

The stability of the ecological distribution of the incidence of treated mental disorders in the city of Mannheim*

S. Weyerer and H. Häfner

Central Institute of Mental Health, Mannheim, Federal Republic of Germany

Summary. In 1965, Häfner et al. (1969) conducted an ecological study of the incidence of treated mental disorders in the industrial city of Mannheim. They found large variations in incidence rates in 20 urban areas: excess morbidity in the socially disorganized areas located mainly in the city center, and low rates in areas on the outskirts. This study incorporates additional data from the Cumulative Psychiatric Case Register established in Mannheim in 1973. It focuses on the short- and long-term stability of the spatial distribution of mental disorders comparing the year 1965 with the period 1974-80, and analysing the individual years from 1974-80. Despite marked changes between 1965 and the seventies (the increase in the number of guest workers; the development of extensive building and urban renewal programs; the establishment of the Central Institute of Mental Health and several community psychiatric services after 1975), the ecological correlation remained relatively high ($r=0.79$). Prior to the establishment of the Central Institute of Mental Health, the spatial distribution of mental disorders in the year 1974 was also very similar to that in 1965 ($r=0.73$). In general, the study revealed a highly stable ecological distribution of treated mental disorders not only on a long-term basis, but also for the individual years from 1974 to 1980.

Despite many problems of method and interpretation, psychiatric ecology has maintained an appeal for psychiatrists and social scientists because it seems to offer the promise of a basis for preventive action. Thus, methods of primary prevention might be indicated by the observed covariance between environmental factors and the incidence of mental ill-

ness; of secondary or tertiary prevention through guidance towards more rational planning and distribution of services (Cooper and Gath 1977). In determining preventive measures it is helpful to identify high-risk areas showing a consistent trend of excess morbidity for a longer period of time than a single year.

Despite the long research tradition in psychiatric ecology (Durkheim 1897, Faris and Dunham 1939), the first large-scale study in Germany in this field was conducted relatively late. In 1965, Häfner and Reimann (1970) determined the incidence of treated mental disorders in the industrial city of Mannheim. A major focus of this study was the spatial distribution of mental disorders. In the 20 urban areas the annual incidence rate of all psychiatric disorders varied between 5.82 and 17.86 per thousand. It was significantly higher in the socially disorganized areas, located mainly in the centre of the city. The lowest rates were found on the outskirts, particularly in the village areas with strong community activities. The differences were much too large to be accounted for by random fluctuation.

In 1973, the Cumulative Psychiatric Case Register was established in the city of Mannheim, providing incidence rates for the years 1974-1980.

Based on these two data sources, we examined the following questions for the incidence of all psychiatric diagnoses and selected subgroups:

1. Is there a systematic pattern in the incidence of treated mental disorders in the census tracts of Mannheim in 1965 and 1974-1980?

This comparison merits particular interest, as the establishment of the Central Institute of Mental Health and numerous community services in the seventies changed the face of mental health care.

2. Is the topographic distribution of the incidence of treated mental disorders stable for the years 1974-1980?

* Revised version of a paper presented at the Symposium on "Epidemiology and the Prevention of Mental Disorders" 15-17 September 1987 - Reykjavik, World Psychiatric Association, Section of Epidemiology and Community Psychiatry

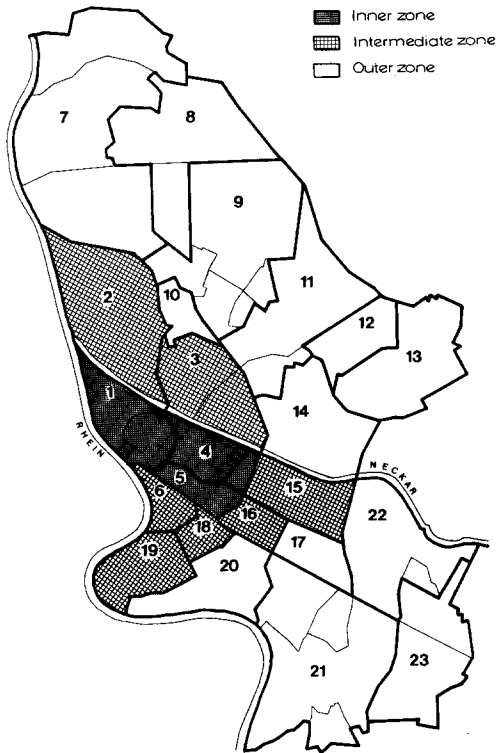


Fig. 1. The city of Mannheim according to the zonal model developed by Nellner (1969)

