

MOBILITY IN NEW TOWNS

by

Mayer Hillman

Thesis presented for the Degree of Doctor of Philosophy
Faculty of Social Sciences, University of Edinburgh

May 1970



TABLE OF CONTENTS

	<u>Page</u>
Abstract	iii
Acknowledgements	iv
List of Tables	v
List of Diagrams	vii
List of Appendices	viii
 INTRODUCTION	 ix
 Chapter 1. <u>MOBILITY AND THE INDIVIDUAL</u>	 1
1.0. Introduction	3
1.1. Pre-School Children (0 to 4 years)	4
1.2. Primary School Children (5 to 11 years)	9
1.3. Adolescents (12 to 17 years)	16
1.4. Adults (women: 18 to 59 years; men: 18 to 65 years)	21
1.5. Elderly Persons (women over 60 years; men over 65)	29
1.6. Disabled Persons (all ages)	37
1.7. Summary and Discussion	45
1.8. Conclusions	55
 Chapter 2. <u>METHODS OF TRAVEL: FACTORS AFFECTING THE INDIVIDUAL</u>	 56
2.0. Introduction	58
2.1. Travel Time	61
2.2. Travel Cost	72
2.3. Travel Safety	82
2.4. Comfort and Effort	99
2.5. Visual Interest of Journey	105
2.6. Purpose of Journey	108
2.7. Limitations on Choice of Travel Mode	116
2.8. Summary and Conclusions	133
 Chapter 3. <u>STEVENAGE TRAVEL SURVEY: 1969</u>	 136
3.0. Introduction	137
3.1. Analyses of Data: Travel Activities	150
3.2. Analyses of Data: Attitudes to Influences Affecting Modal Choice	183
3.3. Discussion of Survey	188
3.4. Conclusions	198
 Chapter 4. <u>METHODS OF TRAVEL: FACTORS AFFECTING THE COMMUNITY</u>	 200
4.0. Introduction	201
4.1. Area Requirements	202
4.2. Public Expenditure	210
4.3. Aspects of Community Health	222
4.4. Social Implications	239
4.5. Summary and Conclusions	246

Chapter 5.	<u>URBAN STRUCTURE AND MOVEMENT SYSTEMS</u>	249
5.0.	Introduction	250
5.1.	Activities	251
5.2.	Location	260
5.3.	Accessibility	266
5.4.	Community Size	277
5.5.	Activity Options	291
5.6.	Movement Systems for New Towns	298
5.7.	Summary and Conclusions	323
Chapter 6.	<u>OUTLINE PROPOSALS FOR A NEW COMMUNITY</u>	← 325
6.0.	Introduction	326
6.1.	Urban Structure	330
6.2.	Land Use	336
6.3.	Movement System	340
6.4.	Community Size and Regional Context	347
6.5.	Costs and Benefits	350
6.6.	Conclusions	<u>353</u>
Appendices		355
References:	Introduction	369
	Chapter 1	370
	Chapters 2 - 4	382
	Chapters 5 - 6	406

ABSTRACT OF THESIS

Review of literature on the relationship between the travel needs and the mobility of the population indicated that planners were generally assessing mobility by considering motorised methods of travel of the household as a unit, rather than all methods of travel used by the individuals of the household. As a result, the importance of independent movement was overlooked. An analysis of the relative benefits and limitations of each of the main methods of travel demonstrated the clear advantages of cars, but showed that only 20% of the population have exclusive use of them, and that even by the year 2000 this proportion will only be 40%; moreover, the advantages are often gained at the expense of the interests of the community as a whole.

A postal survey was carried out in Stevenage New Town. It was found that the mobility of individuals varied substantially according to their age and the car ownership within the household, although basic essential and leisure travel needs were relatively constant.

Criteria for an optimal urban structure were determined, primarily by establishing a relationship between accessibility and population density, in order to assess the efficiency of movement systems in New Towns. In view of the disadvantages to pedestrians and public transport caused by unrestricted car use, it was suggested that current trends be reversed, to allow mobility to become relatively independent of age, income and ability - three prerequisites of car ownership. The thesis established that a movement system orientated towards pedestrians and public transport, without restriction on car use, would satisfy the needs of individuals of all ages more equitably than systems currently being implemented. Outline proposals for a new community environment based on this finding were put forward.

ACKNOWLEDGEMENTS

I am indebted to Professor Percy Johnson Marshall, whose response to the subject of my work has been encouraging, and to Mr. Richard Bigwood, whose help during the preparation of the thesis has been invaluable.

I am grateful for the advice and help in their specialities given by Miss Pat Bagot, Mrs. Connie Byrom, Mr. John Byrom, Professor J.J.R. Duthie, Mr. Robert Kowalski, Mr. William K. Mackay, Mr. John Nimmo, Mr. Derek Peare, Mr. Ivor Samuels, Mr. Lewis Waters, and Dr. Luke Zander. I am obliged to the librarians of the Main Library of the Edinburgh Corporation; the National Library, Edinburgh; the University of Edinburgh - in particular, to Miss Ann Abbott of the Architectural Research Unit, and to Mr. Steven Richard of the Main Statistical Reference Library. Assistance from Stevenage Development Corporation, the Editor of the Hertfordshire Express and Stevenage Gazette, and the help given by Mr. V.G. Olley, District Commissioner of the Stevenage Scouts, and the Scouts themselves is much appreciated.

I am pleased to acknowledge the considerable volume of information given to me by officers of the following organisations: Automobile Association; British Cycle and Motor-Cycle Association Ltd.; British Epilepsy Association; British Heart Foundation; British Medical Association; British Road Federation; College of Aeronautics, Cranfield, Bedford; Cyclists' Touring Club; Department of Education and Science; Department of Employment and Productivity; Department of Health and Social Security; General Register Office; Kennedy Institute of Rheumatology; London Transport; Meteorological Office; Metropolitan Police; Ministry of Housing and Local Government; Ministry of Public Building and Works; Ministry of Transport; National Association for Mental Health; National Corporation for the Care of Old People; National Foundation for Educational Research in England and Wales; Foundation for Educational Research in England and Wales; National Society for Mentally Handicapped Children; Pre-School Playgroups Association; Road Research Laboratory; Royal Automobile Club; Royal National Institute for the Blind; Royal National Institute for the Deaf; Royal Society for the Prevention of Accidents; Scottish Bus Group Limited; Tavistock Institute of Human Relations; University of Edinburgh, Heart Disease Prevention Clinic; Department of Ergonomics and Cybernetics, University of Technology, Loughborough.

Special thanks are due to my brother, Dr. Harold Hillman, for reading the manuscript. Finally, it gives me most pleasure to acknowledge the great help given by my wife, Heidi, by typing numerous drafts, providing an environment conducive to work, and most of all, by her continued moral support.

This study was executed without financial subvention.

LIST OF TABLES

Table 1.1.	Estimated Numbers of Disabled Persons in England and Wales	38
Table 2.1.	Major Influences Affecting Choice of Travel Mode Isolated in Previously Published Studies	59
Table 2.2.	Walking Speeds on Level Ground	68
Table 2.3.	Value of Time Saving in Transport Investment Appraisal	73
Table 2.4.	Vehicular Trips According to Purpose of Journey	115
Table 2.5.	Estimates of Future Vehicular Trips According to Purpose of Journey	115
Table 2.6.	Estimate of Future Car Ownership in Great Britain	122
Table 2.7.	Daily Trip Generation Rates by Basic Trip Purpose	124
Table 2.8.	Car Ownership According to Household Size	128
Table 2.9.	Summary of Relative Advantages of Six Methods of Movement According to Major Factors Affecting Personal Choice	135
Table 3.1.	Household Response by Ward	144
Table 3.2.	Person Response by Ward	145
Table 3.3.	Age Composition of Population	146
Table 3.4.	Sex Composition of Population	146
Table 3.5.	Respondents According to Car Ownership in Household	146
Table 3.6.	Respondent Households According to Car Ownership	146
Table 3.7.	Mean Frequency of Weekly Journeys According to Age and Purpose of Journey	151
Table 3.8.	Mean Frequency of Weekly Journeys According to Age and Household Car Ownership	152
Table 3.9.	Percentage of Unaccompanied Journeys According to Age and Purpose of Journey	154
Table 3.10.	Accompanied Journeys To and From Work and School	155
Table 3.11.	Method of Travel According to Age	157
Table 3.12.	Method of Travel According to Age and Household Car Ownership	159
Table 3.13.	Method of Travel for Work According to Sex and Household Car Ownership	160
Table 3.14.	Purpose of Journey According to Method of Travel	161
Table 3.15.	Method of Travel According to Purpose of Journey	162
Table 3.16.	Method of Travel According to Purpose of Journey and Household Car Ownership	164
Table 3.17.	Method of Travel in Two Stevenage Surveys	165
Table 3.18.	Purpose of Journey in Two Stevenage Surveys	165
Table 3.19.	Method of Travel According to Purpose of Journey in Three Stevenage Surveys	167
Table 3.20.	Method of Travel Within Stevenage According to Purpose of Journey	169
Table 3.21.	Typical Distances Travelled According to Method of Travel	172
Table 3.22.	Mean Distances Travelled for Journeys Within Stevenage	173
Table 3.23.	Typical Distances Travelled According to Purpose of Journey	174
Table 3.24.	Comparison of Mean Distances Travelled Within Stevenage According to Purpose of Journey in Two Surveys	175

Table 3.25.	Mean Distances Travelled Within Stevenage According to Household Car Ownership and Purpose of Journey	175
Table 3.26.	Percentage of Total Journeys Made Outside Stevenage According to Household Car Ownership	176
Table 3.27.	Typical Distances Travelled According to Purpose of Journey and Household Car Ownership	177
Table 3.28.	Work Journeys According to Sex and Typical Distance Travelled	179
Table 3.29.	Mean Distances Travelled Within Stevenage According to Age and Purpose of Journey	180
Table 3.30.	Mean Round Trip Times for All Journeys Within Stevenage According to Age and Household Car Ownership	181
Table 3.31.	Mean Round Trip Time According to Household Car Ownership and Purpose of Journey Within Stevenage	182
Table 3.32.	Mean Speed for Journeys Within Stevenage According to Age and Household Car Ownership	182
Table 3.33.	Mean Speed for Leisure Journeys Within Stevenage According to Age and Household Car Ownership	182
Table 3.34.	Importance of Influences Affecting Modal Choice According to Respondent Opinion and Respondent Journeys	185
Table 3.35.	Importance of Influences Affecting Modal Choice According to Method of Travel	186
Table 3.36.	Importance of Influences Affecting Modal Choice According to Purpose of Journey	187
Table 3.37.	Importance on Modal Choice of Time, Comfort and Effort Over Varying Distances	187
Table 4.1.	Mileage Costs Imposed by Motor Vehicles on Other Vehicles at Varying Speeds in Central London in 1964	213
Table 4.2.	Community Costs Involved when Commuter Travels to Central London by Car Instead of Bus	220
Table 4.3.	Summary of Major Aspects of Six Methods of Movement Affecting the Community	248
Table 5.1.	Potential Frequency of Visits to Social Facilities According to Age or User	256
Table 5.2.	Recommended Distances to Social Facilities in New Towns in Great Britain	271
Table 5.3.	Recommendations for the Size of Urban Communities	279
Table 5.4.	Proposed Populations for New Towns in Great Britain	280
Table 5.5.	Some Existing Residential Densities in London	286
Table 5.6.	Proposed Densities for New Towns in Great Britain	289
Table 5.7.	Population with Easy Access to Facilities, According to Density of Persons per Acre, Age Group and Household Car Ownership	296
Table 5.8.	Area Requirements According to Type of Commuter Traffic and Urban Population	301
Table 5.9.	Daily Vehicular Mileage and Vehicular Occupancy on Urban Roads According to Method of Travel	315
Table 6.1.	Land Use for a New Community of 600,000 People	339
Table 6.2.	Public Costs and Social Benefits of Proposed Community Compared with Existing New Towns	351

LIST OF DIAGRAMS

Diagram 1.1.	Age Structure of the United Kingdom Population	46
Diagram 1.2.	Proportionate Use of Time According to Age Group	50
Diagram 2.1.	Travel Time According to Method of Travel and Length of Journey	71
Diagram 2.2.	Travel Cost According to Method of Travel and Length of Journey	81
Diagram 2.3.	Casualties by Class of Road Users and Age Group (1968)	84
Diagram 2.4.	Casualties According to Method of Travel	96
Diagram 2.5.	Casualty Rates According to Method of Travel	98
Diagram 2.6.	Predicted Levels of Car Use According to Total Population of Great Britain (1960-2000)	130
Diagram 3.1.	Mean Frequency of Weekly Journeys According to Age and Purpose of Journey	151
Diagram 3.2.	Mean Frequency of Weekly Journeys According to Age and Household Car Ownership	152
Diagram 3.3.	Percentage of Unaccompanied Journeys According to Age and Purpose of Journey	154
Diagram 3.4.	Method of Travel According to Age	156
Diagram 3.5.	Method of Travel According to Purpose of Journey	157
Diagram 3.6.	Method of Travel According to Age and Household Car Ownership	159
Diagram 3.7.	Purpose of Journey According to Method of Travel	161
Diagram 3.8.	Method of Travel According to Purpose of Journey	162
Diagram 3.9.	Method of Travel According to Purpose of Journey and Household Car Ownership	164
Diagram 3.10.	Method of Travel Within Stevenage According to Purpose of Journey	169
Diagram 3.11.	Method of Travel According to Purpose of Journey in Stevenage	170
Diagram 3.12.	Typical Distances Travelled According to Method of Travel	172
Diagram 3.13.	Typical Distances Travelled According to Purpose of Journey	174
Diagram 3.14.	Typical Distances Travelled According to Purpose of Journey and Household Car Ownership	177
Diagram 3.15.	Mean Distances Travelled Within Stevenage According to Age and Purpose of Journey	180
Diagram 4.1.	Area Requirements of Six Methods of Travel According to Speed	209
Diagram 4.2.	Road Fatalities and Life Years Lost According to Age (1968)	227
Diagram 5.1.	Distance Travelled and Area of Accessibility According to Method of Travel and Time	292
Diagram 5.2.	Area of Accessibility in Ten Minutes of Travel Time According to Age Group and Household Car Ownership	294
Diagram 6.1.	Plan of Proposed New Community	332
Diagram 6.2.	Comparison of Speeds	346
Diagram 6.3.	Alternative Forms of Growth	349

LIST OF APPENDICES

Appendix 3.A.	Pilot Travel Survey: Edinburgh Questionnaire	355
Appendix 3.B.	Travel Survey: Stevenage Questionnaire	356
Appendix 3.C.	Stevenage Gazette: Press Report and Letter to Editor	357
Appendix 3.D.	Travel Survey: Letter Accompanying Questionnaire	358
Appendix 3.E.	Travel Survey: Printed Return Envelope	358
Appendix 3.F.	Journey Times and Speeds in Stevenage According to Method of Travel and Purpose of Journey	359
Appendix 3.G.	Journey Times in Stevenage According to Distance, Method of Travel and Purpose of Journey.	360
Appendix 6.A.	Project for a Linear New Town, 1957.	361
Appendix 6.B.	Central Borders Study: Urban Form Proposal, 1967.	362
Appendix 6.C.	Brookvale Community, Runcorn Architectural Competition, 1968. Report and Plans.	364
Appendix 6.D.	High Density Low-Rise Residential Development in Britain, 1966-1970.	367

INTRODUCTION

Eighteen and a half million new dwellings will be required in Great Britain between the years 1964 and 2004 to house the predicted population increase and to replace existing stock in poor condition (Stone, 1968). Much of this housing will have to be in new towns constructed at a rate equivalent to one town of one hundred thousand people every few months (Wilson, 1967). With advances in technology, these new towns should be able to provide a more attractive environment and cost less than could be achieved by expanding existing towns (Manners, 1965). It seems highly desirable that the opportunity should not be missed of planning these with ideal social goals in view. Mobility has been isolated for study from the many aspects of the planning of new towns, since circulation is considered to be the prime determinant of urban form (Buchanan et alia, 1963).

Predicted levels of car ownership are currently used to measure mobility. There are indications, however, that there may be better criteria for evaluating this aspect of acceptable environment. At present, about one fifth of the population in Great Britain own cars and therefore, benefit exclusively from their use. Transportation planning for the rest of the population does not appear to give adequate consideration to the needs of pedestrians, nor to the efficiency of the transport system for the community as a whole. If present policies persist, by the year 2000 forty million people are likely to be relying on others for most of their journeys; these will include everyone below the age of sixteen and all adults who cannot drive or are unable to afford cars. However, it is regarded as axiomatic that democratic planning should ensure that each individual should have the opportunity to enjoy urban life optimally and that, therefore, his

mobility should be minimally dependent on his age, ability or income. Clearly a perfect solution will not be found since social attitudes are continuously changing, but we may be more likely to approximate to it by a close examination of the travel needs of individuals rather than of households.

The thesis explores this subject from the viewpoint of the individual, the community and the planner. It begins with a review of literature on the relationship between the travel needs and the mobility of individuals and is followed by an analysis of the characteristics of each of the main methods of movement. A survey is carried out in Stevenage New Town to establish norms of mobility. Patterns of individual activity are studied and the effects of personal choice of travel mode on the community as a whole are considered. Optimal criteria are defined for an urban structure designed to satisfy travel needs equitably. An outline proposal for a new community based on these criteria is put forward. Although this is primarily a study of New Towns, it is hoped that some of the findings may also be relevant to urban redevelopment.

