranoid schizophrenics show a more restricted range of sensitivity towards peripheral sensory channels than do acute paranoid schizophrenic or normal subjects. It is possible to explain both the acute anti-psychotic actions of neuroleptics and their long-term prophylactic effects partly in terms of rectification of a defective perceptual filter, e.g. the fact that they help patients to withstand greater levels of expressed emotion (EE) within the family environment, without breakdown. However, Iversen (1987) states that the neural mechanisms involved in any defect in perceptual filtering are quite unknown, while Frith & Done (1988) propose the alternative model of a dissociation between will and action. They state that possibly through the failure of a normal monitoring process, which might be located in the hippocampus, a discrepancy may arise between self-generated intention and the actions they produce, which are therefore misinterpreted by the subject. Self-generated acts are distinguished from stimulus-driven acts, which occur in response to changes in the environment.

So far as the anatomical basis of such processes is concerned, medial temporal lobe structures are involved in the integration of information from the environment, which cascades down from the sensory cortices to the interrhinal and temporal cortex, where it meets information from the self, ascending from hypothalamic and other structures. Neuropathological studies provide strong evidence that structural changes are present in schizophrenia, mostly in the limbic system and particularly in its temporal components (Johnstone *et al*, 1976). In more than one of these studies, the changes were more marked in the left (usually the dominant) hemisphere. Reveley *et al* (1987), studying brain density values by CT scan in schizophrenic patients and controls, reported that their results supported the hypothesis of left hemisphere dysfunction in schizophrenia; they suggested that it is an environmentally acquired rather than a genetic trait. Trimble (1988) states that the negative symptoms of schizophrenia appear more related to periventricular abnormalities, cerebral atrophy, and environmental insult and less to dopamine dysfunction.

Genetic–environmental interaction

The genetic contribution is at present probably the one unquestionable fact about the aetiology of schizophrenia (Lewis & Murray, 1987), but this knowledge should not lead to its importance being exaggerated. Evidence for the genetic influence comes from family, twin, and adoption studies (Gottesman & Shields, 1982); the highest risk (45%), which occurs in the monozygotic co-twin of a schizophrenic or in the child of two schizophrenic parents, cannot be a function of a shared environment, since the risk remains even if the person concerned leaves the family of origin at birth. Birchwood *et al* (1988) point out that there is no simple equation between concordance rates and the relative contribution to risk of genetics and environment; even when monozygotic twins are discordant, at least two-thirds of the non-schizophrenic twins have abnormal personalities.

Lewis & Murray (1987) state that schizophrenia is one of a group of common disorders in which there is a complex interplay between genetic factors on the one hand and powerful environmental factors on the other. The correlation in liability to schizophrenia among first-degree relatives is similar to those for pyloric stenosis, ischaemic heart disease, and diabetes mellitus – all conditions in which substantial environmental factors are known to operate, in addition to genetic ones. The fact that more than half of monozygotic twin pairs are discordant for schizophrenia, despite sharing all their genes in common, also proves the importance of environmental contributors to liability. Furthermore, the mode of genetic transmission remains unclear: age of onset is often well into adult life and the disease persists at quite high prevalence in spite of an association with reduced fertility (Crow & Done, 1986). Gurling (1986) suggests that factors such as reduced family size and variation in the age of onset may tend to obscure any clear Mendelian pattern of inheritance.

The Danish adoption studies showed that the rate of definite schizophrenia in the biological relatives of schizophrenics (9%) was significantly higher than that in the biological relatives of controls (2%). The rate of 'uncertain schizophrenia' (or spectrum disorder) was similarly higher than in the biological

relatives, but being adopted into a family which contained a schizophrenic parent did not increase the risk of developing schizophrenia for the adoptee. These adoption studies show a much stronger effect of genetic factors than do family or twin studies (Kety, 1983).