Table 1. Sociodemographic characteristics of the inner, intermediate and outer zone of the city of Mannheim

	City of Mannheim	Inner zone	Intermediate zone	Outer zone
Number of districts	23	3	7	13
Population (1978)	306,559	53,956	83,033	169,570
Area (km ²)	145.0	8.9	28.8	107.3
Population density	2,114	6,062	2,883	1,580
Percentage of foreigners	11.9	19.5	12.2	9.3
Average quality of living ^a	2.6	3.0	2.5	2.4

^a According to Miodek (1984): 1=very good; 2=good; 3=moderate; 4=bad

Material and methods

Mannheim, with more than 300,000 inhabitants, is the second largest city in Baden-Württemberg. Because of its favourable location at the junction of two large rivers, the Rhine and the Neckar, it has been a centre of industry, commerce and transport since the 18th century. In recent years it has had the largest inland port in West Germany. The majority

of the working population is employed in manufacturing.

Although the development of Mannheim differs from that of the large American cities, and urban planning plays a greater role than in the United States of the twenties and thirties, Nellner (1969) described the structure of the city in terms of an inner, intermediate and outer zone (Fig. 1). The inner zone contains administrative, business and traffic centres. To a large extent, the housing areas consist of low standard dwellings; mobility of the residents and the proportion of foreigners is very high.

Population density and the percentage of foreigners is highest in the inner zone and lowest in the outer zone (Table 1). There was also a significant difference in the quality of living between the inner zone and the two other zones.

Incidence rates were calculated according to ICD-8 (Degkwitz et al. 1975) for all psychiatric diagnoses (ICD 290-315), as well as for selected subgroups:

Organic psychoses (290, 292-294)

Schizophrenia (295)

Affective psychoses (296)

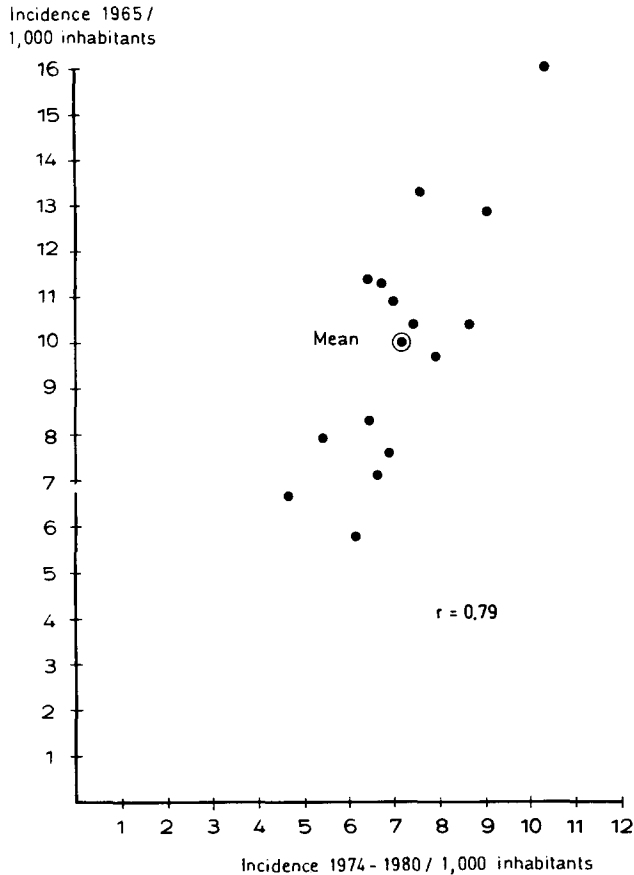
Neurotic depression (300.4)

Neuroses and personality disorders (300 except 300.4, 301, 302, 305-309)

Alcoholism and drug addiction (291, 303, 304)

Age standardization of the incidence rates was made by regression analysis. Considering the fact that the number of inhabitants varies from area to area (range 962-27,661 inhabitants) weighting was done in accordance the population size.