1. MOBILITY AND THE INDIVIDUAL

1.0.	INTRODUCTION	3
1.1.	PRE-SCHOOL CHILDREN (0 to 4 years)	4
1.1.1.	Demography	4
1.1.2.	Social Aspects	4
1.1.3.	Leisure Time	6
1.1.4.	Travel Requirements	6
1.1.5.	Constraints on Mobility	7
1.1.6.	General Comment	8
1.2.	PRIMARY SCHOOL CHILDREN (5 to 11 years)	9
1.2.1.	Demography	9
1.2.2.	Social Aspects	9
1.2.3.	Leisure Time	12
1.2.4.	Travel Requirements	12
1.2.5.	Constraints on Mobility	14
1.2.6.	General Comment	15
1.3.	ADOLESCENTS (12 to 17 years)	16
1.3.1.	Demography	16
1.3.2.	Social Aspects	16
1.3.3.	Leisure Time	17
1.3.4.	Travel Requirements	18
1.3.5.	Constraints on Mobility	19
1.3.6.	General Comment	20
1.4.	ADULTS (women: 18 to 59 years; men: 18 to 64 years)	21
1.4.1.	Demography	21
1.4.2.	Social Aspects	21
1.4.3.	Leisure Time	23
1.4.4.	Travel Requirements	24
1.4.5.	Constraints on Mobility	26
1.4.6.	General Comment	27
1.5.	ELDERLY PERSONS (women over 60 years; men over 65)	29
1.5.1.	Demography	29
1.5.2.	Social Aspects	29
1.5.3.	Leisure Time	32
1.5.4.	Travel Requirements	32
1.5.5.	Constraints on Mobility	33
1.5.6.	General Comment	36
1.6.	DISABLED PERSONS (all ages)	37
1.6.1.	Demography	37
1.6.2.	Social Aspects	39
1.6.3.	Leisure Time	40
1.6.4.	Travel Requirements	40
1.6.5.	Constraints on Mobility	40
1.6.6.	General Comment	43

1.7.	SUMMARY AND DISCUSSION	45
1.7.1.	Demography	45
1.7.2.	Socially Related Aspects of Movement	47
1.7.3.	Leisure Time	49
1.7.4.	Travel Requirements	51
1.7.5.	Personal and Environmental Constraints on Mobility	53
1.8.	CONCLUSIONS	55

1.0. INTRODUCTION

The current method of analysing personal movements in towns is generally based on an examination of car ownership levels and numbers of trips per household. This approach tends to neglect or overlook the particular travel needs and problems of mobility of the individuals within households. This study differs from previously published studies in that it examines the main aspects of movement of individuals. Analyses are made of each stage in the life-cycle, broadly determined by the periods when travel requirements or mobility are similar:

1.1. Pre-school children; 1.2. Primary school children;
1.3. Adolescents; 1.4. Adults of working age; 1.5. Elderly persons.
An additional sub-section, 1.6. Disabled persons, is included.

Movements of individuals in each of these stages are considered according to demography, social aspects, leisure time, patterns of travel, personal limitations on mobility, and the constraints imposed by the urban environment.

1.1. PRE-SCHOOL CHILDREN (0 to 4 years)

1.1.1. Demography

In the United Kingdom there are 4.8 million children in this age group, representing 8.6% of the total population; by the year 2,000 this figure is expected to have risen to 8.8% (Central Statistical Office, 1969, Table 14).

1.1.2. Social Aspects

The first five years of life are generally considered to be the most important for a child's emotional and intellectual development (Welford, 1962; Yudkin, 1967, p.1), and the time when he learns most rapidly (Gesell, 1954, p.252; Bloom, 1964, p.214; Sandstrom, 1966, p.177; Holt, 1968, p.VII); the basic patterns that evolve at this time are subject to only minor modifications in later years (Ambrose, 1969).

Evidence suggests that environmental as well as hereditary factors play an important part in the child's development (Leighton, 1955; Mussen et alia, 1963, p.150; Pickard, 1965, p.86; Dubos, 1967; Mental Health Research Fund, 1968). His social interaction, particularly with those of the same age group, is thought to be essential to the growth of his personality and the principle means for reducing self-centredness (Fowler, 1962; Flavell, 1963, p.279); it has been noted that the child who typically receives his rewards from adults has more difficulty in establishing friendships with his peers (Mussen et alia, op. cit., p.324). The extreme importance of mixing and playing, and of observing older children and adult activities, from about the age

of two, has been cited by psychologists and sociologists (Gesell, op.cit., pp.51-57; Mussen et alia, op.cit., p.323; Pickard, op.cit., pp.32, 76; Yudkin, op.cit., p.3; Soddy, 1967, p.284). The young child has a need for relationships at varying degrees of intensity with adults other than his parents, which the extended family used to provide in the past (Wall, 1969).

Studies of infants showed that if they were deprived of learning opportunities, there were marked deficiencies in their development (Narajan, 1957) and young monkeys denied play in their early years developed into socially inadequate adults (Harlow, 1962). The total quantity rather than quality of sensory stimulation from the environment is considered to be the essential factor in the development of perception and discrimination (Gewirtz, 1961). It is thought that there is almost no limit to the stimulation the child can receive; ideally, his potential for intellectual development and ability to cope with new circumstances should be maximised by creating opportunities to match each stage of his progress (Hunt, 1961, pp.247-279). The external environment which has an increasing influence with age, can provide many of these opportunities in the informal circumstances that neither home nor school provides.

The UNESCO Seminar on Child Education (1952) concluded that the most urgent single reform needed in this field was the provision of 'subsidiary environments' outside the family, to encourage the child's latent independence, and to develop his individuality. This could also serve as a much needed outlet to 'let off steam' without disturbing neighbours unnecessarily, and so relieve parents of the responsibilities of constant supervision (Antony et alia, 1968).

For these reasons, a year at nursery school is considered preferable to an extra year in the sixth form (Wolff, 1969), and playgroups and outdoor playspaces are thought to be essential; they can also counteract trends towards the social isolation of mothers (vide 1.4.2.).

1.1.3. Leisure Time

As the child grows older the proportion of time sleeping decreases. In the first year of life, a baby is awake for over eight hours a day (Newson and Newson, 1963); this period gradually increases to about twelve hours by the age of five (Spock, 1966). The majority of this time can be devoted to the child's physical and social development. At the age of one, six hours a day are spent playing, and in the subsequent years of this age group, the majority of waking time (Maddi, 1961).

1.1.4. Travel Requirements

For the first two or three years of life, a child is usually dependent on his parents for journeys outside the home, and generally has to be taken by his mother whenever she wishes to go out during the day. The motion during these outings appears to be appreciated, perhaps for the same reason that baby monkeys prefer a rocking mother substitute (Harlow, 1959); like older children, a baby can become bored and lonely, and benefits from being visually and aurally stimulated (Hasselmeyer, 1964).

In the early years, outdoor playspaces may be in the garden or on a balcony. Later however, the child's need for new experiences is satisfied only by more stimulating and more public spaces, providing that mother is within easy reach (Madge, 1965; Plowden et alia, 1967, p.326).

From the age of three, he prefers to play with a group of other children (Valentine, 1956), and this poses a problem of an adequate population which is easily accessible to him (vide 5.1); this is further aggravated by an increasing discrimination in favour of friendships on the basis of like age and sex (Challman, 1932; Mussen et alia, op.cit., p.329). Visits to parks or playgrounds are regular needs and attendance at nursery schools is becoming more widespread; this form of education will probably be available to all children over the age of two, by 1980 (Short, 1970).

However, much of a young child's day is not devoted to particular objectives, but is spent in satisfying his curiosity and interests (Mussen et alia, op.cit., p.269); in this sense he also has diverse though physically limited travel needs.

1.1.5. Constraints on Mobility

His newly acquired ability to walk at the average age of fifteen months (Sheridan, 1968), enables him to explore wider dimensions of his surroundings, and thus expand his experience. Longer journeys are usually undertaken in the perambulator or pushchair, which have their own problems of movement, particularly on bus journeys. Even for a mother with the use of a car, the physical effort involved in manhandling the collapsible perambulator or pushchair can be sufficient to discourage her from all but the most essential trips. In addition to the value of mixing with other children, outdoor play spaces are important for his physical development; it is perhaps relevant to note that at an early age the tricycle is the child's favourite toy (Gesell, op.cit., p.57).

Piaget's motivational theory stresses the important of curiosity and exploratory drives. He considers that the child needs to 'nourish his cognitive schemes' with environmental stimulation (Flavell, op.cit., pp.78-80). Gibson (1959) argues that perceptual learning is dependent on the stimulus of the environment. As the child grows older, the outside world has increasing relevance in this respect, and restriction on independent exploratory behaviour could deprive him of some of this learning process, and inhibit his natural development. Any limitation is frustrating, and this often explains the child's aggressive actions (Mussen et alia, op. cit., pp.209, 269).

1.1.6. General Comment

Apart from accompanying his mother on most of her journeys during his waking hours, the two routine journeys of the pre-school child are visits to outdoor playspaces and, at the age of about three years, attendance at nursery schools, when these facilities are available. He also begins to have a desire for diverse and self-directed experiences, opportunities for which should preferably exist in the immediate neighbourhood. Thus the pre-school child has his own limited, though clearly defined and significant travel needs; in view of the importance of these formative years, they can be considered as no less essential to the welfare of the community than those of his elders.

1.2. PRIMARY SCHOOL CHILDREN (5 to 11 years)

1.2.1. Demography

In the United Kingdom there are 6 million children in this age group, representing 10.9% of the total population; by the year 2000 this figure is expected to be 11.8% (Central Statistical Office, 1969, Table 14).

1.2.2. Social Aspects

According to Gesell and Ilg (1946, pp.323-4), this is the most active period of a child's life, when he wishes to exercise his physical abilities; Comfort (1965) states that by the age of twelve, the human body is at its most vigorous.

Many of the observations on the social needs of the pre-school child are equally applicable to the primary school child. However, by the age of five years, he is thought to have reached a clearly defined stage in his emotional development, for he has become far more adaptable (Sandstrom, op.cit., pp.53-62). He can make his own group of friends, whose company he prefers to that of his parents (Trasler, 1968, p.5; Mussen et alia., op.cit., pp.388-390). He is also receptive to cultural influences which are considered to be one of the functions of his play (Huizinga, 1949). His need to be treated as an individual with personal rights has been stressed (Brierley, 1953, pp.426-7).

Child psychologists and educationalists consider that as the child grows older, contact with the outside world is of increasing value in educational attainment and emotional development (ibid., p.456; Isaacs, 1961; Hadfield, 1962; Bloom, op.cit., p.77; Wiseman, 1966, p.76;

Trasler, op.cit., p.14). Different types of social relationships to those of the school and home, dependent more on the child's initiative, can be established in this way. The child needs a variety and an intensity of experiences with adults, particularly if he is growing up in a 'nuclear' family (Mead, 1969). The environment makes a significant difference to the child's 'psychic equilibrium' by the opportunities for spontaneous action that it provides (Brierley, op.cit., p.424; Fromm, 1960, pp.222-226). Freedom from adult authority is considered a basic need (Opie and Opie, 1969, pp.15-16). If he can wander, explore, and even experiment with danger, he is more able to familiarise himself with the environment (Wall, 1960), and to develop superior achievement (Mussen et alia., op.cit., p.461). According to Bruner (1961, p.199), an environment with reduced opportunities, ultimately produces an adult organism with less ability to discriminate and less desire for exploratory behaviour; it has been suggested that this may affect later creativity (Morris, 1969, pp.226-227). Physical restraints on a child's mobility can also induce a deficiency in metabolic turnover (Scott Williamson, 1938).

Controlled observations of wild and domestic animals have shown that they achieve earlier maturity in a stimulating environment (Kavanagh, 1964); studies have also demonstrated that the desire to explore is a primary drive in learning (Gibson and Walk, 1956). The efficacy of generalising from studies of animal species may be questioned; however, they do have some relevance to the behaviour of young children.

The child's need to observe adult activities and situations is considered to be important for its intrinsic interest and for insight into different types of relationships: it can also make a significant contribution to early learning (Wall, 1960; Aaron, 1965, pp.28-37). Holt (op.cit., pp.184-185) views this method of acquiring knowledge to

be quicker and more permanent than formal teaching. Duhl (1963) also asserts that learning does not come exclusively from the school - "it feeds upon vital experiences, the exploration of a new environment, the sensing of open space, perception of nature, and the stimulation of a city." The need for direct and vicarious experience with a complex world is viewed as essential to the development of intelligence (Bloom, op.cit., p.88)

Freedom from adult authority in children's play is considered a basic need (Opie and Opie, 1969, pp.15-16). It would seem insufficient to provide this need in a safe playground for this would conflict with the desired diversity of stimulation. This may account for the insecurity and frustration that leads to petty vandalism at this age; children have been noted to be far more aggressive inside than outside playgrounds (ibid., p.13). The child's outdoor activities should preferably take place on safe streets or other easily accessible and interesting places (Jacobs, 1964; Hole, 1966, p.33; Ash, 1966), which provide the essential ingredients for play, of fantasy, imitation, adventure, and physical activity, in safety (Abernethy, 1968), and for socialising (Morris, 1967; Opie and Opie, op.cit., p.14). It is perhaps for these reasons that children do not regularly visit parks and playgrounds: a study in Birmingham found that available facilities within ten minutes walk were used by children only about six times a month during the summer, and three times a month during winter (Masser, 1966); in a new Coventry estate, only 5% of children's play locations were in the purpose-built play spaces (Adams, 1967).

1.2.3. Leisure Time

As the child grows older, there is a marked increase in his leisure time, which is primarily due to a reduction in the hours needed for sleep. As a result, the travel needs of the primary school child change much faster than those of other age groups; this coincides with his rapid physical and mental development. Although attendance at school occupies a large part of the 'working' week, there is a surprisingly high proportion of the day free to organise himself outside school hours; in one study in the United States, it was noted that children spend approximately two-thirds of their total time as they wish (Aaron, op.cit., p.39). The figures for this country would not be substantially different as the 40-week school year is very similar (Department of Education and Science, 1968). A survey of 10 and 11 year old children found that one third of their time between returning from school and bedtime was engaged outdoors, averaging six to twelve hours per week (Himmelweit, Oppenheim and Vance, 1958, Table 49); another survey recorded that roughly double the amount of the child's indoor leisure time was spent outdoors (Hole, 1966, p.29, Table 12).

1.2.4. Travel Requirements

The main reasons for travel are school journeys and leisure activities. All children from the age of 5 are obliged by law to attend primary school. Younger ones may have two daily journeys to school if they go home for lunch, which is thought to benefit them psychologically (Levin and Bruce, 1968); a change of environment has also been shown to improve children's efficiency (Kallio, 1964).

The school may also serve a dual function in providing facilities for out-of-school activities such as cub scout meetings (Ministry of Housing and Local Government, 1966).

At this age the child is developing and expressing himself in imaginative play during his leisure hours. His preferred activities are most related to physical exercise (Hole, 1966, p.30). However, the type changes rapidly: at 6 years he enjoys playing ball, but at 7 years cycling, skating, swimming, running and wrestling are his favourite activities; interest in group games commences at 8 years, and in organised forms at 9 years (Gesell and Ilg, op.cit., p.368; Crowther et alia., 1959, p.9); between the ages of 10 and 12 years of age, sports are usually his consuming interest (Gesell, Ilg and Ames, 1956, p.324). In a survey of the leisure activities of children in this latter stage, preference was shown for outdoor activities, including aimless wandering, loitering and shopping expeditions (Himmelweit, Oppenheim and Vance, op.cit., Table 61). In a survey of twelve New Towns, it was noted that over one third of the use of hired accommodation was for children's pursuits such as cub and scout meetings, clubs, and dancing classes (Ministry of Housing and Local Government, op.cit., p.2). Interest in the cinema was shown in the higher frequency of attendance at this age (Osborne, 1950).

Gesell and Ilg, (op.cit., p.347) noted that the child usually enjoyed family outings only up to the age of 7 years, after which he preferred leisure activities independent of his parents.

1.2.5. Constraints on Mobility

The child's mobility is largely dictated by his walking capacity or in later years by his ability to cycle, by parental constraints, and by his perception of the environment (Lewin, 1952, pp.107, 245-247). Although by the age of ten, he can appreciate the layout of a town in relation to places with which he is familiar (Lunzer, 1969), his effective mobility is very dependent on the character of the immediate neighbourhood; if he is unable to walk or cycle to his destination in safety and without undue effort, he may be prevented or discouraged by his parents from going where he chooses (Hole, 1966, pp.24, 33). In a survey of twelve housing estates, 43% of 3-year olds played outside on their own, the majority within sight or calling distance of parents, whilst 93% of the 7-14 year age group played outside on their own, the majority quite independent of their parents (Hole, 1966, p.10, Table 5); it was not until the age of 8 or 9 that the majority were allowed off their estates (ibid., p.24). Informal activities which play a significant role in children's development, are particularly influenced by the ability to act on their own initiative. Proximity has been noted as an important determinant of child friendship (Festinger, Shachter and Back, 1950; Langner and Michael, 1963; Mussen et alia., op.cit., p.388; Gans, 1968, p.159), and can be crucial at this stage when, as has already been cited, friends are almost exclusively of the same sex, and change frequently as interests alter.