Gottesman & Shields (1982) emphasised the difficulty of identifying environmental causes or contributors, particularly if these only have interaction effects; thus, a factor might have no noticeable influence as an independent cause when whole populations are examined, though it would be critical in the minority who were genetically vulnerable. Their estimate is that environmental factors may contribute about 30% to the individual differences in liability to schizophrenia of whole populations. For those individuals who are at the extreme tail of a distribution of genetic liability, almost any life events or environmental stresses will be enough to provoke illness, but for the much larger number who are less predisposed, relatively gross events would be needed to have the same effect. However, this interaction only applies to people who are in the zone of combined liability, near the threshold of overt schizophrenia; most people do not develop a major psychiatric disorder, even when they are exposed to severe and multiple stressors. Nor is there any evidence for the view that schizophrenia represents a *specific* response to stress (Birchwood *et al*, 1988). Both genes and environmental factors are necessary but not sufficient causes; the latter may only be specifiable at present on a case-by-case basis, however.

Thus, where an individual's vulnerability is great, schizophrenia could occur even though environmental events were neither more severe nor more frequent than amongst people in general. This would account for the frequent clinical observation that illness begins after an event to which most people would adjust normally, e.g. starting work, examinations, adolescent relationships. On the other hand, it would be reasonable to postulate the existence of environmental factors that could serve to insulate people from pathogenic factors, such as those within the family (Neale & Oltmanns, 1980). Other precipitating stresses for illness could be such biological ones as drug abuse, head injury, or intra-cranial infections, though sometimes after long delay. Environmental insults of this kind represent "plausible mechanisms by which both cerebral pathology and later illness arise in some patients" (Lewis & Murray 1987).

These authors have also proposed the existence of an inverse relationship between the presence of cerebral pathology on the one hand and manifest family history on the other, in unselected populations of schizophrenic patients. The cerebral pathology is seen as the consequence of environmentally mediated processes. Thus, a causal continuum is said to exist between these environmental factors at one pole and genetic factors at the other. A further aspect to this question is the evidence of previously unsuspected abnormalities in the CT scans of about one-third of schizophrenics; these seem likely to represent early neurological damage (Reveley *et al*, 1984). Since studies in infants show that obstetric difficulties can cause enlarged ventricles and cortical atrophy, it seems quite possible that perinatal environmental events might be the cause of these neurological abnormalities, which are similar to those observed in patients with birth injuries (Manschrek, 1981).

The general multifactorial model of disease conceives of liability being normally distributed throughout the population, and representing the sum of many factors – both genetic and environmental – each of which has a small but additive effect. However, Lewis & Murray suggest that the radiological data of cerebral pathology rather imply that the environmental contribution often comprises single, but relatively large events. As organic abnormalities are present in the earliest stage of schizophrenia and are not progressive, they may be the sequelae of earlier environmental events.

However, family history may be an unreliable factor because first-degree relatives carry only 50% of the genes of the proband, and even then the mode of inheritance is uncertain (Eaton *et al*, 1986). This point is disputed by Lewis & Murray (1987), who maintain that it is only through the selection of patients with positive family histories that samples can be constructed in which it would be useful to study genetic influences.

Saugstad & Odegard (1986) note that there is a male susceptibility perinatally, with excess mortality; those factors causing mortality at birth are similar to the factors leading to perinatal morbidity and its sequelae. If perinatal morbidity is in fact a risk factor in schizophrenia, the disorder should be more frequent in males in the lower social classes and there should be a sex difference at the age of onset, with females becoming ill later; both these differences are in fact observed. A possible explanation of the early male excess is that progressive sexual brain differentiation takes longer in the male fetus; therefore, it could be complicated by external factors or go wrong more often, resulting in greater vulnerability perinatally. Post-natally, it is unlikely that one single environmental factor would be both necessary and sufficient to cause schizophrenia, as well as being identifiable; however complex, inter-related

environmental factors could well produce disabling illness in a vulnerable individual.