The longrange comparison between 1965 and 1974-1980 was complicated by the fact that the boundaries of some city boroughs had changed. For this reason we had to use larger areas in some cases. Another problem was the use of 98 institutions, including all Mannheim psychiatrists, whereas the case register included only 43 institutions. There was thus evidence of incomplete participation on the part of Mannheim psychiatrists in private practice. Finally, the 8th revision of the ICD was not in use in 1965. Distribution of psychiatric diagnosis adhered to the Würzburg classification (Häfner and Kisker 1964). This fact, together with the possibility that diagnostic usage might have changed in the time between studies, somewhat blurs the comparison. The selection of relatively broad diagnostic subgroups helps minimize this drawback. The concentration indices determined for the inner, intermediate and outer zone were composed of the quotients of psychiatric incidence (%)/population (%) per geographic unit (Welz 1983). The stability of the distribution pattern between 1974 and 1980 was deter-



	1965
1974	0.73***
1975	0.66**
1976	0.71***
1977	0.48*
1978	0.72***
1979	0.81***
1980	0.67**
1974-1980	0.79***

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$

Fig. 2. Correlations of the incidence rates in 15 area units of Mannheim for all psychiatric diagnoses between 1965 and 1974-80

mined by covariance analysis and Kruskal-Wallis rank variance analysis. To exclude the effect of varying participation by psychiatric services in the individual years, we examined the deviation in rates from the mean annual incidence i.e. the differences between the rates observed and the annual rates arrived at via the areas. Using the Kruskal-Wallis analysis we have catalogued the deviation in rates from the mean annual value over seven years according to size and have thus assigned each area seven ranks between 1 and 161 (7 times 23 possibilities). The higher the deviation of incidence from the mean annual value, the higher the rank. These levels were established for each borough. Finally, rank variance

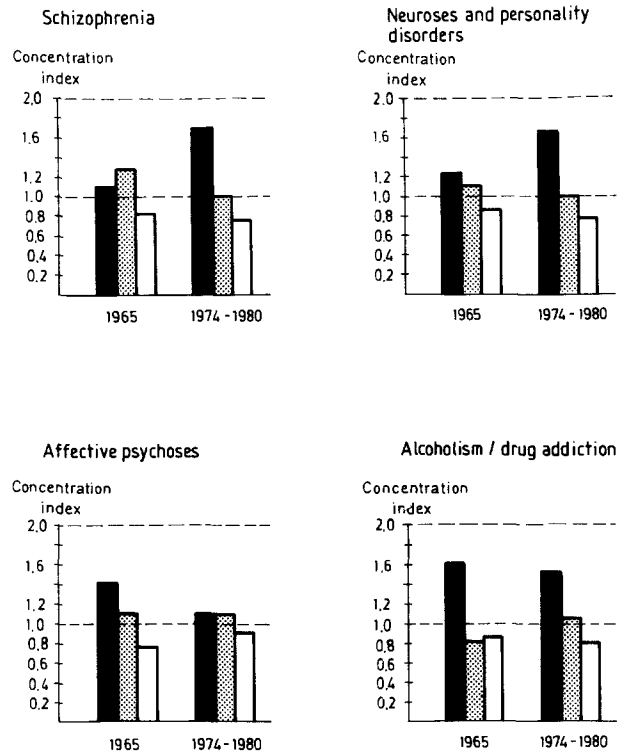


Fig. 3. Spatial concentration of the incidence of psychiatric diagnoses according to the zonal model of Nellner (1969). ■ inner zone; ▨ intermediate zone; □ outer zone

analysis shows whether or not the mean levels among the areas constitute a constant rank order.

Results

Data from 15 boroughs of the city of Mannheim yielded a relatively high correlation ($r=0.79$) between the total incidence in 1965 and the corresponding mean values for the years between 1974 and 1980 (Fig. 2).