In the early years of this age group, children are not usually considered sufficiently responsible to travel on their own by public transport; journeys by car require a parent's congruence of time and inclination for the trip and the return journey. They are therefore

very dependent on activities and friends within reasonable and safe walking distance. Although the ability to act spontaneously is considered an essential element of the activity of an integrated personality (Fromm, op.cit., p.222-226), it appears that the autonomous mobility of children is declining as a result of increasing reliance on motorised movement (Parr, 1969). Parents have even been advised never to allow their children out of home if they are upset (Pratt, 1970):

1.2.6. General Comment

The primary school child's life is usually considered to revolve around home, school and formal playground, and journeys between these should obviously be possible in safety and within reasonable time. However, the child can become relatively isolated in this fairly ordered arrangement. It has been noted that development of social competence depends on learning through play, friendship formation, observation of adult activities, and the stimulus of new experiences; clearly the external environment plays an important role in this respect. It should, therefore, provide a minimum of built-in deterrent to freedom of movement so that, within reason, the child can act on his own initiative and reap the benefits or bear the consequences of his actions. It would be preferable if the only constraints were the limits of the child's own mobility.

1.3. ADOLESCENTS (12 to 17 years)

1.3.1. Demography

In the United Kingdom there are 4.7 million in this age group, representing 8.5% of the total population; by the year 2000, this figure is expected to be 9.4% (Central Statistical Office, 1969, Table 14). At present, one fifth of adolescents stay on at school up to the age of 18, though this proportion is likely to grow considerably (Department of Education and Science, 1969). The number of students in higher education is planned to double by 1981, from the present figure of over four hundred thousand (MacArthur, 1969).

1.3.2. Social Aspects

Adolescents develop physically, emotionally and intellectually at a rapid though uneven pace (Wall, 1952; Prince, 1969, p.3). Their place in society has been described as 'similar to marginal members of an underprivileged minority group' (Lewin, op.cit., p.144), and their psychological state as overlapping both childhood and adulthood (Wright, 1960).

By the age of 12 or 13, the adolescent wishes to assert his independence, and establish his own identity apart from the family, which usually results in emotional conflict (Mussen et alia, op.cit., p.546). He derives his social needs and satisfactions from a new style of relationship, usually dependent on intimate ties with his own age group and its sub-culture (Hauser, 1962, p.81; Wiseman, op.cit., p.55; Soddy, op.cit., pp. 324, 328). He also needs the opportunity for interpersonal relationships with people of different ages (Miller, 1969,

p.69), and freedom to isolate himself from society if he chooses (Spencer, 1964, p.74). He spends a high proportion of his leisure time outside the home, and rarely in the company of his parents.

Social stability is crucial to the emotional development of adolescents, particularly in view of the decline of opportunity for relationships within the extended family (Miller, op.cit., p.9). For this reason the value of clubs has often been stressed (Himmelweit, Oppenheim and Vance, op.cit., pp.344-365; Wall, 1952, pp.19, 43; Albermarle et alia, 1960, para. 220-223; Miller, op.cit., pp.66-84). However, at this awkward age, too great a degree of adult control may create in him a sense of frustration. If social facilities are not provided or are not easily accessible, and if there are insufficient outlets for adventure and new experiences, the adolescent may feel bored and isolated and this can alienate him from society (Albermarle et alia, op.cit., para. 113-126); alternatively, he may deliberately or unconsciously behave irrationally to draw attention to himself (Parr, 1966, p.43). These symptoms are perhaps reflected in the high incidence of crime in this age group: the peak age of delinquency is 14 years (McLintock and Avison, 1968). It is clear that the adolescent's ability and need to become a social personality in his own right can easily be jeopardised.

1.3.3. Leisure Time

With long holidays and few family responsibilities, the adolescent has a high proportion of the day free. As with younger children, there are only forty weeks of the year at school. Even during term, evenings and weekends provide ample time for social and

recreational activities, which are mainly enjoyed away from home.

1.3.4. Travel Requirements

The regular travel needs of this age group are school journeys; late afternoon and evening activities in schools are also becoming more frequent (Pitt, 1960, p.14), and this extension of the school day is now Government policy (Newsom et alia., 1963). The change from primary to secondary or comprehensive school from the age of 11 or 12 years usually entails longer journeys, necessitating the use of public transport. The necessity of making longer journeys also applies to the majority of adolescents who travel to work from the age of 15 years.

At this age, there is a marked change in leisure interests, which are increasingly orientated towards group organisations and adult subjects (Gesell, Ilg and Ames, 1956, pp.423-427). Sports, particularly swimming, are preferred activities, and there are high attendances at cafes, clubs and other social locations. The extent of participation in social and recreational pursuits has been shown: a survey of two thousand teenagers recorded that over 60% were members of organisations - the boys spent their leisure time mainly at games and sports, clubs, and cinemas, and the girls went dancing, to clubs, games, cinema, and to arts and crafts sessions (Wilkins, 1955); a comparison between the activities of teenagers in 1946 and 1958, showed a marked increase in membership of organisations, particularly those from which their parents were effectively excluded (Stewart, 1960); in two surveys of teenagers, their most frequent activities were outdoor recreation, cinema, dancing, youth clubs, and visiting friends and relatives (Crowther et alia., op.cit., Table 33; Schofield, 1965); in a study

of three thousand teenagers in West Scotland, leisure activities were divided between the mass entertainment category of cinema, dance hall and cafe, and the more personal variety such as visiting friends or playing scratch football - activities which did not require planning ahead (Jephcott, 1967, Tables 14, 20); the favourite activities of young teenagers in a London survey were similar to those described in the other surveys (Greater London Council, 1968, p.5).

Most of these surveys confirm that adolescents spend their leisure time outside the family group, and that social and recreational pursuits interest them more than entertainment at home (Himmelweit, Oppenheim and Vance, op.cit., p.365; Pitt, op.cit., p.15; Jephcott, op.cit., Tables 23 and 25).

1.3.5. Constraints on Mobility

The activities of adolescents are limited by the cost, service and frequency of public transport services, as the majority of recreational pursuits are usually located beyond reasonable walking distances; from the age of fourteen, adolescents are obliged to pay an adult fare. Even if there is a choice of travel mode, they are unlikely to want to be taken in a car by parents, since this runs counter to a desire to assert their independence; in any case, return journeys have to be made! The marked effect on adolescent activity of a cheap and convenient bus service was noted among teenagers in the West Scotland survey (Jephcott, op.cit., p.118), and over half the complaints made in a New Town survey related to lack of entertainment and poor transport (Sykes, Livingstone and Green, 1968). An American study recorded similar problems in a new suburb, and referred to the great

isolation of teenagers because of their reduced mobility, relative to adult car owners (Gans, 1967). It is unfortunate that bicycles, which are the most convenient method of transport for adolescents, are unpleasant and dangerous to use on most roads.

The influence of the environment on the activities of adolescents is primarily related to the fact that many recreational facilities, such as cinemas, youth clubs and sports centres, are becoming increasingly centralised and dependent on wide catchment areas for their support (vide 5.1); as a result, they are more difficult to reach. Distance and accessibility also affect social relationships (Miller, op.cit., p.68). A suitable outdoor environment can serve a useful function for many adolescents who use the street as an informal area of social activity (Waldorf, 1966, p.1700).

1.3.6. General Comment

It is clear that, apart from essential school journeys, the social functioning of adolescents requires casual and regular social interaction, and opportunities to participate in many forms of mass entertainment. In view of their preference for leisure pursuits independent of their families, they have to rely very much either on the proximity of social facilities, or on a convenient public transport system to reach them.

1.4. ADULTS (women: 18-59 years; men: 18-64 years)

1.4.1. Demography

In the United Kingdom, the adult working population consists of 31.3 million persons, representing 56.5% of the total population; by the year 2000, this figure is expected to decline to 55.9% (Central Statistical Office, 1969, Table 14). In 1967, 35% of the total working population were women, 56% of whom were married (Pinder, 1969, p.642, Table 1).

1.4.2. Social Aspects

The individual's mental and physical powers have reached their peak by early adulthood, and decline slowly in subsequent years (Office of Health Economics, 1969, p.5). This stage of maturity generally ensures an optimum ability to cope with practical and emotional problems. Working adults have two main spheres of social interest in which to maintain their equilibrium - at the personal level at home, and at the less personal though much needed level, at their place of work.

In the past, some adults could return home at lunch-time, which made a useful contribution to the family life, particularly of very young children. Nowadays, there is little opportunity for this social function, and even during weekday evenings, the father usually returns home after children have been put to bed. As a result, the housewife, whose life centres on home and children, often feels lonely and isolated (Hopkinson, 1961; Spencer, op.cit., p.74; Gans, 1968, p.184; Pickard, op.cit., p.110). Even the daily shopping trip can be a welcome opportunity to make contact with other adults; this may explain why some women shop almost every day. Indeed, a survey established that most

people viewed shopping as a social occasion (Consumers Association, 1969).

Loneliness may also occur because young couples usually live in their own homes, independent of parents, and without the mutual help which the extended family has traditionally afforded (Yudkin, op.cit., p.8). In these circumstances there is a need for a closer type of relationship with neighbours if only for occasional practical help. When children commence school, the mother has more spare time and so may become more lonely during the working day. It is not surprising, therefore, that increasing numbers of married women are choosing to take up part-time or full-time work (Douglas and Blomfield, 1958; Gavron, 1966, p.33; Plowden et alia., op.cit., p.305); a desire for company and an escape from boredom are frequently given as reasons for working (Gavron, op.cit., pp.107, 113; Hunt, 1968, p.19). In a recent survey, 92% of mothers had firmly decided to return to work once their youngest child went to school full-time (Gavron, op.cit., pp.69, 112).

Although many firms run shifts in order to provide part-time jobs (O'Callaghan, 1968), there is an acute National shortage of women for this type of work (Beckermann, op.cit., pp.231-232; Abrams, 1968; Hunt, 1968, pp.19-20). Nevertheless, industries such as entertainment, catering, repair work, hairdressing, retail distribution and nursing, which usually employ women, are all expanding; for instance, two-thirds of the hundred thousand workers employed in supermarkets are female (Times, 1969b). In the United States, there are already more jobs in the service than in the manufacturing industries (Webber, 1968), and almost half of the former are occupied by women (Newsweek, 1968); the same trend is forecast for this country (Thomas, 1969, p.455).

1.4.3. Leisure Time

Men have an economically active life of over forty-five years before the age of retirement; women who do not bring up children, have over forty years. However, most women have two potential periods of employment: the stage before marriage and until the birth of the first child which occurs on average eight years after commencement of work (Gavron, op.cit., p.31), and the second stage of at least fifteen years after the youngest child reaches adolescence, up to the age of retirement (Registrar General, 1968). This second period is increasing as a result of mothers choosing to, or having to return to work whilst children are still at school (Pinder, op.cit., p.629).

A study in 1958 estimated that the American adult had about forty-five leisure hours a week (Anderson, 1961, p.103). Similar figures, based on the average current working week of forty-five hours, were found in the National Recreation Survey, which also recorded that over half of the time at weekends was spent away from home (Rodgers, 1967, Sections 2.1 and 2.4).

Leisure time spent outside the home declines from early adulthood, because family responsibilities subsequently reduce the opportunities, particularly when children are young (Scheuch, 1960, p.42; British Broadcasting Corporation, 1965; Gavron, op.cit., p.141; Tarrant and Joyce, 1967, Table 3.14; Sillitoe, 1969, p.25); this appears to be confirmed by the decline, with advancing age, of membership of adult organisations (Pitt, op.cit., pp.8,11).

Working women are usually obliged to fill the traditional role of housewife in addition to their hours of employment; although these working hours are currently only thirty eight hours full-time, and

twenty hours part-time (Department of Employment and Productivity, 1968), household duties greatly reduce their effective leisure time. It has been calculated that housewives who do not go out to work have about five hours a day, free of household duties (Hole and Attenburrow, 1966, p.6).

By the year 2000, the average working week is likely to last only thirty five hours (Beckermann, op.cit., p.99); as a result of this, and the development of more efficient means of urban movement, weekly leisure time is likely to total sixty hours. With rising standards of living, and with greater use of labour-saving devices, leisure time for the housewife should also increase; in the United States household tasks occupy less than a third of the time taken in British households (Dumazedier, 1967). Working adults may, in future, choose more leisure time and lower incomes, or, as Kreps (1968) has suggested, a longer working life, but with shorter hours of work.

1.4.4. Travel Requirements

Adults travel to places of work, shopping and leisure. The vast majority of the male adult population, and over half the female adult population travel to work; one third of the latter are employed part-time (Hunt, 1968, p.23). The pattern of travel is, however, changing: the labour force is slowly increasing and the number of people working shifts has risen to a level at which it now accounts for one fifth of the total working population (Ministry of Labour, 1967); more employees are obtaining second jobs - in 1957, 13% of workers had two jobs, and by 1964 the proportion was 16% (Boston, 1968); the number of women working part-time, particularly in service industries is also increasing; in South East England, there are twice as many in white

collar and clerical employment as in manufacturing industry (Thomas, 1969a, p.946). Although there is a trend towards a shorter working week (Willmott, 1969, p.299), it can be seen that the number of journeys to work is rising, but that they are being spread geographically and beyond the traditional rush hours.

Shopping is the most regular travel need of the housewife not employed in full or part-time work. However, the more mobile may follow the American pattern of weekly shopping, as a result of the increase in supermarkets and ownership of cars, refrigerators and deep-freezers; delivery services are also becoming common.

The greatest increase in travel over the last decade has been for leisure, which is being spent more culturally and actively than in the past (Rodgers, op.cit., section 1). Over two million people go to evening courses at present, in the United Kingdom, and a further three quarters of a million attend part-time education during the day (Department of Education and Science, 1969); it has been forecast that these numbers for 1960 will be doubled and trebled respectively by 1975 (Beckermann, op.cit., p.481).

Young unmarried adults spend the majority of their leisure time away from home (Hole and Attenburrow, op.cit., p.8). Participation sports, such as team games, swimming and tennis in town, and sailing, skiing, camping, golfing and angling outside town, are the most common recreational activities (Rodgers, op.cit., Tables 3.5.6); these are gradually replacing spectator sports, particularly for those with cars (Barr, 1965). One fifth of free time is already spent in outdoor recreation in the United States; it seems unlikely, however, that driving simply for pleasure, which is the most popular activity there (Outdoor Recreation

Resources Review Commission, 1962), will become popular in this country (Rodgers, op.cit., Section 4.18). A survey amongst women between the ages of 16 and 34 showed that sports, outdoor recreation, cinema and dancing were their most popular leisure pursuits (Tarrant and Joyce, op.cit., Tables 4.1, 4.2). There may be a trend towards more social rather than recreational activities, particularly after marriage. In particular, mothers enjoy social visiting and have a need to take babies and very young children to watch interesting activities in pleasant surroundings.

1.4.5. Constraints on Mobility

Adults of working age are generally the most mobile of all age groups. The car represents an attractive choice for an increasing number, although it is unlikely ever to be available as extensively for women as it is for men (vide 2.7). It is particularly convenient, and often essential, for those recreational activities which require the carriage of bulky or cumbersome equipment or access to sites some distance out of town. The number and variety of such trips has grown substantially in recent years, with the rise in car ownership and a National Survey has recorded far higher participation rates in leisure activities in car-owning households (Sillitoe, op.cit., p.108).

Nevertheless, half of the households in the United Kingdom are without a car, and therefore all individuals within them are dependent for most journeys on public transport, which may be inconvenient or inadequate; with two working adults in a one-car family, one of them is usually dependent on this service (vide 2.7).

Mothers of young children have the greatest problems of mobility, and many have to restrict their journeys to those that can be made on

foot; as a result, their activities are very influenced by physical proximity. They often have to manage one or two children and a perambulator or pushchair, as well as carrying shopping. The physical effort involved is a constant deterrent to many inessential journeys, particularly if they have to be made by public transport. The use of a car could provide an escape for the isolated mother from the boredom of housework (Gavron, op.cit., pp.106-107); paradoxically, when a car is available, the housewife may be obliged to act as a chauffeur to husband and children (Bracey, 1964). It is not sufficiently realised, also, that husband and wife may spend their spare time in separate recreational activities (Gavron, op.cit., p.93; Pitt, op.cit., p.11), and therefore have to travel by different means.

The physical environment can encourage or deter journeys made on foot; it can influence in particular journeys which are made with a perambulator, by the location of potential destinations such as shops, within reasonable walking distances and with some measure of protection from the weather (ibid., p.17). Easy accessibility to a job was considered by women to be the most important factor, after high wages, in making a job pleasant (Hunt, 1968, p.187).

1.4.6. General Comment

The majority of adults are able to satisfy their travel needs without undue difficulty. However, the problem of mobility of housewives and mothers of young children deserves greater consideration, for they are frequently isolated during the working day from many urban activities which they should be able to enjoy with or without their children. Easy access to shopping, social facilities and place of work,

and within a reasonable time, can obviously prove to be a strong catalyst to adult motivation.