On the other hand, Crow & Done (1986) suggest that the onset of schizophrenia is determined by genetic or prenatal factors, rather than by environmental precipitants in postnatal life. A pathogen (e.g. retrovirus) might be integrated in the genome of an affected individual, either by inheritance from a parent who was affected or predisposed, or else by acquisition at an early stage of development. This pathogenic element would be expressed in adult life, resulting in a vulnerability to schizophrenia; the clinical outcome, in terms of whether or not psychosis emerged, would depend on that individual's subsequent environmental experience.

At present, it is not possible to make a firm choice between these alternative explanations, but in either case, the genome interacts with environmental factors, whether these are prenatal or perinatal. Kendler & Tsuang (1988) investigated variation in outcome, to see if it was associated with differences in familial psychopathology. No such relationship was found, and there was no confirmation of the hypothesis that an 'environmental' form of schizophrenia, presumably caused by brain injury, is the form with the worst prognosis.

Psycho-social influences

Most current thinking on schizophrenia shares the assumption that it involves a bio-psychological vulnerability, manifest as a sensitivity by affected individuals to their psycho-social environment, even when they are not currently experiencing symptoms. So far as aetiological influence is concerned, socio-environmental factors are more likely to affect the timing than the probability of illness (Birchwood *et al* 1988). There are four important aspects of these environmental influences which deserve examination: stress, life events, institutional environments, and family environments.

Stress

Though models which seek to explain the interaction between a schizophrenia-prone individual and the environment generally use 'stress' as a concept under which the pathogenic qualities of the environment can be subsumed, this does not mean that such stress can generally be categorised in any specific terms (Freeman, 1987). In the case of highly vulnerable individuals, the experiences do not need to be obviously harmful to provoke illness.

Eaton *et al* (1986) describe stress as produced by the random effects of circumstances, and as including both life events and confluences of psychological conditions, e.g. overly demanding social environments. They propose that liability to the type of stress most toxic to vulnerable individuals varies over the life-span, being virtually absent before puberty, rising to a peak in young adulthood, and then gradually diminishing with age – which would be consistent with the age of onset of schizophrenia. The early-onset group of schizophrenics would be dominated by very vulnerable individuals, whose episodes of illness are triggered by relatively trivial stress; a high proportion of these would have structural damage to the brain, but their genetic loading would be lower than that of later-onset groups. In later years, those who become ill for the first time would increasingly be of moderate vulnerability, not having experienced highly stressful events earlier in life. For those in the middle range of vulnerability, episodes of illness would be expected to come and go, depending on the individual's experience of environmental stress. It is quite likely that those in the lower social classes would generally experience more adverse life events (*vide infra*). However, studies which claim to measure the proportion of a population subject to significant stress are of doubtful value.

This model has clear implications for the role of prophylactic medication, since it would be precisely those in the middle range of vulnerability, with liability to recurrent episodes of illness, who could be expected to gain most benefit from continuous pharmacological protection. Long-range studies which use individual schizophrenic patients as their own controls appear to confirm that this is the case (Freeman, 1980).

Life events

Study of these environmental factors has been confused by the search for clearly harmful and stress-producing experiences, whereas for the vulnerable individual, it is normal, routine life events which help to produce cognitive disorganisation and breakdown. Day *et al* (1987) state that unlike the cases of depression, anxiety states, and demoralisation, in which stressful life changes have been implicated, the data on schizophrenia suggest that the role of life events in the onset and course of this disorder may be of a more limited nature, with stresses acting in most cases to 'trigger' initial or subsequent episodes of illness. Attempting to re-examine the evidence originally put forward by Brown & Birley (1968), they undertook a cross-national study in nine centres. Their findings confirmed the results of prior studies which had concluded that socio-environmental

stresses may precipitate schizophrenic attacks, and that such events tend to cluster in the two-to-three week period immediately preceding the onset of illness. The consequences of such stresses for the underlying illness process appeared to be relatively independent of the patient's cultural setting. However, they estimated that in any series of schizophrenic patients with acute onsets of illness, less than half may be expected to report at least one life event that could not have come about as a direct result of the prior onset of the illness. Thus, life events constitute only a single category of relevant environmental factors associated with the onset of schizophrenia, and can be described as 'acute', unlike such on-going features of the subject's life as family relationships.