With regard to the individual years between 1974 and 1980 the relationship is significant for all correlation coefficients, which range from 0.48 (1977) to 0.81 (1979). Prior to establishment of the Central Institute of Mental Health, for the year 1974 there was a highly significant correlation ($r=0.73$). The generally high correlation is due primarily to the largest groups: neuroses and personality disorders ($r=0.75$), together with alcoholism and other addictions ($r=0.76$). The relationship is, however, markedly lower for the diagnoses schizophrenia ($r=0.13$) and affective psychoses ($r=0.20$). In the case of the last two diagnoses, it must be acknowledged that only 13 boroughs could be compared.

When the spatial concentration of treated mental disorders is determined for the structural zones devised by Nellner (1969), there is a marked increase over 1965 in the concentration index in the inner zone between 1974-1980 for schizophrenia, as well

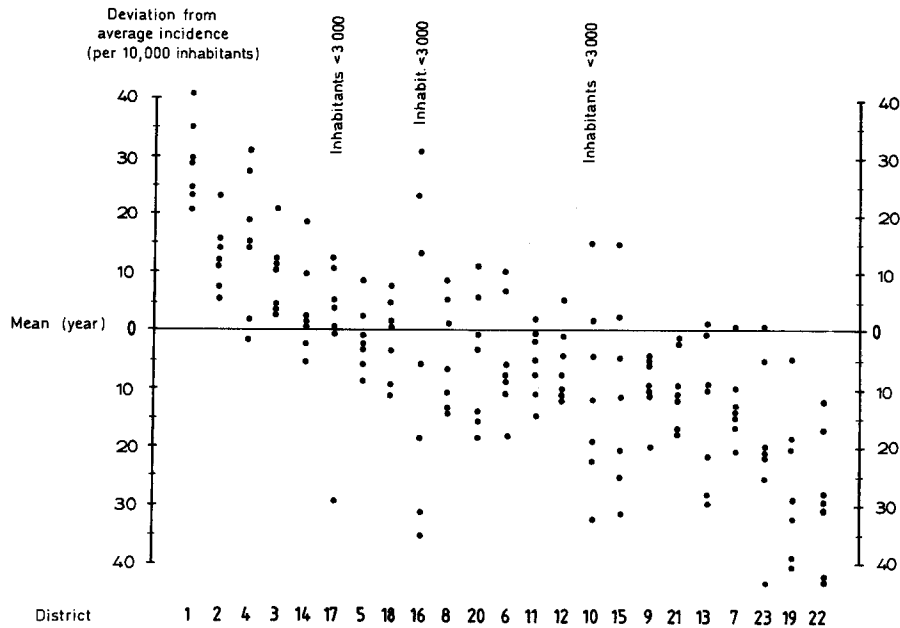


Fig. 4. Deviation from the average incidence rates for all psychiatric diagnoses over 7 years (1974-1980). The districts are sorted according to average deviation (for topographical location see Fig. 1)