1.5. ELDERLY PERSONS (women over 60 years; men over 65 years)

1.5.1. Demography

In the United Kingdom, there are 8.6 million old age pensioners, representing 15.5% of the total population; by the year 2000, assuming the pensionable age remains unchanged, it is expected that this proportion will be 14.1%. There has been a significant increase, over the last thirty years in the number of very old persons, mainly women; over the age of 65, women outnumber men by three to two, and over 75 years of age by two to one (Central Statistical Office, 1969, Table 14).

1.5.2. Social Aspects

Loneliness and isolation are recurrent social problems of elderly persons. These conditions, which they do not like to admit, are aggravated by the understandable desire to remain independent for as long as possible. The vast majority at present prefer to live alone rather than to go to an old persons' home, of which there is generally a fear (Tunstall, 1966, p.55). Between 1951 and 1961 the number of elderly people living alone increased by almost 50%, the percentage increasing with age (ibid., pp.46, 49). It has been estimated that 30% are in private households with no relatives nearby, and roughly one half of these two million are living completely alone (Office of Health Economics, 1968, pp.18-19).

Loneliness in retirement is intensified by the loss of 'distanced intimacy' - the opportunity at work to communicate at an impersonal level about personal problems (Jones, 1969). It is further aggravated by the fact that a widow has a mean life expectancy of fifteen years after the death

of her husband (willmott, op.cit., p.294), and that nowadays young couples are less likely to settle near their parents (Bracey, 1966, p.46; Mental Health Research Fund, 1966, p.3).

The psychological benefits derived from social visits and community activities have been noted in several studies: Haynes and Raven (1963, p.33) concluded that relatives and friends were 'the main sustaining force' for the elderly; Beyer and Woods (1963, pp.13, 18) considered that social activities were probably the most enjoyed and essential ones for them to maintain; Agutter (1963, pp.92-94) noted the value of clubs in encouraging social participation and reducing loneliness; Bracey (1966, p.165) found children and grandchildren to be a strong source of satisfaction which the majority welcomed for the stimulation that they brought, and Shanas and Townsend (1968, p.277) established a correlation between seeing children and the frequency of loneliness.

The happiness and efficiency of old people is often dependent upon their mobility (Sheldon, 1948, pp.135, 150-156; Shanas, Townsend et alia., op.cit., p.277), and the effect of physical incapacity is therefore, a predominant fear of the aged (Arkley, 1965, p.21); this applies particularly to women whose physical ability declines with age more rapidly than that of men (Hobson, 1957, p.11). Their mobility has a significant influence on daily activities outside home (Shanas, Townsend et alia., op.cit., p.266). Distance and inconvenient forms of transport make it more difficult to preserve the frequency and informality of social visits in the traditional three-generation family - reference will be made later to the valuable reciprocal role that this used to serve (vide 1.7.2). It follows that elderly persons are particularly vulnerable, unless they live in areas with a strong sense of community (Hauser, op.cit., p.21).

Enforced retirement results in boredom and loneliness (Haynes and Raven, op.cit., p.6; Mental Health Research Fund, op.cit., p.4; Clark, 1969, p.13), and appears to increase the likelihood of illness (Selye, 1957, p.265). Ropschitz and Ovenstone (1968) showed a causal relationship between retirement and suicide, and attributed it, as others have done, to loneliness (Hauser, op.cit., p.77; World Health Organisation, 1969). This is particularly unfortunate when it is appreciated how worthwhile a contribution the elderly can make, particularly through engagement in part-time work or in voluntary services: Welford (1958, p.288) has referred to the helpfulness that many retired people show when they have the time and opportunity to practice good works.

The Ministry of Labour (1966) has recently started to encourage pensioners to take up part-time employment, regardless of their age; its successor, the Department of Employment and Productivity (1969) is urging industrialists to provide work for the increasing number of elderly persons seeking part-time employment to augment their pensions, and sometimes to offset the traumatic effects of retirement, previously referred to.

Psychologists, sociologists, and doctors in the field of preventive medicine, have stressed the value of independence and of participation in communal, social and recreational activities, as old people are more able in these circumstances to maintain their self-respect, instead of being passive recipients of care (Halmos, 1948, p.92; Sheldon, 1956, p.378; Townsend, 1957; United States Committee on Ageing, 1962; Boucher, 1962; Agutter, op.cit.; Caplan, 1964, p.61; National Council of Social Service 1968). It has been suggested that social welfare focussed on the integration of old people within the community is preferable to the simple accommodation of their needs (Shanas, Townsend et alia., op.cit., p.426).

1.5.3. Leisure Time

As a man aged 65 may now expect to live for a further twelve years, and a woman of 60 for nearly twenty years (Central Statistical Office, 1969, Table 27), this final stage in the life-cycle represents a significant proportion of adult life, which will increase if earlier retirement is enforced. Those in retirement have the whole waking day free to pursue lifetime hobbies and interests for the first time in their lives. Surveys have indicated that the average length of their day is fifteen hours, only five to six of which are devoted to such essential activities as eating, housework and personal care (Hole and Allen, 1962, pp.16-20; Beyer and Woods, op.cit., pp.7-8; Haynes and Raven, op.cit., pp.9-13); as they become older, these activities are carried out in a more leisurely way.

1.5.4. Travel Requirements

There appears to be a general decline in the activities of elderly persons outside the home. They travel mainly for part-time work, shopping, social visits, recreation and medical treatment.

A survey recorded that 28% of male pensioners in Britain were working; 77% of these stated that they will never stop work (Shanas, Townsend et alia., op.cit., p.340). Another survey found that 25% of the younger male pensioners were working full-time, and a further 11% part-time (Clark, op.cit., p.14, Table 5).

Shopping is the most frequent travel need of pensioners: a survey showed that it was a daily habit of female pensioners, who welcomed a change of environment, an incentive to walk, and an opportunity for casual encounters with neighbours and friends - 70% of them went shopping at least

three to four times a week (Haynes and Raven, op.cit., p.18); another survey found that 73% of pensioners, and 90% of the ones who lived alone, did most of their own shopping (Bracey, 1966, pp.23, 193). The findings of two other surveys were similar (Hole and Allen, op.cit., p.13; Tunstall, op.cit., p.190).

Elderly persons often make social visits: Haynes and Raven (op.cit., p.20) recorded that 71% of those who lived alone, and 36% of those who lived with one other person, visited relatives about once a week. Old persons also visit public houses, restaurants, cinemas, social and lunch clubs, libraries, public meetings, hospitals and clinics, the journeys to which often entail travel by car or bus, since the population they serve tends to be widely dispersed. The need that old people have for places in which they can sit peacefully, yet have plenty of activity to observe at close quarters, has been noted (Greater London Council, op.cit.).

1.5.5. Constraints on Mobility

Elderly persons are limited in their movement primarily by physical disability. The slowing down of mental reactions and increasing physical incapacity are the most apparent changes that occur in old age (Sheldon, 1956, p.379; Hobson, 1956; Hinchcliffe, 1962; Shanas, Townsend et alia, 1968, pp.36-38), though the correlation between ageing and the incidence of disability is by no means constant (Clark, op.cit., p.8). The physical limitations occurring with ageing are related to sensory impairment, including hearing, vision and balance; impairment of mobility and physical agility; increased susceptibility to environmental constraints and climatic changes. These factors will be examined in more detail (vide 1.6).

Although definitions of incapacity vary, surveys of the condition of old persons in this country have recorded the following: one third were

found to be suffering from impaired physical capacity as a result of chronic illness (Hobson, 1957); 30% had some difficulty in seeing; 6% had severe difficulty in hearing; and 24% some impairment in hearing (Townsend and Wedderburn, 1965, pp.55, 59); nearly three quarters of the over 80's were mobile though the mobility of two thirds of these was limited (Brockington and Lempert, 1968). A survey in Bristol recorded that 87% of old people were able to walk unaccompanied, and a further 6% accompanied (Bracey, 1966, p.189); three other surveys showed similar proportions who were able to get about outdoors without help (Townsend and Wedderburn, op.cit., p.24; Shanas, Townsend et alia., 1968, p.23, Table II-2; Harris, 1968). These figures no doubt reflect the strong desire to remain independent for as long as possible, and perhaps the value of social activity on the street in giving old people a sense of belonging. Indeed, it has been stated that the urge to remain independent is so strong as to delay the onset of increasing immobility (Sheldon, 1956, p.372).

A recent Commission recommended that car drivers should be medically examined at regular intervals (Norman, 1968); if this happened, it is likely that a large number of present drivers would be disqualified. Many do not wish to take on the problems of owning a car, and a high proportion may not be able to afford one. It is for such considerations that a maximum vehicle ownership rate of 50% has been forecast in this age group (Tanner, 1965, p.7). Nevertheless, the incentive to drive a car increases with age because of its inherent advantages over other forms of travel in most urban situations. In a survey in the United States, it was noted that old people often continued to drive after their skill at the wheel had declined markedly, because of the fear of isolation (Bracey, 1966, p.185). As the motor age develops, the urban environment could become less

attractive for old people; in this respect, British pensioners are thought to be more fortunate than Americans, a far higher percentage of whom go shopping by car (*ibid.*, pp.23-24).

Although public transport is the main alternative to the car, old people often hesitate to travel by it because of the strain of the journey, which can entail walking in inclement weather, waiting in queues, mounting high platforms of buses, and sometimes standing during rush hours (*ibid.*, p.193); high fares may also discourage old persons with low fixed incomes from travelling.

It is obvious that environmental conditions progressively affect many of their activities. Surveys repeatedly refer to the influence of distance and accessibility on the activity of the aged (Hobson, 1957, pp.32, 35-37; Blau, 1961; Haynes and Raven, *op.cit.*, pp.18-21; Hole and Allen, *op.cit.*, pp.14-18; Soddy, *op.cit.*, pp.293, 324); in one study, 25% thought that it was more important to be near shops than to have a house they liked. The proximity of urban facilities must affect the use made of them; visits to cinemas, clubs and clinics, for instance, are apt to present problems since these facilities serve large populations and therefore their location is likely to necessitate long journeys. A significant proportion of old age pensioners state that they would partake of more social activities but are prevented from doing so because they live too far away from them (Arkley, *op.cit.*, p.37; Bracey, 1966, p.23); opportunities to do so may also be dependent upon the proximity of those able to give practical help or even physical support.

The fear of road accidents, the high rate of which is mainly attributable to their decreasing ability to react quickly in emergencies (*vide* 2.3.1), may act as disincentives to movement. Further limitations

on old people's mobility are frequent or awkward changes of level and inclement weather which can often deter them from making inessential journeys.

1.5.6. General Comment

The activities of elderly persons are particularly sensitive to the urban environment in view of the likely decline of their physical, social and economic conditions. It is clear that physical mobility is crucial to their independence and mental health, and that easy accessibility has a strong influence on the extent of their activity outside the home.

Since the care of elderly persons is a major social problem, more consideration should be given to modifying the environment so that this vulnerable section of the community is able to remain mobile and independent for as long as possible.

1.6. DISABLED PERSONS (all ages)

1.6.1. Demography

Accurate figures of the prevalence of physical disablement in the United Kingdom are not known, although the Department of Health and Social Security has recently initiated an investigation to find out. There are about four hundred thousand mentally disordered persons being cared for outside hospitals or institutions and within the community (National Association for Mental Health, 1967). Estimates of the total disabled population depend on the system of classification: Townsend (1967a) has calculated it to be 3% of the total population in the United Kingdom, and considers that between 3% and 6% of adults below pensionable age are physically or mentally handicapped (1967b, p.8); he refers to the fact that in Scandinavia it is thought to be as high as 6% of those under 65 years (ibid). It is likely, therefore, that in this country there are between 1½ and 3 million disabled persons, whose disablements can be classified as handicap in communication, usually involving sensory disability, or handicap in movement, normally resulting from damage to the motor system.

The problems of handicap are individual to each classification, and are usually greater in old age: for instance, visual acuity declines after the age of 62 (Slataper, 1950); two out of every three blind persons are over 65 years (Gray and Todd, 1966); the prevalence of deafness rises sharply in old age (Soddy, op.cit., p.163); about four out of five of those who use wheelchairs, are over the age of 50 (Goldsmith, 1967, para.2207).

Table 1.1. illustrates the estimated numbers of disabled persons. It can be seen that there are many categories of disablement, which often differ so fundamentally in nature, that there is no common solution to the

Table 1.1. Estimated Numbers of Disabled Persons in England and Wales

Handicapped Persons on Local Authority Registers ¹	582,197
Handicapped in communication	
<hr/>	
Total Deafness (with and without speech) ¹	24,937
Hard of Hearing (Great Britain) ²	1,500,000
Registered Blind (registration voluntary) ¹	102,730
Partial Sight ¹	35,000
Mental Disorder (one third hospital; two thirds community) ³	592,000
Handicapped in Movement	
<hr/>	
Rheumatoid Arthritis (two thirds women) ⁴	315,000
Osteo Arthrosis ⁵	315,000
Cerebral Palsy ⁶	96,000
Spina Bifida ⁷	12,000
Epilepsy (one third children) ⁸	300,000
Amputation ¹	11,688
Wheelchair Users (three quarters over age of fifty) ⁵	85,000
Temporary Handicap	
<hr/>	
Alcoholism (Great Britain) ⁹	500,000
<hr/>	

SOURCE:

- 1 Department of Health and Social Security, 1969.
- 2 Central Office of Information, 1965.
- 3 National Association for Mental Health, 1967.
- 4 Arthritis and Rheumatism Council, 1969.
- 5 Goldsmith, 1967.
- 6 New Society, 7 November 1968.
- 7 Association for Spina Bifida and Hydrocephalus, 1969.
- 8 British Epilepsy Association, 1970.
- 9 World Health Organisation, 1969.

travel problems of any two of them. They do, however, represent a significant proportion of the total population, which is likely to rise substantially as a result of lower mortality rates, the greater efficiency of modern medicine, and an increasing life span (Beckermann et alia, op.cit., p.430; Goldsmith, op.cit., para.1220).

1.6.2. Social Aspects

The desirability of integrating disabled persons into the community and reducing the degree of their dependence, has been stressed by numerous authorities (Wooly, 1952; Ministry of Health, 1967; Townsend, 1967b, pp.3, 22; National Association for Mental Health, 1967b, p.2; Mental Health Research Fund, op.cit., p.4). Indeed, a relationship between mental health and dependence has been established (Langner and Michael, op.cit., pp.17-19). Not surprisingly, there is an unusually high incidence of loneliness and depression, particularly amongst mentally disordered persons (Mental Health Research Fund, op.cit., p.4). Frequent social interaction through activities and work opportunities outside the home are recommended to reduce this (Katz, 1969), and are thought to contribute to a reduction in disablement (Caplan, op.cit., p.67).

Physical disability does not alter intelligence characteristics. Disabled people have aims and ambitions, which may be amplified by their condition; indeed, it has been suggested that their desire for a role in society is more acute (Goldsmith, 1967, para.1512). In some ways it has to be, to compensate for the limitations on choice of locus for their activities, or because the specialised facilities on which they rely, are likely to be sited some distance from their homes.

1.6.3. Leisure Time

Although the time available to disabled persons for activities away from home may differ little from that of the rest of the population, their speed of movement is usually slower, and this effectively reduces the amount of time which they are able to devote to leisure.

1.6.4. Travel Requirements

Travel needs for work, shopping, social visiting and recreational purposes are obviously similar to those of the rest of the community. In a limited survey in Edinburgh, disabled persons who did not go out to work stated that their most frequent journeys were to shops, banks, restaurants, department stores and special clubs (Planning Research Unit, 1969, p.18).

Although there is an increasing number of disabled persons in normal employment, many have to travel to 'sheltered' industries, or places of work which can provide employment suited to their capabilities; disabled children may have to attend special schools which cater for their particular disabilities. Regular visits to hospitals or clinics are often necessary, particularly in view of the new pattern of care for mentally sub-normal persons, the aim of which is to keep all those who do not need constant attention out of hospital (Townsend, 1969).

Finally, there are social, cultural and recreational activities, in which young disabled people in particular, have a strong motivation to participate (Goldsmith, 1967, para.1512).

1.6.5. Constraints on Mobility

The desire and ingenuity of handicapped persons to accommodate

their disability permits many to remain independent, though it generally reduces their opportunities to engage in activities outside the home. However, for the more severely disabled, constraints on movement can be critical. These are numerous but a few categories can be mentioned.

The independence of a blind person is related to his ability to walk in safety and relative quiet, free of conflicting sounds, so that he can detect auditory cues. In these conditions, blindness is not as severe a handicap to mobility as might be assumed (Liddle, 1965); in a survey of blind people, 90% of those who went out unaccompanied, walked for over one hour a week (Gray and Todd, *op.cit.*). Although advances are being made in developing aids and techniques for greater mobility in existing urban situations (Ministry of Health, 1967), the dependence of blind persons on mechanised transport for most journeys is very likely to deter them from travelling for purposes which are not essential.

There is no discrimination against deaf persons who wish to take a driving test. However, the deaf pedestrian must obviously exercise exceptional care, particularly in view of the trend towards the production of quieter vehicles.

Epileptics have no difficulty in walking or travelling on public transport, but legislation at present prohibits them from driving motor vehicles. Even if the law were amended in their favour, there are unlikely to be a substantially greater number who would benefit (British Epilepsy Association, 1969). In these circumstances, a convenient public transport service is undoubtedly vital to them.

Persons with cardio-vascular disorders are advised not to drive for at least a year after a heart attack, in view of the stress that this imposes on their circulatory system (Hoffman, 1969).