Birchwood *et al* (1988) point out that retrospective studies of life events cannot show how many individuals at risk face similar life crises *without* incurring an emergence of symptoms; nor can they answer the question whether or not the schizophrenic episodes would have occurred without exposure to the life events. Furthermore, the 'independence' of life events may be very difficult to assess, since a patient's personality and the nature of his social network may influence his exposure to them, e.g. a small and distorted network might reduce their frequency (Katschnig, 1987). Only prospective research can resolve these issues.

Institutional environments

Wing & Brown's three-hospital study (1970) showed marked social differences between the hospitals in terms of environmental poverty, to which chronic schizophrenics seemed very vulnerable. Making such a poor environment more socially stimulating can be expected to result in decreased negative symptoms (though to very varying extents in individual patients), improved morale, and reduced secondary handicaps from social disadvantage. However, this improvement only occurs within a 'therapeutic window'; if environmental stimulation is increased above a certain level, it will begin to have adverse effects, and patients will progressively start to relapse, depending on their degree of chronic vulnerability (which is seen as sensitivity to the social environment). Thus, understimulating and over-stimulating social environments have equally adverse effects, but knowledge of such environmental influences needs to be translated into hypotheses about methods of care, which can then be tested. The methods of care themselves should then be modified in the light of these new findings (Wing, 1987).

Family environments

Both the aetiological and therapeutic principles that have been outlined above can be applied as well to family environments as to others. Like short-term life events, longer-term family pressures are stressors that may interact with biological predispositions to precipitate schizophrenic symptomatology (Strachan, 1986). There is no convincing evidence that those who later develop schizophrenia have experienced adverse rearing environments to a greater extent than other people (Hirsch & Leff, 1976), nor that family size or birth rank are of significance in this respect. However, where a pre-schizophrenic individual showed disturbance, the family's reaction to this could reciprocally influence the individual's behaviour, which in turn would affect parental behaviour (Birchwood *et al*, 1988). Crider (1979) conceptualises the interaction of the vulnerable child with the environment as a spiralling of psychological incompetence, with increasing age; impaired stress tolerance and poor modulation of emotional response are often noted by professionals in such cases, as well as being confirmed by recordings of autonomic over-reactivity and slowed habituation to environmental stimuli.

Hogarty & Anderson (1987) pointed to evidence that stresses in either therapeutic or natural environments require the patient to make adaptive responses to complex or emotionally charged expectations; in the vulnerable individual, the response to these is itself capable of precipitating cognitive dysfunction. If either environmental demands, or internal deficits, or both are severe enough, relapse may then occur, even when medication is assured. On the other hand, by lowering the impact of environmental events, family therapy can reduce relapse rates; this finding has been confirmed independently several times (Tarrier, 1988). However, the direction of causality remains uncertain: in 25% of untreated families, EE changed from high to low, perhaps because the patient was not currently psychotic. Therefore, at least in a proportion of cases, change in EE may be a consequence, and not a cause of a change in illness. There is a notable lack of specificity, though, about such concepts as 'confusing' or 'over-demanding' in relation to environments.