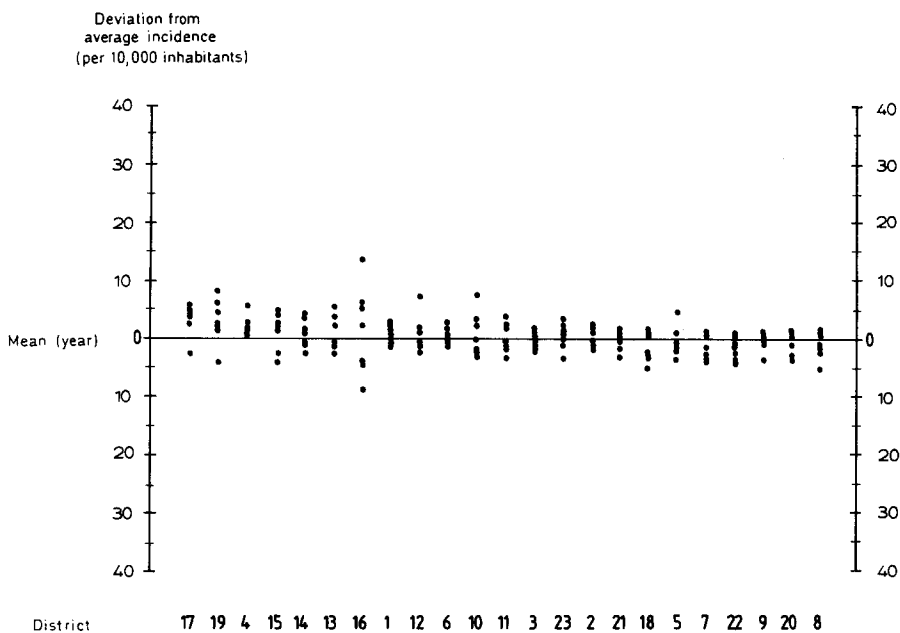


Fig. 5. Deviation from the average incidence rates for affective psychoses over 7 years (1974-1980). The districts are sorted according to average deviation (for topographical location see Fig. 1)

as for neuroses and personality disorders (Fig. 3). The diagnoses alcoholism and other addictions were strongly concentrated in the inner zone during both periods of study. However, the concentration in the intermediate zone increased markedly during the seventies. Although in 1965 there was a visible concentration of affective psychoses in the inner zone, it had almost vanished between 1974-1980.

In the following, we analyse the influence of the variables "time", that is, the years 1974 to 1980, and "statistical borough" on the deviation of rates from the annual value. The influence of the covariate "time" on the variance of the deviation is generally very slight ($F=0.008$; $1df$; $P=0.927$), that of the

variable "statistical borough", extensive ($F=243.007$; $22df$; $P=0.000$). Results relating to individual diagnoses were analogous.

Figure 4 depicts the deviation of the rates from the mean annual value for the seven years 1974-1980. The differences between the observed and mean rates were calculated for 23 neighbourhoods for all diagnoses. The boroughs Innenstadt (1), Neckarstadt-West (2), Oststadt (4) and Neckarstadt-Ost (3), all located in the inner city, show high rates over these years. The values in Waldhof-Gartenstadt (9), Neckarau (21), Wallstadt (13), Sandhofen (7), Friedrichsfeld (23), Niederfeld (19) and Seckenheim (22) are all clearly beneath the average.

Table 2. Correlation matrix of average incidence rates of psychiatric diagnoses (1974–1980) in 23 districts of Mannheim

Schizophrenia					
0.72***	Neuroses and personality disorders				
0.47*	0.71***	Alcoholism/drug addiction			
0.47*	0.47*	0.53**	Organic psychoses		
0.46*	0.70***	0.28	0.31	Neurotic depression	
–0.02	0.01	–0.03	–0.22	–0.08	Affective psychoses

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$

These districts are located mainly on the outskirts of Mannheim. A pattern of distribution corresponding largely to Fig. 4 was also established for individual diagnostic groups, with the exception of affective psychoses (Fig. 5).

Rank analyses of variance according to Kruskal-Wallis showed that the rank of deviations during the years 1974–1980 was independent of the time variable. In other words, the rank order of the boroughs changed little. We declined the null hypothesis, in which the rank of deviation in 23 boroughs shows no systematic change over time ($\text{Chi}^2 = 89.44$; 22 df; $P = 0.000$). The same holds true if we differentiate according to diagnostic groups, the only exceptions being affective psychoses, for which we cannot decline the null hypothesis ($\text{Chi}^2 = 30.89$; 22 df; $P = 0.098$). There is no consistency in the rank order of boroughs over time for the last group of disorders because they are equally distributed between boroughs.

If the correlations of the incidence rates of psychiatric diagnoses (1974–1980) in 23 boroughs in Mannheim are compared, significant positive values are in the main found for the diagnoses schizophrenia, neuroses and personality disorders, organic psychoses, and neurotic depression, but affective psychoses do not correlate significantly with any other diagnostic group (Table 2). The extremely low correlation between neurotic depression and affective psychoses ($r = -0.08$) is remarkable. Conversely, the ecological distribution pattern of neurotic depression strongly resembles that of the other neuroses and personality disorders ($r = 0.70$).