Most adult wheelchair users should preferably be mechanically mobile; cars for the physically handicapped are now recognised to be of the highest priority (Times, 1969a), and can bring about a substantial increase in mobility. This need becomes more acute with the greater degrees of disablement. Nevertheless, there are disabled persons who are too poor to afford a car, or too young, too old or too incapacitated to drive. For this reason, a Parliamentary Bill to enable slow-moving invalid carriages to be driven on pavements, and by children, is in the process of enactment (Times, 1969c).

Disabled persons often find public transport inconvenient. Access to bus stops, and crossing of roads can be difficult; the wait for the bus in adverse weather conditions, and an uneven ride may also discourage them from making trips which are not vital. In a Swedish study of disabled persons over 30% who did not require special aids to move, said that they had great or unsurmountable difficulty in using public transport (Olsson, 1969).

Arthritis, which is probably the greatest single cause of disablement, is a condition affecting joints in the body, and therefore influences walking ability: a survey in Norwich recorded that 27% of disabled persons were able to walk a quarter of a mile, and 43% at least fifty yards (Goldsmith, 1968b).

Respondents in the Edinburgh survey referred to earlier, were unanimous in mentioning environmental problems and adverse weather conditions as reducing their activity (Planning Research Unit, op.cit., p.47). Nevertheless, the personal inconvenience of the majority of disabled persons is thought to be sometimes exaggerated, and can often be simply resolved; where movement on one level is impracticable, more ramps

or lifts could be provided, and for those who drive cars or invalid tricycles, reserved areas for parking, under cover and close to shopping and social facilities, would be very beneficial (Goldsmith, 1968a). Disabled persons should have to negotiate a minimum of curbs, steps and other changes of level. Covered ways and seating, consistent surfaces, and reasonable distances can increase the radius of their movement (Planning Research Unit, op.cit., pp.19-21); On the other hand, underpasses or foot bridges employed to effect complete separation of pedestrians and vehicles may be difficult or even impossible to negotiate. All these considerations are of particular relevance to the movement of wheelchair users; the extent to which these disabled persons are limited by personal and environmental constraints may be gauged from the Swedish study which recorded that the control group made twice as many journeys as those in wheelchairs (Olsson, op.cit.)

1.6.5. General Comment

Disabled persons represent a small and generally neglected section of the community who, as a result of their condition, are far more dependent on the characteristics of the urban environment. Although their problems of mobility often differ substantially, there is little doubt that many disabled adults are only able to lead active lives if they have a car, whilst others have to rely on being able to reach their destinations on foot.

Their limitations are further aggravated by the likely need to travel farther to the specialised facilities on which they often rely. The design of the environment and siting of these facilities can clearly play an important role in enabling them to integrate more easily into

society and lead normal lives. Whilst their travel needs must be accommodated within the pattern of the physical environment designed for the rest of society, further consideration of their problems could afford them greater freedom of choice and action in their daily activities. They would have better opportunity to act independently and thus improve their status and dignity.

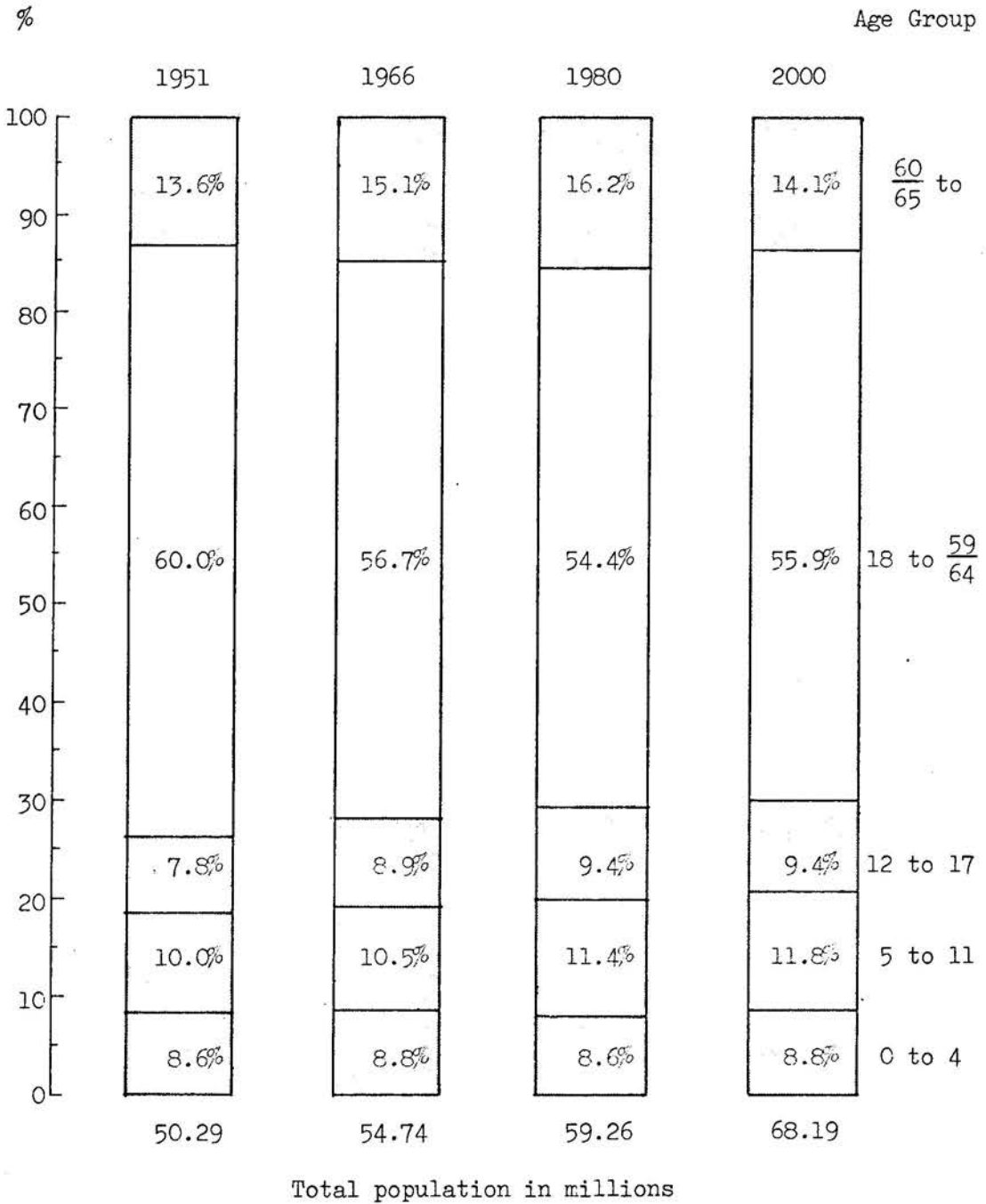
1.7. SUMMARY AND DISCUSSION

The analyses of the travel needs and associated problems of individuals through the life-cycle has been mainly drawn from available sources in many fields. Although it is by no means comprehensive, it is suggestive of wide variations due to age and ability.

1.7.1. Demography

The proportion of the population in each age group analysed in the previous sections is set out in Diagram 1.1. This illustrates the age structure of the population in the United Kingdom for the years 1951, 1961 and 1968, and predictions for the years 1980 and 2000. In 1951, pre-school, primary school, secondary school children and other adolescents below the age of 17, represented 25% of the total population; retired persons of whom two thirds were women, represented a further 13.6%. It is anticipated that in the year 2000, 30.0% of the population will be below the age of 17, and 14.1% will be above the current retiring age; as a result, there will be a total increase to over 44% of the population which will be largely dependent on the working population. In addition, the planned expansion of students in full-time education at colleges and universities, the increase in the numbers of pensioners resulting from a reduction in the retiring age, and the anticipated rise in the disabled population of working age, should be added to this figure. Finally, it could be noted that current research into the causes of ageing may result in a significant extension of life years (Comfort, 1969); this would, of course, affect the demographic analysis in a totally unpredictable way.

Diagram 1.1. Age Structure of the United Kingdom Population



Source: Central Statistical Office (1969, Tables 6 and 14)

1.7.2. Socially Related Aspects of Movement

The broad stages of the life-cycle, relevant to movement, are briefly summarised below:

0 to 4 years. This is the most influential period of life for the individual's emotional and intellectual development. Although the very young child is mainly dependent on parents for movement outside the home, this sphere of activity can contribute significantly to his social competence.

5 to 11 years. The child at this age is increasingly allowed to choose his own leisure activities. Learning through play, by observation of adults and through the stimulus of new experiences is an essential aspect of his social development, and is related to the extent to which he is able to act on his own initiative.

12 to 17 years. This is a period of emotional instability when the adolescent wishes to establish his claim to be treated as an individual with equal rights to the adults upon whom he is still dependent. He usually prefers to lead a social life with those of his own age; the freedom to do so is limited more by the availability of convenient public transport services and the physical characteristics of the environment than by his parents' authority.

18 to 59 or 65 years. This period typically covers three stages in the life-cycle: the early years before marriage when few familial responsibilities and relatively high earning power engender the greatest freedom of choice for leisure pursuits; the subsequent years when young children are likely to effect a distinct reduction in the frequency of leisure activities outside the home; the late years which is potentially a period of increased leisure and comparative economic prosperity, once the responsibilities of bringing up children have passed.

60 or 65 years and over. This final stage of life is typically a period of reduced economic circumstances, coinciding with a maximum time available for leisure. Loneliness and boredom are recurrent problems, particularly of women who have a far greater longevity relative to men. These problems are aggravated by reduced mobility resulting from a decline in mental and physical capabilities, and the increasing influence of the characteristics of the external environment.

Whilst the individual is naturally disposed towards social living (Storr, 1968), in the examination of the social problems of each age group, the terms 'isolation', 'loneliness', and 'boredom' have frequently recurred. In this respect, the value of frequent interaction with people of all ages is a significant element in the development of children and adolescents into competent adults, in the lives of housewives and mothers of young children, for whom adult company is often absent during weekdays, and particularly in the lives of elderly persons whose status and function within the family and community gives them the identity and dignity, which are essential to their well-being. This interaction has the further advantage of countering the increasing polarisation of age groups (Gist and Fava, 1967, p.406).

Increasing mobility for work and home location have contributed to this polarisation of family life, the social hazards of which are only now becoming apparent. The essential difference from the traditional form of the family unit is due to the 'greater sensitivity' of the nuclear family to life-cycle changes (Anderson, op.cit., p.157). There are advantages in old people and young families living in close proximity and forming integrated groups. The benefits are mutual, for the reciprocation of services between individual members involves grandparents

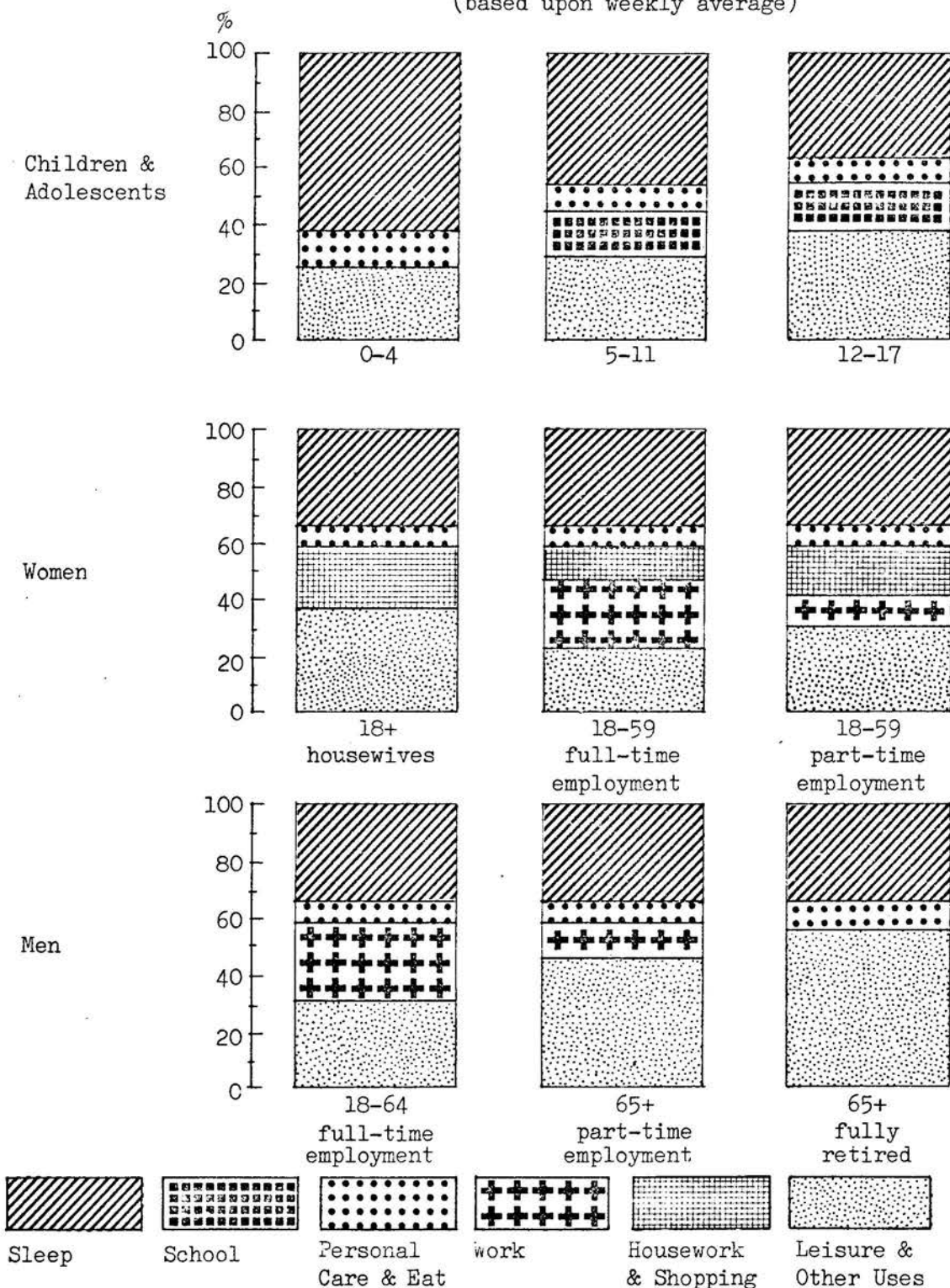
in the growth of the next generation and makes the task of child-rearing less arduous. Their presence during the child's formative years is a fundamental function of his understanding of the meaning of growing old, and has a profound effect on his subsequent attitude to age and ageing; at the same time, elderly persons have the reassurance of assistance from their own family in time of need. These interactions are, however, dependent upon the opportunity for the elderly and the very young to reciprocate visits and services, and this is much related to their mobility. All too often there is a one-way traffic of the independent young family visiting their less mobile ageing relatives; the effect of this tends to result in more formal relationships being established.

However, there is a danger in too exclusive a family-orientated way of life (Scheuch, *op.cit.*, p.54), and the need and opportunity for all age groups to participate in community activities has, therefore, been seen as the most effective preventive measure against isolation, loneliness and boredom. This aspect is of growing importance since it is clear that society can only function satisfactorily today if its members provide each other with the mutual support that the traditional kinship social structure afforded (Young and Willmott, 1957; Spencer, *op.cit.*, p.5; Gist and Fava, *op.cit.*, p.370).

1.7.3. Leisure Time

An indication of the manner in which each age group spends the twenty four hour day is shown in Diagram 1.2. It can be seen that age has a strong influence on the free hours remaining from those devoted to the essential functions of school or work, 'maintenance' - eating, washing etc. - and sleep.

Diagram 1.2. Proportionate Use of Time According to Age Group
(based upon weekly average)



Sources:

Children and Adolescents: Spock(1966); Dept.of Educ.& Science(1969)
 Adults: Anderson(1961); Haynes and Raven(1963); Hole and Attenburrow
 (1967); Tarrant and Joyce(1967); Harris(1968); Hunt(1968);
 Department of Employment and Productivity(1969); Clark(1969)

The greatest amount of free time exists for a substantial number of years at each end of the life-cycle: for children, the time devoted to sleep declines sharply up to adolescence, so that free time on average reaches a maximum of nearly ten hours daily during the seven day week; for working male adults there is on average seven hours of free time daily, and for female adults between four and eight hours, depending on whether they go out to work; for elderly persons, the day is relatively uncommitted except for the hours devoted to housework and shopping.

Existing trends towards a shorter working week, longer holidays, earlier retirement and lengthened life expectancy, will substantially increase available leisure time, with the result that there could well be a doubling of non-working time between the years 1950 and 2000 (Eversley, 1967).

1.7.4. Travel Requirements

Travel needs have been analysed from the point of view of the individual at each stage of his life; it can be seen that the family operates as a unit on a relatively small number of the total journeys made by the individuals within it, since increasingly age groups spend their leisure times differently (Rodgers, op.cit., Section 4.24). The variety of roles that each individual plays is usually more related to the practical and social activities outside rather than within the family. This trend is perhaps more evident in the more affluent and educated families, and in those that have been formed in recent years (Willmott, 1969, pp.295-301).

In examining the patterns of these needs at various stages in the life cycle, the following significant points emerged:



Pre-school child's journeys outside the home, other than those specifically made for adult purposes, provide opportunities for social mixing and for identification of a world beyond his immediate family. Owing to his limited capabilities, however, these journeys are usually made on foot and can rarely be made independently.