Expressed Emotion, which is regarded as an operationalised measure of environmental stress in the home, has been a very powerful concept in recent research on schizophrenia. However, it is not specific to schizophrenia, having been examined in families containing members suffering from other forms of psychiatric or physical disorder, particularly when this is of chronic duration. Nor is it likely to be

specific to relatives, since non-relatives in the home and professional carers in non-family situations can probably demonstrate the same phenomenon and with similar effects. McCarthy *et al* (1986) have suggested that the distinguishing characteristic of High EE relatives is the lack of predictability of their responses in family interactions; this could result in increased information-processing, increased levels of autonomic arousal, and then symptomatic relapse in the vulnerable family member. High contact with such relatives would thus represent a social stressor, especially for patients with cognitive impairment, who probably function best in a predictable environment. The recent literature on EE has been reviewed by Tarrier (1988): psychophysiological studies have shown that face-to-face contact with a High EE relative is associated with higher levels of electrodermal arousal than contact with a Low EE relative, which provides evidence that the measure of EE is associated with environmental stress. However, a much more rigorous understanding of the EE concept is still required, and up to now, it has thrown no light on the primary aetiological factors of schizophrenic illnesses.

Socio-economic factors

Eaton *et al* (1986) divide socio-economic factors into: (a) mutable e.g. social class, marital status, migration; and (b) immutable e.g. ethnic group, sex, place of origin. This distinction is important because there is a possibility that mutable characteristics could be a result, rather than a cause of the disorder; therefore, this group of factors needs to be considered with particular caution.

Migration

Fifty years of research have produced conflicting findings, but there is no clear evidence that stresses associated with migration are pathogenic for schizophrenia; even if relatively more migrants do develop the disorder, this may be interpreted more convincingly as due to the selection of vulnerable individuals than to the stress of the migration experience or of the new environment. One of the most important aspects of this question may well be the characteristics of the migration, e.g. voluntary or enforced, uncontrolled or selective: Rosenthal *et al* (1974) found that Danish schizophrenics were less likely than controls to migrate, because their medical history resulted in them being excluded. However, when opportunities for movement are relatively free, the unstable may be more likely to migrate, and then to become ill.

Social class

That various factors associated with lower social class could increase the risk of schizophrenia is a view with some face-validity: e.g. more life event stresses, more exposure to environmental hazards, higher risk of prenatal or perinatal injury, and fewer resources to deal with those stresses that are experienced. Kohn (1973) has argued that cognitive and other aspects of lower-class socialisation have a similar pathogenic influence, but the evidence offered for this view is equivocal. However, any apparent lower-class excess has to be examined in terms of the non-aetiological explanation of social mobility-selection (intergenerational) or drift (intra-generational); Eaton (1980) used a stochastic model to examine class differences in males, and found that mobility was sufficient in itself to explain them. Even if social class is not an aetiological factor, though, it is still quite likely that social factors (not necessarily associated with low social class) play a part in precipitating illness or maintaining chronic impairments. Saugstad & Odegard (1986) state that a significant excess of prevalence in schizophrenia in the lower social classes is very similar to that of mild mental retardation, and that both could be related to perinatal morbidity, for which a marked social-class differential persists. Drift factors therefore account for a higher prevalence rate of schizophrenia in lower social classes, but differences between these classes in incidence are much less certain.

Ecology

Because of the tendency of place of residence to be highly correlated with social class, this factor needs to be considered together with the previous one. Since the original findings by Faris & Dunham (1939) of the greater central location in Chicago of persons admitted with schizophrenia, possible ecological causes of the illness have been repeatedly examined. In Bristol, Hare (1956) concluded that prodromal symptoms often caused patients to drift to the anonymity of the city centre, but once they were there, social isolation might worsen the condition. In Plymouth, Dean & James (1985) found a spatial concentration of female readmissions for schizophrenia in areas of lower social class and poor quality housing; inability of families to cope with patients may be spatially ordered, through processes of residential sorting. Dunham (1976) concluded that there was no evidence that schizophrenia could be caused by social pressures, in particular urban environments (the 'breeder' hypothesis), but that the findings were better explained in terms of mobility

and selection. Although inner-city areas are characterised by a lack of social support, individuals who migrate to them tend to show social incompetence and withdrawal before moving.