Discussion

Since the first psychiatric-ecological study was conducted in 1965 in Mannheim (Häfner et al. 1969; Häfner and Reimann 1970), several important changes have occurred:

- a marked increase in the number of guest workers and their families, whereby segregation has become the norm in individual boroughs (Miodek 1984); despite this increase of foreigners (1965: 25,019;

1978: 36,425) the total population decreased from 328,656 (1965) to 306,559 in 1978 due to the diminishing German population;

- the founding of the Central Institute of Mental Health and the development of community psychiatric services since 1975, chiefly located in the inner city (Häfner and an der Heiden 1982);

- the development of extensive building programs, primarily in the outer zone, and of urban renewal programs, especially in the inner city (Stadt Mannheim 1983).

Despite these marked changes, the distribution pattern of 1965, which corresponded to the zone model, still prevailed. Although in the interim wide-ranging urban renewal programs were carried out in the inner city to improve the standard of living, rates in this area continued to be high in the seventies. This result agrees with that of Giggs (1983) for the city of Nottingham, where the rates of schizophrenia over a period of twenty years were above average in the inner city, despite intensive urban renewal measures. Giggs concluded that factors other than the living situation might provide an explanation. These results corroborate Hawley's (1967) finding, according to which the spatial distribution of the elements of the city demonstrates a remarkable resistance to change and that the source of this resistance more likely lies in the social, rather than the physical, structure of city boroughs.

The spatial concentration of the illness groups schizophrenia, neuroses and personality disorders in the inner zone increased markedly compared to 1965. The inner zone is characterized by a high population density, a high percentage of foreign residents and a fair-to-poor standard of living. As opposed to the studies of Hare (1956) and Levy and Rowitz (1973), in which the frequency of neuroses is higher in the better upper- and middle-class neighborhoods, there has been an increased trend towards concentration in the inner city since 1965. The concentration of alcoholism and other addictions decreased somewhat in the inner zone from 1974–1980, but decreased sharply for affective psychoses. For the diagnoses alcoholism and other addictions the incidence increased in some boroughs of the intermediate zone whose standard of living is high. As opposed to schizophrenia and neuroses and personality disorders, alcoholism and drug addiction appear to be encroaching upon the better neighborhoods. The fact that affective psychoses exhibited virtually no concentration trend between 1974–1980 and that the temporal changes in the individual boroughs tend to be incidental corresponds to the results of other ecological studies

(Faris and Dunham 1939; Levy and Rowitz 1973; Klusmann and Angermeyer 1986; Giggs 1986). Furthermore the city of Mannheim demonstrates minimal fluctuation of the incidence of this illness group in individual city boroughs. Also remarkable is the distinct topographic distribution of affective psychoses compared to all other diagnostic groups and to neurotic depression for the years 1974–1980, as shown by the correlation coefficients. Separate evaluation of affective psychoses and neurotic depression is recommended. In contrast to our results, Bagley et al. (1973) reported strong ecological correlations in Brighton between affective psychoses and depression as well as with other psychiatric diagnoses.

Since information on the incidence of organic psychoses is not available for the year 1965, no equivalent comparison with the rates from the seventies can be made. For the years 1974–1980 the topographic distribution for this illness group is similar to that of schizophrenia ($r=0.67$), so here, too, there is a stark concentration in the inner city areas with a high degree of social disorganization, a finding similar to that of Faris and Dunham (1939) and Klee et al. (1967). Further interpretation requires consideration of the situation in old people's homes and nursing homes, in which the percentage of demented patients exceeds the average (Cooper et al. 1984).

This study generally verifies a high degree of stability in the ecological distribution of the incidence of treated mental disorders, not only on a long-term basis for the two periods of study, but also for the individual years between 1974–1980.

Further evaluation is needed of the availability of psychiatric services, and of the spatial distribution for certain risk groups (e.g. old people, foreigners, single persons), together with a more differentiated social characterization of the boroughs in Mannheim. In proceeding beyond the zone model, further sociodemographic, geographic and infrastructural characteristics will be considered and area units will be constituted which are as homogeneous as possible with the aid of cluster analytical procedures, similar to those in Gigg's studies (1983, 1986). The relationships between these indicators and rates of illness will be determined for the newly constituted ecological units.

Acknowledgements. We would like to thank Dr. E. Maylath, Dipl. Inform. M. Pfeifer-Kurda and Dr. B. Krumm for their help.