Journeys of the primary school child are made mainly to school and for leisure purposes; the latter are often of an exploratory nature, and are not therefore easily identifiable. In most circumstances, the child prefers, and is able to, make them on his own, on foot or by bicycle, provided that there are no environmental constraints.

Journeys of the adolescent differ from those of the primary school child only to the extent that journeys to secondary school and to social and recreational activities are more likely to require greater travelling distances, since they serve larger populations; this is particularly true of the sphere of mass entertainment. In view of the desire to lead an independent life, the adolescent makes most journeys by bicycle when this is possible, or by public transport.

Journeys of the male adult and to a lesser though increasing extent, the journeys of the female adult, are primarily for work purposes during the weekday. The main travel need of housewives is for shopping though the frequency of journeys for those with the use of a car is declining in view of the ease with which large quantities of goods can be carried. A rising proportion of journeys are made for social and recreational purposes as a result of the increase in leisure time, affluence and car ownership.

Journeys of elderly persons for work and shopping are similar to those of younger adults, though comparatively few seek or are able to gain employment. The reduction in social and recreational activity may

be due to decreased physical capacity or unsuitable location of facilities in relation to the home rather than to any decrease in desire to participate. The level of car ownership is usually low, owing to reduced financial circumstances, with the result that elderly persons are likely to be dependent on public transport for a high proportion of their journeys.

Journeys of disabled persons at any age are similar to those of the rest of the community. However, because of their greater need for specialised facilities, they are often obliged to travel longer distances. Many of the adults can only achieve an acceptable level of independence by using a car, whilst others have to rely on the proximity of facilities to which they can walk, as public transport is inconvenient to use.

1.7.5. Personal and Environmental Constraints on Mobility

Physical mobility changes with varying stages in the life-cycle, from the entire dependency of the baby, to the energetic child able to walk and later to cycle, to the adolescent often relying on public transport, to the mother limited by dependent children, to the male adult with his high degree of mobility, and culminating in the increasing dependency of elderly persons. The degree of mobility appears to be more influenced by age than by socio-economic circumstances. Although the adult usually has the widest choice of methods of movement, with the minimum of limitations on mobility, an appreciable proportion of the total population is, and will almost certainly continue to be restricted in its choice by legal, physical or economic conditions, and is, therefore, dependent on the services of a driver for all journeys which cannot easily be undertaken on foot (vide 2.7).

Much emphasis has been placed on the value of social independence in respect of each age group. The value of independence applies equally to freedom of movement, for it is clear that to be dependent on the service of others must act as a restrictive influence in both practical and psychological respects.

Physical mobility is closely linked with environmental planning, and its importance to the needs of many groups in society emerges strongly from consideration of their needs. In some circumstances, the urban environment may play a dominant role in encouraging or discouraging individuals from engaging in leisure interests outside the home, and it is thus an important influence on the extent of their participation in urban activities. It can also provide opportunities for individuals to extend their personalities through unforeseen and diverse experiences.

The catchment areas of urban facilities are continuously growing larger because of the wider range of services that they provide (vide 5.1). This accentuates the problems of accessibility of the less mobile, since the incentive to engage in activities outside the home is a function not only of personal choice but also of easy accessibility. It could be said that there exists a latent demand for many urban activities which can only be met in a favourable environment, or that there is less motivation in an unfavourable one (Lewin, op.cit., p.259).

Travel outside the home may have an indirect influence on behaviour, for the external environment is an essential dimension of activity for many people. The stimulation that it provides for children is now widely believed to have a marked effect on personality development, the pattern of behaviour in later years, and learning ability throughout life. Informal activity on the street may also have a useful social value, particularly for young and elderly persons.

1.8. CONCLUSIONS

Repeatedly in the examination of travel needs, the problems of individuals being dependent upon others for their mobility and having access to urban facilities have recurred.

It could be argued that more consideration should be given to the needs of children because, during their development, the environment has the greatest influence on mental and physical characteristics (Wilner et alia, 1962; Bloom, op.cit., pp.49-50, 209-210; Erikson, 1965) which are consolidated by late adolescence (Mussen et alia, op.cit., p.532; Bloom, op.cit., p.87, Chart 8); it has been suggested that the only satisfactory test of an human institution is to measure the extent to which it enables youth to achieve its potential (Gesell, 1956, p.4). On the other hand, a case could be made for preferential consideration for working adults, since the community depends upon them for its standard of living - indeed, this is often implicit in the current approach to planning (vide references in 2.7); alternatively, the needs of elderly or disabled persons could be considered paramount, to compensate for their handicaps. The paradox of the present situation is that those most socially dependent on the community are also the most limited in their mobility; yet it could be contended that the urban environment should be planned to lessen the limitations on their independence of movement.

Taking into account all the considerations in this chapter, it is concluded that no individuals should be more favoured than any others when suitable planning can permit the optimal satisfaction of the travel needs of all individuals.

2.	<u>METHODS OF TRAVEL: FACTORS AFFECTING THE INDIVIDUAL</u>	
2.0.	INTRCDUCTION	58
2.1.	TRAVEL TIME	61
2.1.1.	Travel Time by Car	63
2.1.2.	Travel Time by Motor-Cycle	64
2.1.3.	Travel Time by Bus	64
2.1.4.	Travel Time by Taxi	66
2.1.5.	Travel Time by Bicycle	67
2.1.6.	Travel Time by Walking	67
2.1.7.	Comparative Times by the Six Methods of Travel	68
2.2.	TRAVEL COST	72
2.2.1.	Costs of Car Travel	74
2.2.2.	Costs of Travel by Motor-Cycle	76
2.2.3.	Costs of Travel by Bus	77
2.2.4.	Costs of Travel by Taxi	78
2.2.5.	Costs of Travel by Bicycle	78
2.2.6.	Costs of Walking	78
2.2.7.	Comparative Costs by the Six Methods of Travel	79
2.3.	TRAVEL SAFETY	82
2.3.1.	Relationship of Age to Travel Safety	83
2.3.2.	Main Causes of Road Accidents	85
2.3.3.	Prevention of Road Accidents	90
2.3.4.	Road Safety by Methods of Travel	93
2.3.5.	Comparative Safety by the Six Methods of Travel	95
2.4.	COMFORT AND EFFORT	99
2.4.1.	Comfort and Effort in Travel by Car	100
2.4.2.	Comfort and Effort in Travel by Motor-Cycle	101
2.4.3.	Comfort and Effort in Travel by Bus	101
2.4.4.	Comfort and Effort in Travel by Taxi	101
2.4.5.	Comfort and Effort in Travel by Bicycle	102
2.4.6.	Comfort and Effort in Walking	102
2.4.7.	Comparative Comfort and Effort by the Six Methods of Travel	103
2.5.	VISUAL INTEREST OF JOURNEY	105
2.5.1.	Visual Interest in Travel by Car	105
2.5.2.	Visual Interest in Travel by Motor-Cycle	106
2.5.3.	Visual Interest in Travel by Bus	106
2.5.4.	Visual Interest in Travel by Taxi	106
2.5.5.	Visual Interest in Travel by Bicycle	106
2.5.6.	Visual Interest in Travel on Foot	106
2.5.7.	Comparative Interest on Journeys by the Six Methods of Travel	107

2.6.	PURPOSE OF JOURNEY	108
2.6.1.	Journeys to Work	108
2.6.2.	Shopping Journeys	110
2.6.3.	Journeys to School	111
2.6.4.	Journeys for Leisure	112
2.6.5.	Comparison of Proportion of Journeys for Different Purposes	113
2.7.	LIMITATIONS ON CHOICE OF TRAVEL MODE	116
2.7.1.	Age and Condition	116
2.7.2.	Possession of Driving Licence	118
2.7.3.	Vehicle Ownership	119
2.7.4.	Availability of the Six Methods of Travel	124
2.7.5.	Discussion	131
2.8.	SUMMARY AND CONCLUSIONS	133

2.0. INTRODUCTION

Considerations affecting movement in towns may be divided between those likely to be taken into account by the individual, and those concerning the community; the former are examined in this Chapter and the latter in Chapter 4.

Many studies have been carried out in the last seven years into the influences on personal choice of travel mode. The great majority of these are directed solely towards the choice between the use of the private car or public transport, and are usually focused on the journey to work during the rush hour (vide 2.7.1).

Parameters identified as having the main influence on modal choice, in ten studies examined by the author, are listed in Table 2.1 (Campbell, 1963; Fairthorne, 1963; Deen, Mertz and Irwin, 1963; Meyer, Kain and Wohl, 1965, p.88; Freeman, Fox and Partners, 1966, pp.72-73; Ling and Associates, 1967, p.131; Wilson, 1967, p.170; Transportation Research Institute, 1968; Lennox and Clark, 1969; Bliss, 1969). It may be seen that both time and cost are consistently employed to measure the attractions of alternative methods of motorised movement, although safety, comfort, the purpose of the journey, car ownership level, economic status, and convenience are sometimes also included. 'Convenience' can involve a variety of factors which Chapman (1950) considers to include distance, gradient, time, availability of services, cost location of facilities en route and the amenity of the route itself; even in the studies which include this parameter of convenience, it appears to be too vague a term to be used in analytical investigations. Since the ten studies are concerned with motorised movement, it is not surprising that they all omit the specific influences of effort involved in travel and the visual interest

Table 2.1. Major Influences Affecting Choice of Travel Mode Isolated in Previously Published Studies

Author	Time	Cost	Safety	Comfort	Convenience	Journey Purpose	Vehicle Ownership
Campbell (1963)	*	*	*	*	*		
Fairthorne (1963)	*	*					*
Icen et alia (1963)	*	*					*
Meyer et alia (1965)	*	*		*	*	*	
Freeman Fox & Pts. (1966)	*	*		*			
Ling & Assoc. (1967)	*	*				*	*
Wilson (1967)	*	*					*
Transport Res. Inst. (1968)	*	*		*	*		
Lennox and Clark (1969)	*	*	*	*			
Bliss (1969)	*	*	*	*	*		

of routes, which primarily affect pedestrian movement; moreover, no reference is made in the studies to the age of travellers, yet the relative importance of all the factors is likely to be affected by changes in age.

Since the main difference of the author's study from others previously published is that it is concerned with all methods of movement in relation to the travel needs of individuals, the following influences are considered in this Chapter:

- 2.1. Travel time; 2.2. Travel cost; 2.3. Road safety;
- 2.4. Comfort and effort on journey; 2.5. Visual interest of journey;
- 2.6. Purpose of journey; 2.7. Limitations on choice of travel mode.

Six methods of travel are examined: car, motor-cycle, bus, taxi, bicycle and walking. Journeys by train have been excluded as they are only an economical form of intra-urban travel in large cities, and do not therefore fall within the scope of this study. Statements regarding motor-cycle movement generally refer to all motorised two-wheeled vehicles, including mopeds and scooters.

2.1. TRAVEL TIME

Travel time has been referred to as the rarely acknowledged 'fourth dimension' of the day which is basically divided between work, sleep and leisure (Crowther, 1963, para.15). It has been calculated that adults spend 8% of their waking hours travelling (Sneed, 1968a, p.33). Saving of time is one of the main considerations influencing choice of method of travel, and there is little doubt that time spent travelling is highly valued.

Much evidence indicates that travel time is increasing: a recent National Survey records an average of six hours a week on the journey to and from work alone (Rodgers, 1967, C.23); other calculations have shown that in the United States, there was an eightfold rise in the average mileage travelled by each person between the years 1906 and 1956 (Haggett, 1965), and in Britain, a rise of 43% between the years 1956 and 1966 (Tressider, 1968). These increases have been primarily due to the vastly improved mobility afforded by motorised vehicles, and, in particular, cars. Many surveys have shown that the number of vehicular trips generated by car-owning households is significantly higher than those by households without cars (Wilbur Smith and Associates, 1961, p.78; Freeman, Fox and Partners, 1964, p.158; Freeman, Fox, Wilbur Smith and Associates, 1968a, p.94). This mobility has encouraged a form of urban growth which, concomitantly necessitates more travel time or higher vehicular speeds.

The public seems to be conditioned to accept the inevitability of long hours of travel. In the United States, commuting time of thirty minutes for school children was considered 'fair compensation' for the advantages of living in low density residential areas (Meier and Blumenfeld,

1966); a typical work journey of thirty seven minutes in an American suburb was not believed to appreciably affect family life by depriving children of their father's presence (Gans, 1967). Conversely, in the United Kingdom, many families set off the increased travel time resulting from living in suburbs against the cheaper housing (Kirwan, 1969), and some prefer to live in comparatively expensive flats in congested urban areas in view of the shorter journeys to work (Thomas, 1969, p.460).

It is obvious that availability of time determines the distance that can be covered by any method of travel and should, therefore, be an important consideration in the location of home in relation to place of work, shopping and leisure facilities. Bouladon (1967) suggests that a 'law' exists of which people are subconsciously aware - that there is an acceptable period of time for travelling various distances; this 'law' varies also with the frequency and purpose of the journey, the distance covered for regular journeys to work or shopping being more critical as a rule than for infrequent journeys for leisure purposes.

The paradox lies in the fact that whilst a greater proportion of time is spent travelling, an increasing value is attached to time itself, since the total available hours in which one can engage in activity of one's own choice is thereby reduced. With the expanding range of opportunities that urban life can offer, this aspect is becoming more significant.

Travel time is not however simply a function of speed; comparisons of alternative methods of travel can only be made on the basis of measurements of all the time-consuming components of a journey.

2.1.1. Travel Time by Car

There are three stages for car journeys: the walk to and from the car at each end of the trip, the length of which depends on the siting of the car park or garage - the walk is usually short at the residential end of a trip, but is likely to be much longer at the work or shopping end, owing to the location of parking areas and intensity of traffic; secondly, car preparation, including time spent starting the engine, and the occasional mechanical check or cleaning of the windscreen - this depends on the condition of the car and whether it is garaged or kept under cover; finally, the car journey, the time for which varies with the power of the car, the density of traffic, the nature of the road network, weather conditions and the time of year.

Average rush hour speeds in London in 1962 were 10 m.p.h. (Smeed, 1964, p.155) and 21.5 m.p.h. during off-peak periods (Freeman Fox and Partners, 1964, p.158); a later study of traffic in Central London recorded similar rush hour speeds (Holroyd and Scraggs, 1964, p.173, Fig.6). The average time of 6.5 minutes to park a car in Central London effectively reduced speeds to 5 m.p.h. for one mile journeys, and 8 m.p.h. for five mile journeys (Smeed and Wardrop, 1964, p.307). Time spent from origin to destination, excluding actual driving time, in Coventry and Edinburgh during rush hours totalled 3.7 minutes and 4.3 minutes respectively (Wilson, op.cit., p.102; Jackson and Palmer, 1968, p.357), thereby reducing effective door-to-door speeds, though less dramatically than in London.

It can, however, be assumed that design speeds of 40 m.p.h. for recent New Towns will be achieved, in view of the refined techniques now employed in traffic engineering and forecasting. Furthermore, adequate

parking areas can be provided adjacent to factories, offices, shops and leisure facilities; in some cases multi-storey garages, integrated into town centre complexes are proposed. The effect of these measures will be to reduce the ancillary time components of a car journey. Nevertheless, it is anticipated that 6 minutes will be required for these purposes in Runcorn, with the result that the average work journey speed of 25.7 m.p.h. will be reduced to an effective door-to-door speed of 14.6 m.p.h. (Ling and Associates, 1967, p.132); in Stevenage New Town, average work journey speeds of 24 m.p.h. are reduced to effective door-to-door speeds of only 11 m.p.h. (Claxton, 1969).

2.1.2. Travel Time by Motor-Cycle

Journeys by motor-cycle can be similarly analysed. Whilst their typical urban speeds have not been published, it may be presumed that they are faster than other vehicles over short distances, due to their greater manoeuvrability in traffic, and the ease with which they can be parked.

2.1.3. Travel Time by Bus

There are three stages for bus journeys: the walk from home to the bus stop, and at the other end, the walk from the bus stop to the destination - distances depend upon the proximity of a bus route and the distance between stops; waiting for the bus, the time for which may be a strong deterrent to its use; riding on the bus, the time for which is dependent upon speed, stops to pick up and set down passengers, and, as with the car, on road and traffic conditions.

The relationship between the time spent travelling by bus and the total journey time has often been demonstrated. Obviously shorter journeys have lower ratios; this has been borne out in several surveys in which walking and waiting take up between one third and two thirds of total travel time (Smeed, 1964, p.142; Freeman Fox Wilbur Smith and Associates, 1968a, pp.73-75 and Table 15.9, p.289; Scott, Wilson Kirkpatrick and Partners, 1967).

Average walking distances to bus stops are 350-450 yards in central areas of towns (Smeed, 1964, p.139). In well-populated towns with high demands for bus services, the average waiting time is from six to ten minutes in the rush hour, and up to twenty minutes during off-peak hours (Scottish Bus Group, 1969). In smaller towns, the population is unlikely to support such frequent services.