Two areas (both ethnically homogeneous) show high prevalence rates for schizophrenia which are well above the usual range; these are the Istrian peninsula in Yugoslavia and the western counties of the Irish Republic. In the first case, the excess seems to be highly concentrated geographically; for the rural Irish areas, the earlier report of excessively high incidence has not been confirmed (Nuallain *et al*, 1987). Both places have been affected by substantial emigration, which in western Ireland has been continuing for over 150 years, and in the case of that area, selective departure of healthier people would seem a very likely process. The various sociological and cultural explanations that have been offered for these 'pockets' of high prevalence tend to be self-contradictory and have never been submitted to empirical testing.

A rather similar situation has been identified in Salford – an inner-city industrial area of the north of England (Freeman & Alpert, 1986), where the population fell by 50% in the 50 years from 1928 – a process very similar to the fall in the west of Ireland, which began earlier. The treated prevalence rate for the adult population for 1974 (6.8 per thousand) was at the top of the range for reported figures; one explanation is that the number of long-stay in-patients for the year surveyed derived from a much larger population than the current one, while another is that the migration had almost certainly taken a differential form, leaving behind relatively more of those affected by morbidity of all kinds. By contrast, areas of immigration, e.g. newly developed suburbs or new towns, tend to show relatively low rates, but as pointed out above, ecological differences are almost impossible to separate from social-class differences. The increased prevalence (and in some cases incidence) associated with unemployment, lower social class, migration, and single status in fact strongly suggests "a genetic factor that leads to social disability predating clinical onset" (MRC, 1987). Downward social drift and social alienation, beginning at puberty and often leading to migration to inner-city areas, are quite commonly observed among pre-schizophrenic males; this group of individuals, where the onset is insidious, tend to have a poor prognosis (Birchwood *et al*, 1988).

Culture

A number of studies, particularly the International Pilot Study of Schizophrenia, have found the overall course of schizophrenia to be less severe and less chronic in developing than in industrial countries. This certainly does not mean, though, that chronic, negative syndromes are rare in agrarian, pre-industrial societies (Westermeyer, 1980); the difference seems most likely to derive mainly from the 50% of schizophrenics who are in the intermediate range of prognosis. On the basis of the evidence reviewed above, these might be regarded as of middle-range vulnerability, with their clinical course strongly influenced by the degree and frequency of environmental stress. If so, a less developed society characterised by extended families, simple agricultural tasks, limited social mobility, and a low level of the kind of environmental input characteristic of industrialised societies would offer a milieu something like that described by Warner (1985) as ideal for schizophrenics – "protective but not regressive, stimulating but not stressful, and warm but not intense". It would, of course, be quite wrong to regard peasant societies as free of stress, but even so, the agrarian community does seem likely to provide a much more favourable environment than the industrial one for moderately handicapped schizophrenics. Unfortunately, very few epidemiological studies in developing countries have so far been acceptable from the methodological point of view. Torrey (1980) suggested that industrialisation causes exposure to additional viruses and toxins, which could increase liability to schizophrenia through damage to the nervous system; this is quite possible, but has not been proved. Stevens (1987) has suggested that brief, schizophrenia-like psychoses have a high incidence in developing countries and that if they were misdiagnosed as schizophrenia, they might inflate the prevalence rate of schizophrenia, and thus apparently improve the outcome in those countries. She called for more accurate prevalence studies, including community surveys and with a minimum duration requirement, since statistics based on service contacts there could be misleading. However, Jablensky *et al* (1987) report that in the WHO collaborative study (1986), Third World patients with a gradual onset of schizophrenia still had a less severe course of illness than those in developed countries with the same type of onset. It should also be noted that patterns of the dimensions of EE and the prevalence of High EE relatives may vary between different cultures (Wig *et al*, 1987).