References

Bagley C, Jacobson S, Palmer C (1973) Social structure and the ecological distribution of mental illness, suicide, and delinquency. *Psychol Med* 3: 177–187

- Cooper B, Gath D (1977) Psychiatric illness, maladjustment and juvenile delinquency: an ecological study in a London borough. *Psychol Med* 7: 465–474
- Cooper E, Mahnkopf B, Bickel H (1984) Psychische Erkrankung und soziale Situation bei älteren Heimbewohnern. *Z Gerontol* 17: 117–125
- Degkwitz R, Helmchen H, Kockott G, Mombour W (1975) (Hrsg) *Diagnosenschlüssel und Glossar psychiatrischer Krankheiten*. Deutsche Ausgabe der internationalen Klassifikation der WHO; ICD 8. Revision. Springer, Berlin Heidelberg New York
- Durkheim E (1960) *Le suicide*. Presses Universitaires, Paris (first published in 1897)
- FARIS REL, DUNHAM HW (1939) *Mental disorders in urban areas. An ecological study of schizophrenia and other psychoses*, Hafner Publ, New York
- Giggs JA (1983) Schizophrenia and ecological structure in Nottingham. In: McGlashan ND, Blunden JR (eds) *Geographical aspects of health*. Academic Press, London, pp 197–222
- Giggs JA (1986) *Mental disorders and ecological structure in Nottingham*. *Soc Sci Med* (in press)
- Häfner H, Heiden W an der (1982) *Evaluation gemeindenaher Versorgung psychisch Kranker. Ergebnisse von 4 Jahren wissenschaftlicher Begleitung der Aufbauphase des Mannheimer Modells*. *Arch Psychiatr Nervenkr* 232: 71–95
- Häfner H, Kisker KP (1964) Ein psychiatrisch-klinisches Diagnoseschema. *Nervenarzt* 35: 34–38
- Häfner H, Reimann H (1970) Spatial distribution of mental disorders in Mannheim, 1965. In: Hare EH, Wing JK (eds) *Psychiatric epidemiology*. Oxford University Press, London New York Toronto, pp 341–354
- Häfner H, Reimann H, Immich H, Martini H (1969) Inzidenz seelischer Erkrankungen in Mannheim 1965. *Soc Psychiatry* 4: 125–135
- Hare EH (1956) Mental illness and social conditions in Bristol. *J Ment Sci* 102: 349–357
- Hawley AH (1967) *Theorie und Forschung in der Sozialökologie*. In: König R (Hrsg) *Handbuch der empirischen Sozialforschung*, I. Bd. Enke, Stuttgart, pp 480–521
- Klee GD, Spiro E, Bahn AK, Gorwitz K (1967) An ecological analysis of diagnosed mental illness in Baltimore. In: Monroe RR, Klee GD, Brody EB (eds) *Psychiatric epidemiology and mental health planning*. *Psychiatric Research Reports of the American Psychiatric Association*, 107–148
- Klusman D, Angermeyer MC (1986) Ökologische Faktoren und Rehospitalisierungsrisiko bei psychotisch Kranken. *Eur Arch Psychiatr Neurol Sci* 235: 231–242
- Levy L, Rowitz L (1973) *The ecology of mental disorder*. Behavioral Publications, New York
- Miodek W (1984) *Bevölkerungsentwicklung und innerstädtische Umzüge in Mannheim 1977–1982*. Mannheim: Amt für Stadtentwicklung und Statistik
- Nellner W (1969) *Die Entwicklung der inneren Struktur und Verflechtung in Ballungsgebieten – dargestellt am Beispiel der Rhein-Neckar-Agglomeration*. Jancke, Hannover
- Stadt Mannheim (1983) *Mannheimer Wohnungsbericht. Wohnungsbau und Wohnungsverorgung*. Amt für Wohnungswesen
- Welz R (1983) *Drogen, Alkohol und Suizid*. Enke, Stuttgart

Accepted June 29, 1988

Dr. S. Weyerer
Central Institute of Mental Health
J 5
P.O. Box 1221 20
D-6800 Mannheim 1