Walking and waiting times for bus journeys in London's rush hours averaged ten minutes (Holroyd and Scraggs, op.cit., p.172; Wilson, op.cit., p.102), and fourteen minutes at other times (Webster, 1968, p.40, Fig.3). In Coventry's rush hours, the combined times were eight minutes (Wilson, op.cit., p.102), and in Edinburgh they were seven minutes (Jackson and Palmer, op.cit., p.357). Smeed and Wardrop's survey (op.cit., pp.304-306) showed that an average of twenty seconds was lost at each stop, thereby effectively reducing overall door-to-door speeds to 3.1 m.p.h. for one mile journeys, and 4.7 m.p.h. for three mile journeys; Webster's survey (op.cit., p.37, Table 20) recorded 2.6 m.p.h. for one mile journeys and only 4.0 m.p.h. for three mile journeys; Jackson and Palmer's survey (op.cit., p.357) recorded mean times of buses waiting at stops of 11.5 seconds. One-man buses suffer even greater time loss as the collection of fares by the driver at a stop takes between five and six seconds per passenger (Times, 1969a).

In many New Towns the maximum distance to bus stops is planned to be between 400 and 500 yards (Ling and Associates, op.cit., p.18, para. 3.3; Llewelyn-Davies, Weeks and Partners, 1967, para.253). In Runcorn, it has been estimated that the average walking and waiting time will be seven minutes, and the effective door-to-door speed will be 14 m.p.h. (Ling and Associates, op.cit., p.132). In Stevenage, the effect of these delays is to reduce the average bus speed of 14 m.p.h. to an effective door-to-door speed of 7 m.p.h. (Claxton, 1969). Their deterrent effect can be gauged from surveys which have recorded that walking and waiting time is considered more than twice as important as overall trip time in discouraging people from using buses (Quarby, 1967), and that passengers prefer to spend three minutes extra in a bus than one minute extra walking to the stop and waiting in the queue (Local Government Operational Research Unit, 1969). It is, however, claimed that if mini-buses were employed on the 'Dial-a-Bus' system proposed in an American study, the door-to-door time would be almost as fast as by taxi (Haar, 1968).

Time spent travelling by bus is further affected by the frequency of services if punctuality is necessary; in these circumstances, more time must be allowed to ensure arrival at one's destination on time. This aspect particularly concerns those living in suburban areas or New Towns, where off-peak services usually run at half hour intervals (London Transport, 1969).

2.1.4. Travel Time by Taxi

Travel by taxi can be the fastest method of urban travel as the journey at speeds similar to those by car, may account for most of the door-to-door travel time. However, the effective speed depends greatly on

whether the taxi is hailed in the street, or whether it has to be ordered by telephone. In the former case, it would be faster than by private car as there would be no parking problems and less walking distance at the destination; in the latter case it may be slower.

2.1.5. Travel Time by Bicycle

Pedal cyclists have the advantages of door-to-door travel, with the minimum of 'preparation' time, except for extra dressing up against the weather. There is only the need to take out the bicycle, occasionally to pump up tyres, and to walk from where it is parked; this is likely to be close to the destination, in view of the small space that is required to accommodate it.

The average speed of cyclists varies with traffic conditions, road gradients and surfaces, and the age and condition of the rider. In towns with a comprehensive cycleway system, average speeds are high: in Stevenage New Town, pedal cycle speeds vary between 10 and 20 m.p.h. on the cycle ways, with an average speed of 12 m.p.h.; for short journeys up to one and a half miles, cycling compares favourably with the effective door-to-door speed by car (Claxton, 1968, p.114).

2.1.6. Travel Time by Walking

Walking is the only time component of pedestrian journeys; it has the further advantage that the most direct route can normally be taken, since the pedestrian is not confined to a road network. Time spent on regular journeys is also very predictable.

The distance that can be reasonably covered, without undue effort,

varies with age, sex and physical condition: average speeds of 3.25 m.p.h. have been measured on journeys to work (Smeed and Wardrop, op.cit., p.306). Walking speeds are recorded in Table 2.2. However, on stairs and ramps they are considerably slower for instance, on a 12° gradient, they are reduced from 4.4 feet per second to 3.1 feet per second (Road Research Laboratory, ibid., p.393, Table 12.3).

Table 2.2. Walking Speeds on Level Ground

Age and Sex	mile/hr.	ft./sec.
Men under 55 years of age	3.7	5.4
Men over 55 years of age	3.4	5.0
Women under 50 years of age	3.1	4.5
Women over 50 years of age	2.9	4.3
Women with small children	1.6	2.3
Children between 6 and 10 years of age	2.5	3.7
Adolescents	4.0	5.9

Source: Road Research Laboratory, 1965.

The main limitation on pedestrian movement is the time involved in long journeys and delay in crossing busy roads (Inwood, 1968; Greater London Council, 1969a, pp.91,93). Many post-war New Town plans have assumed half a mile to be an acceptable walking distance; however, a number of other factors such as the physical characteristics of the route and climatic conditions must be taken into consideration. This subject is explored in more detail later (vide 2.4, 2.5 and 5.3).

2.1.7. Comparative Times by the Six Methods of Travel

A comparison of travel times under present conditions shows that door-to-door journey times by car are approximately one quarter of those

by bus for distances of one mile, and less than one half for distances between three and five miles (Webster, op.cit., p.38, Table 31). A survey in Coventry recorded door-to-door travel times by car to be a minimum of five minutes and an average of eleven minutes faster than by bus (Wilson, op.cit., p.97); the East Scotland Transportation Survey (Freeman Fox Wilbur Smith and Associates, 1968a, pp.73-75) recorded that, in the Edinburgh area, journeys by bus took on average twice as long as those by car. This time difference is similar to findings in the United States. In twenty-five American cities, the average rush hour car speed was consistently 20 m.p.h. and the bus speed 13 m.p.h.; the bus had at least a ten minute initial handicap compared with the car (Bello, 1958). Meyer, Kain and Wohl (op.cit., pp.104, 251) have stated that the bus would have to travel at speeds quite unrealistic in towns in order to compete with overall times by car. Even advocates of public transport systems admit this disadvantage (Neal, 1965).

In New Towns, much faster traffic speeds are anticipated; in Runcorn, buses are planned to run at 21.6 m.p.h. at two minute intervals in the rush hour, and at between five and fifteen minute intervals during off-peak hours (Ling and Associates, op.cit., p.73); nevertheless, whilst this town has been planned around a rapid transit network, the time spent travelling by the more direct bus route, including the walk to the stop and the wait for the bus, will be no shorter than by car for the work journey, and four minutes longer for typical shopping trips (ibid., pp.132-133). In the planning of Irvine, it has been assumed that bus journeys will take 50% longer than the equivalent car journeys (Israel Institute of Urban Studies, 1969, p.87).

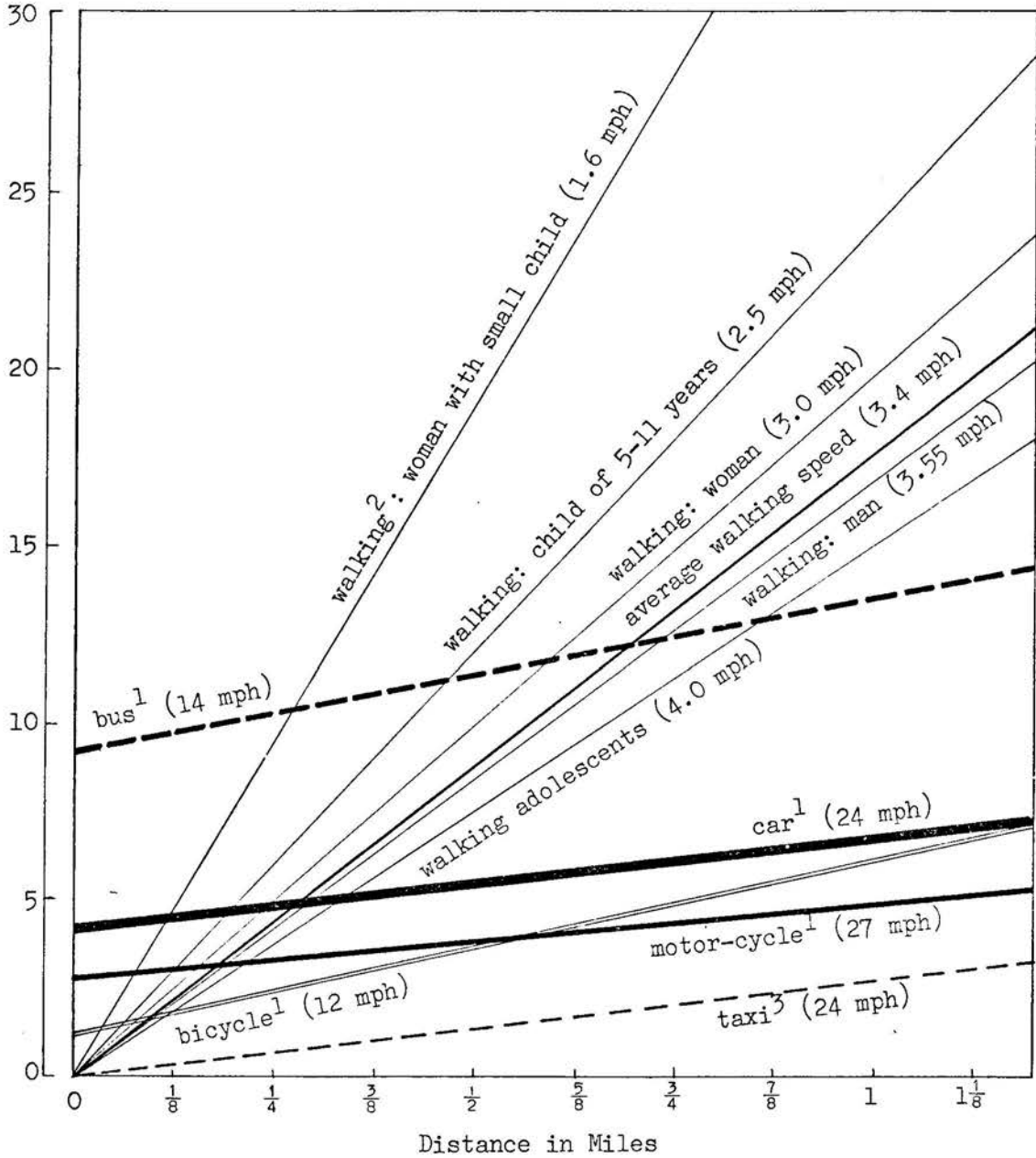
Whilst in theory time spent travelling by bus can be used productively, such as by reading the newspaper, in practice the superiority of the car over the bus in terms of time appears to be firmly established, both in existing and in New Towns. A further time advantage of journeys by car is the freedom from dependence on bus service schedules, enabling the individual to travel at his own convenience. Other disadvantages of bus travel are the extra time to be allowed for possible delay if punctuality is important. In larger towns, the passenger may require extra time for transferring to another route; this proves to be a great deterrent (Burns, 1967, p.40), and explains why multi-purpose journeys are extremely inconvenient by bus. The most important reason given by commuters for travelling by car instead of by bus was mainly the former's time advantage (*ibid.*, p.39; Wilson, *op.cit.*, p.119; Travers, Morgan and Partners, 1968, pp.173-176).

The efficiency of the car in saving time, as compared with other methods of travel, must however be set against the effective number of hours that have to be worked in order to earn the necessary money to run a car (*vide* 2.2.1); moreover, account must be taken of the time spent in refuelling, servicing and maintaining it.

Diagram 2.1 illustrates the comparative time advantage of each method of travel over varying distances. It can be seen that distance alone is insufficient in determining the duration of trips. Whilst most urban journeys are quicker by car or bus than by walking, this is not true with short distances: if one takes into account time lost on car journeys, other than the actual ride, it is quicker to walk up to about one quarter of a mile, and to ride a bicycle or motor-cycle for distances up to about one and a half miles; walking is also faster than journeys by bus for distances of up to about two thirds of a mile.

Diagram 2.1. Travel Time According to Method of Travel and Length of Journey

(time in minutes)



1. Calculation based on door-to-door travel times (vide Appendix 3F)
2. Road Research Laboratory (1965)
3. If hailed in street

2.2. TRAVEL COST

The expenses of travel can have a strong influence on modal choice. The ability to pay these costs also appears to affect the chosen location of residential accommodation, since peripheral areas of towns are usually occupied by families of higher than average socio-economic status (Schnore, 1954). Obviously travel costs are more likely to affect those with low incomes, especially pensioners and disabled persons (vide 2.7): in London car-owning households with incomes of £2000 made 40% more journeys per day than those with incomes of £1000 (Freeman Fox and Partners, 1964, p.159, para 9.51).

Average weekly household expenditure on transport has been rising steadily over the last few years, from 10.6% in 1962 to 13.1% of the weekly total in 1968 (Department of Employment and Productivity, 1969, p.9); in London, £71 per head is spent annually on fares and travel (British Road Federation, 1968). The relative importance of this item of expenditure can be inferred from the fact that it now exceeds household expenditure on housing; its increase is in contrast to the general decline in all other measurable groups of consumer expenditure (Beckermann, 1965, p.180, Table 6.2).

Webber (1963) has pointed out that, as effective costs of communication decline, this influence will become less significant. However, the value attached to time may replace it as individuals widen their leisure interests. This value is difficult to calculate since there is such a variety of factors to consider, but a number of surveys have been undertaken with this aim in view. Reeder (1956) confirmed his hypothesis that the value attached to time on work journeys tends to vary according to socio-economic class. Beesley (1965) found that people

minimise journey time, irrespective of the expense as long as cost differences do not exceed some absolute limit: he quoted from a study for the new Victoria underground line in London, in which savings were valued at seven shillings per hour in working time, and at five shillings per hour in non-working time. His own survey of office workers in London confirmed that time spent on public transport was valued according to income: for workers with an average wage level, at about one third of their wage, and for more highly paid people at about one half of their wage. These findings were very similar to those of a survey in the United States to which he referred. Stephen (1968) obtained similar results in a survey of lower paid civil servants and University staff in London, who valued their time at 32% and 50% of their wage rates respectively.

The value of time saving employed in Ministry of Transport road investment calculations is shown in Table 2.3, comment on which is made later (vide 2.7.4).

Table 2.3. Value of Time Saving in Transport Investment Appraisal

Working Time	pence/hr.	Non-Working Time	pence/hr.
All Time Spent Travelling:		Travelling Time:	
All workers	234	All adults	39
Car drivers	261	Children	13
Car occupants	225	Walking and Waiting Time:	
Bus users	137	All adults	78
		Children	26

Source: Dawson, 1969.

2.2.1. Costs of Car Travel

The total costs of running a private car are a major element in household expenditure. A number of organisations have recently analysed current costs, itemising them under the headings of standing and running expenses: the former include vehicle excise licence, driving licence, loss of interest on capital, depreciation and insurance; the latter cover petrol, tyres, oil, servicing, repairs and replacements. An investigation carried out by The Consumers Association (1968) demonstrated that the annual costs for average mileages varied from £290 for a £600 car retained for three years, to £495 for a £1200 car retained for the same period; the annual expenditure on a typical family car costing £800 was £350.

It is perhaps paradoxical to note that the saving of time achieved by car travel (vide 2.1) is considerably less than the hours that have to be worked to earn the sum of £6 to £8 per week, which usually has to be paid out of a much larger untaxed income.

On the basis of an average annual mileage in 1968 of 8200 miles (Ministry of Transport, 1969a, p.45, Table 35) and an average engine capacity of a British car of 1346 cc. travelling for 28 miles per gallon (Everall, 1969), a post 1969 budget figure for the cost per mile is 13 pence; average annual expenditure based on these calculations is therefore about £400, or £8 per week (Royal Automobile Club, 1970).

However, a comparison with other forms of transport related to fuel costs only appears to be more realistic than one determined by total annual costs, since most people tend to assess relative costs in this way (Quarmby, op.cit.; Travers, Morgan and Partners, op.cit., p.182; Wilson op.cit., p.111; Williams, 1969, p.85). On this basis, cost per mile for the average family car is 3 pence, which is only 23% of costs based on

total annual expenditure; if an average occupancy rate of cars of 1.93 persons is taken into consideration (Smeed and Wardrop, op.cit., p.312), the cost per person per mile is further reduced to only 1.5 pence.

It is anticipated, however, that car costs will continue to rise as in the past; annual depreciation of car values is now between 17% and 25% (Consumers' Association, 1969), and Government safety measures are resulting in more expensive constructional costs. Increasing affluence is likely to result in the purchase of more optional perquisites such as fog lamps, heating and air-conditioning equipment, radio, reclining seats, and headrests. Mandatory safety and anti-pollution measures introduced in the United States recently, already cost the motorist 75-125 dollars extra, and higher standards for braking energy absorbing bumpers, and seat restrainers are now planned (Charles, 1969b); inflatable air bags which are likely to be compulsory safety equipment in cars by 1972, will raise costs by a further 250 dollars (Charles, 1969c). All these measures may well be made obligatory in this country during this decade.

Taxes paid annually by road users in Great Britain have doubled in the last five years (British Road Federation, 1969a, p.8); service charges are also increasing as a result of wage rises and the Selective Employment Tax. In addition, insurance premiums will probably be higher to cover liability for non-fare paying passengers and what Dawson (1967a) has described as 'subjective losses' which include loss of expectation of life, loss of amenities of life and affective injury. Since the average cost of an injury in a road accident in Great Britain was £1020 (ibid., pp.40-41), current insurance premiums are insufficient to meet these costs and increased premiums have been forecast for the near future (Blanden, 1969).