Season of birth

The proportion of schizophrenics born during the winter season is about 10% higher than expected, and this occurs also in the southern hemisphere, even

though the winter there does not coincide with the division of the calendar year, in defining the year of birth. This excess is not shared by the siblings of schizophrenics and is greater in those without a family history and in men with paranoid illness (Shur, 1982; Hsieh *et al*, 1987). Odegard's (1974) survey of over 60 000 Norwegian psychiatric in-patients who were born between 1866 and 1939 showed a striking excess of the winter-born, but this was less pronounced for patients from the higher social classes, which is in agreement with other findings. A 'neural damage' hypothesis, whereby fetal or neonatal morbidity which predisposes to later schizophrenia is maximum for the winter-born, due to some environmental factor, seems most likely at present (Hare, 1983). Murray & Lewis (1987) state that the cause could be a viral infection or a seasonal difference in other complications that occur during pregnancy or delivery: visualised cerebral abnormalities are more common in those schizophrenics with a history of obstetric complications (Murray & Reveley, 1985). Neuropathological findings in schizophrenia (e.g. Kovelman & Scheibel, 1984) are suggestive of neuronal damage in early life, which could occur from such complications. However, the question remains how such abnormalities could be linked with the emergence of psychosis some two decades later: Murray & Lewis (1987) suggest that since a latent period has been noted between obstetric complications and epilepsy or dyskinesias, the same might occur in schizophrenia, the lesion lying dormant until the brain matures sufficiently to call the damaged systems into use. "The greater vulnerability of the male brain to early damage as well as differential rates of myelination could explain the earlier onset of schizophrenia in men".

The exact mechanism of this effect has still to be determined, but early neuro-developmental abnormality could well be one of several risk factors. The seasonal effect may also be greater in subgroups, e.g. of low genetic risk (Kinney & Jacobsen, 1978), and in those born in urban environments, where their mothers would be more susceptible to viral infections (Machon *et al*, 1983). Dalen (1988) points out that the seasonal distribution of births varies with maternal age, probably as a result of age-dependent changes of fertility: age might not be causally connected with schizophrenia, but possible intra-uterine influences on the foetus are still largely unexplored.

Vulnerability models

Mirsky & Duncan (1986) proposed a diathesis-stress (vulnerability) model, in which schizophrenia arises firstly from a genetically inherited predisposition, enduring over the individual's lifetime, and secondly, from environmental stress, which may be limited in time. The two act additively, so that high stress and low vulnerability, for instance, may produce illness, or varying degrees of either factor. The same factors, but at lower intensity, would produce spectrum disorders. This vulnerability model represents the first of three basic models of genetic disorders proposed by Kendler & Eaves (1986). Goldstein (1987) has concluded that personal vulnerability factors relate to: (1) brain biochemistry (dopamine dysfunction); (2) dysfunction in information-processing; (3) autonomic nervous system hyper-activity; and (4) certain personality traits.

Eaton *et al* (1986) describe a Two-Factor Vulnerability Model, which incorporates Crow's division of schizophrenia into two types (1982). Vulnerability is said to arise from two sources: source A arises from polygenic influences on the personality, which are normally distributed, so that vulnerability from this cause is continuous, the upper 2.5% of the population showing spectrum disorder and a much smaller proportion definite schizophrenia. Source B affects 0.2% of the population; it arises from a structural change in the brain, occurs early in life, is relatively permanent, not strongly related to genetic factors, associated with seasons of birth, and possibly caused by perinatal insult or infection. The distribution of vulnerability is tri-modal, and interacts with environmental stress over the course of life to produce schizophrenia, in various forms and at different times. At present, there is not sufficient evidence to make a definite choice between the available models of vulnerability.

Conclusion

The person–environment interaction is one of the many dimensions along which the phenomena of schizophrenia can be studied: the evidence outlined above indicates that genetic and environmental factors are of equal importance in relation to the aetiology and management of schizophrenia. Furthermore, schizophrenia is not a single clinical entity, but a syndrome subsuming different sub-entities, which may have varying aetiological bases: there might even be a need for several separate vulnerability-stress models (Nuechterlein, 1987). However, scientific understanding of each aspect still remains at a fairly early stage.

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