There are also costs incidental to car ownership, including those for parking, garaging and occasionally for fines, as a result of the extension of meter zones and the prohibition of street parking; in 1959 payment of 12s.6d. per day in Central London was recommended (Committee on London Road, 1959). These costs are likely to increase as more multi-storey garages are built to accommodate cars in central areas, in order to make their construction and operational costs economical. There is a distinct possibility that road pricing for vehicles will be introduced within the next few years (vide 4.2.7).

Depending on the severity of cost increases and the prevailing road conditions, the car owner may be motivated to consider travelling by other means. However, a study of the demand for car parking space concluded that "many potential parkers would pay considerable sums for the convenience of parking quickly and centrally" (Roth, 1965). This conclusion was confirmed in a later survey of regular car commuters in London: 40% claimed that they were unaffected by any increase in the cost, and 60% stated that they would only be deterred if the increases were over twenty to thirty shillings a week (Williams, op.cit., p.87). Tax relief on car use for business purposes is a further consideration influencing modal choice.

2.2.2. Costs of Travel by Motor-Cycle

The overall costs of running a motor-cycle have been estimated at between three pence and five pence per mile for the typical 350 c.c. engine (Royal Automobile Club, 1969a), and one third of the running costs of a car (Webster, op.cit., p.28, Table 17). Cost of travel by mopeds and powered scooters are even lower, with petrol consumption at 100-150 miles per gallon, and insurance premiums as little as £2 per annum

(Waterhouse, 1969), costs of travel by these means are clearly minimal.

2.2.3. Costs of Travel by Bus

Bus fares have relatively little effect on travel movement, largely because the majority of those who travel by this mode have no alternative. It could also be influenced by the fact that payment is made for each journey at the time, in small amounts, and therefore is not felt as a significant proportion of overall expenditure.

Nevertheless, owing to the increase in car ownership, the share of the total passenger mileage by public transport has declined in ten years from 35% to 16%, whilst the share by private transport has risen from 45% to 74% (Ministry of Transport, 1969e, p.2, Tables 1 and 2); as a result, the ratio of consumer expenditure on bus and car travel has steadily widened from 1:2.0 in 1957, to 1:5.3 in 1967 (ibid., p.3, Table 3).

The reduced number of passengers utilising public transport has, of course, aggravated the task of keeping fares stable. Fares have increased by 48% between 1958 and 1967 (Ministry of Transport, 1969e, p.3, Table 4). It is now the Greater London Council's intention that London Transport fares should be set at a commercial level, without subsidy, and they will therefore have to rise substantially; an average increase of 12% in fares has recently been approved, raising the minimum from fivepence to sixpence and the majority of larger fares by threepence or sixpence (Times, 1969c). Typical fares in provincial towns have doubled in the past decade; charges are now sevenpence for one mile, and ninepence for two miles (Scottish Bus Group, op.cit.).

2.2.4. Costs of Travel by Taxi

Taxis represent a financially attractive form of public transport, where time is highly valued, since the door-to-door service saves time parking and walking. A typical fare for taxis is: half a mile or first five minutes - two shillings; one mile or ten minutes - three shillings; two miles or twenty minutes - five shillings (Commissioner of Police of Metropolis, 1969). Tips of about 15% of the fare are normally added.

2.2.5. Costs of Travel by Bicycle

The main cost of travel by bicycle is the purchase price; the Family Expenditure Survey includes a figure of elevenpence household expenditure per week for "the purchase and maintenance of bicycles, perambulators etc." (Department of Employment and Productivity, 1968c). An enthusiast who has kept records for the last forty-six years found that the cost of his cycling 716,886 miles has been £507.17. 1d. or one fifth of a penny per mile (Chambers, 1969)! It is clear that the bicycle is an extremely economical form of movement since there are no fuel costs or taxes, and maintenance is minimal.

2.2.6. Costs of Walking

The cost of walking is also difficult to assess. There are no precise figures of the average distance walked in this country, but an American survey found the distance walked daily, both indoors and outdoors, by housewives was 8.75 miles, and by men was 7.5 miles (Kauth, 1960). The average annual expenditure on footwear with leather uppers in this country is just over £2 (Shoe and Allied Trade Research, 1969), with an average

repair bill of ten shillings and sixpence (calculated from Central Statistical Office, 1969, Table 230). This would suggest that the cost per mile is approximately one fifth of a penny - the same as for bicycles.

2.2.7. Comparative Costs by the Six Methods of Travel

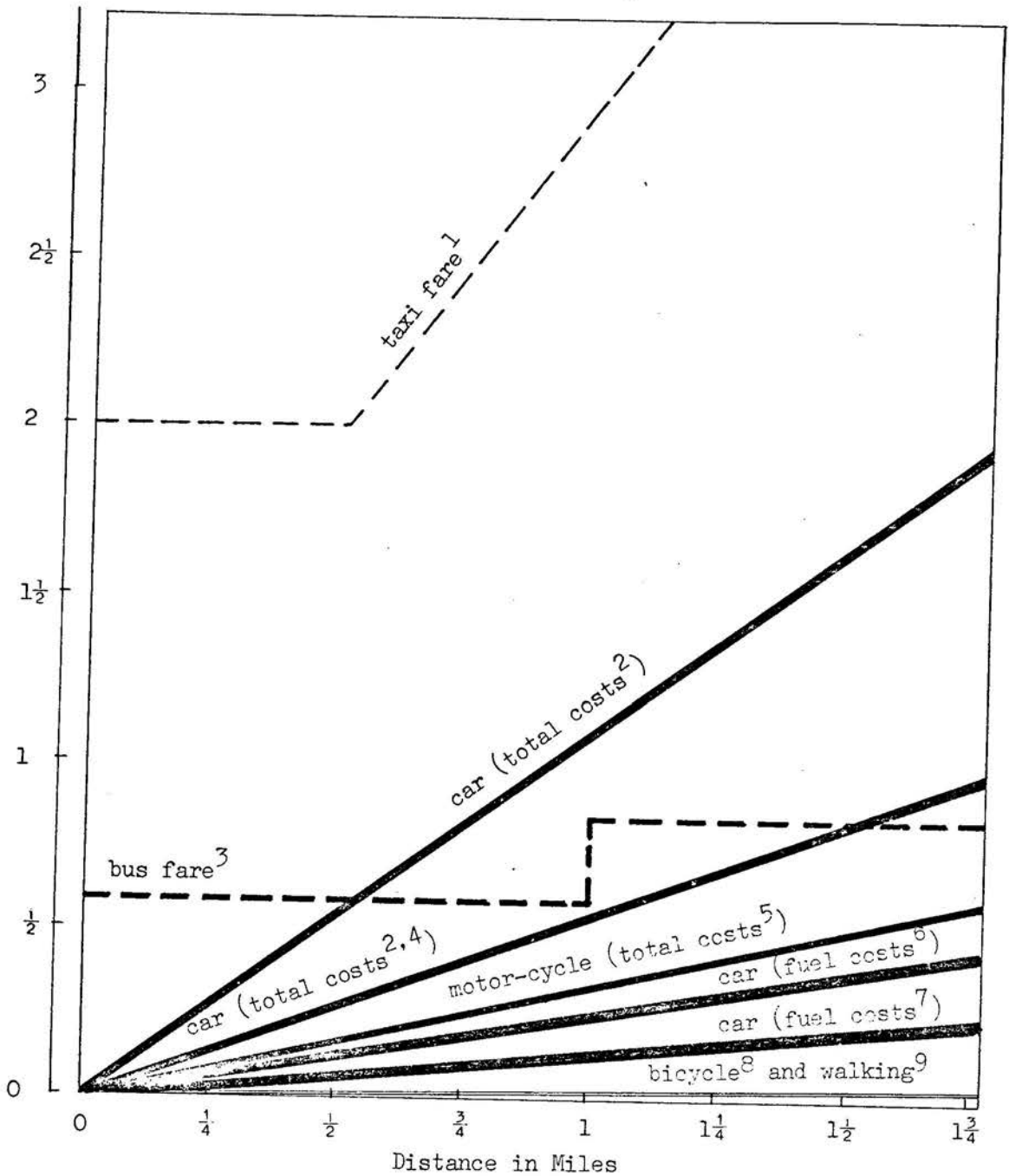
If as it is commonly held, incomes rise and no fundamental changes in current attitudes occur, it may be expected that both working and non-working time will become more highly valued, with the result that the advantage of the car over the bus will become more significant; however, even excluding any value attached to time, the cost per mile by public transport is expected to be considerably higher than by car, in 1981 (Greater London Council, 1969, p.148, Table F.2). It is not surprising, therefore, to note that in an urban area in the United States, it was thought that payment would become necessary to passengers on all modes of public transport in order to divert many of those currently travelling to work by car (Moses and Williamson, 1963). In a survey in Britain, only 51% of car commuters stated that they would transfer to public transport if it were free (Williams, op.cit., p.86). Perceived costs are also very relevant to the choice of travel mode: approximately the same percentage of car commuters in the same survey (ibid., p.85) thought the car cheaper than public transport as those who thought to the contrary. Similar divergences of opinion were noted in a study of a provincial town (Sharp, 1967, pp. 20,55).

For those who do not make long or regular journeys, travel by taxi is cheaper than by car, since the fare of three shillings a mile is equivalent to the mileage costs of running a car for only 1400 miles a year.

In these circumstances, the economics of hired cars for specific periods such as weekend out-of-town travel, and taxis for in-town journeys, are apparent. Even in a New Town, travel from outer neighbourhoods to the town centre has been found to be as cheap by taxi as by bus (Vincent, 1967, p.60).

Diagram 2.2. illustrates the costs per mile of each method of travel: on the basis of total annual costs of the car, costs of bus travel are substantially cheaper; if cost calculations are based on fuel only, or if typical car occupancy rates are taken into consideration, travel by car is substantially cheaper! Motor-cycles are the cheapest form of powered movement and are, therefore, an attractive choice to those with limited financial resources. The cost advantage of the taxi improves when parking charges are high, if the car driver has to park some distance away from his destination, or if only a few journeys have to be made; for those who have no car and who value their time highly, this is certainly an acceptable alternative for journeys that are too long by foot. The most economical forms of movement are walking and cycling.

Diagram 2.2. Travel Cost According to Method of Travel and Length of Journey
(cost in shillings)



1. Metropolitan Police (1969)
2. Calculated for 1970 annual costs (Royal Automobile Club, 1968)
3. Scottish Bus Group (1969)
4. Costs per person based on typical car occupancy
5. Royal Automobile Club (1969a)
6. Based on fuel costs only
7. Costs per person based on fuel costs and typical car occupancy
8. Chambers (1969)
9. vide 2.2.6.

2.3. TRAVEL SAFETY

Road accidents are without doubt the worst hazard of vehicular movement in towns. In the last twenty five years, one hundred and fifty thousand persons have been killed on the roads, and over six and a half million injured (calculated from Ministry of Transport, 1969a, p.14).

It has been suggested that our apparent indifference to the danger arising from people and vehicles using the same roads will in future be viewed with the same horror that we now view inadequate sanitation (Crowther, op.cit., para.16), and that the quality of an urban area is directly related to the freedom with which people can walk about in safety (Buchanan et alia, 1963, para.96). These points of view are now implicitly accepted, and planning proposals often include at least partial separation of pedestrians and vehicles.

Safety is an important consideration in relation to movement. Its significance is more often apparent to those responsible for the safety of others, such as mothers with young children, or to old people whose slow reactions accentuate their vulnerability. For instance, Levin and Bruce (1968, pp.57-58) reported that parents take their children to school to know that they arrive safely as well as to lessen the risk involved in the journey; old people are often deterred from making journeys because of the fear of crossing busy roads.

Driving is one of the comparatively few activities in which individuals risk the lives of others repeatedly: consistently over the last ten years, approximately 40% of the annual road accident fatalities have been pedestrians (Ministry of Transport, 1968d).

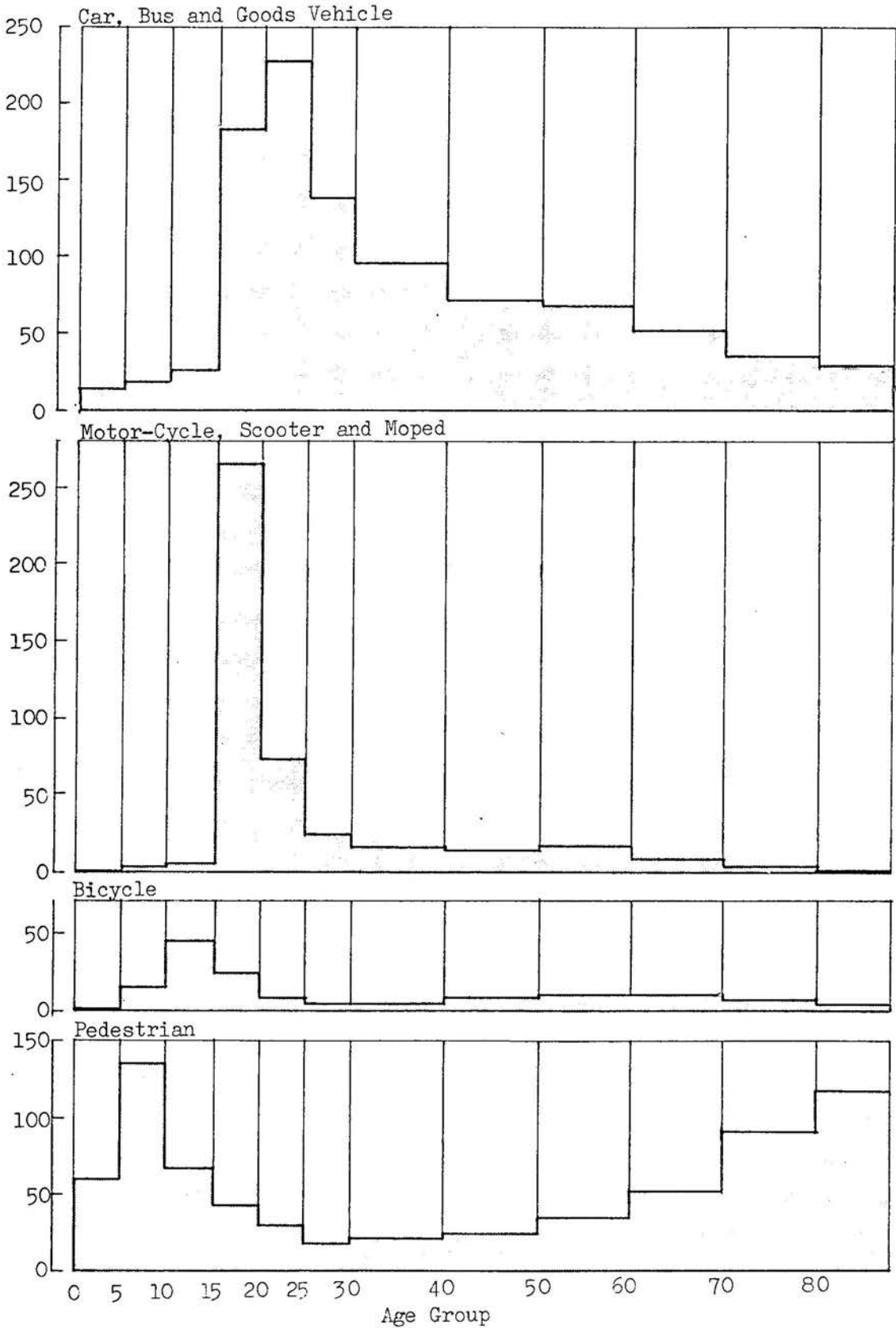
2.3.1. Relationship of Age to Travel Safety

Accidents correlate significantly with age and low or declining sensory acuity; people below the age of twenty and over the age of sixty-five are most in danger. The high rate amongst children is probably due to inexperience and lack of training in road safety: much higher levels of risk-taking have been recorded in a survey of young children, who tended to act impulsively, without assessing hazards (Moore and Older, 1965, p.22); it has also been noted that they undertake kerb drill as a rite, often without even focussing on the traffic (Pease and Preston, 1967).

Road accidents are the second leading cause of death of young adults (Office of Health Economics, 1966c). Although these adults are at the peak of their sensory and physical capacities, the high level of accidents has been aggravated in the past by the fact that they were more likely to ride a motor-cycle, which is potentially far more dangerous than a car; lack of driving experience may be a further contributory factor. However, a recent survey recorded much higher scores of aggression and anxiety in the lower age groups of motorists (Parry, 1968, p.98). The steeply declining insurance rates, up to the age of thirty one, has been introduced in view of the marked concentration of young offenders (Royal Insurance Co. Ltd., 1969; Midland, Northern and Scottish Insurance Co.Ltd., 1969): the accident rate of drivers between the ages of fifteen and nineteen years is about five times the average of all drivers, and between the ages of twenty and twenty four, twice the average (vide Diagram 2.3).

The other highly vulnerable section of the community are elderly persons, for they are the only group in which physical illness or disability plays a large part in causing accidents (Capener, 1969). Their slower reactions which result in a loss of flexibility of movement, and the

Diagram 2.3. Casualties by Class of Road Users and Age Group (1968)
(per one hundred thousand population)



Source: Constructed from Ministry of Transport (1969a, Table 18)

deterioration in their eyesight are thought to be contributory factors to their high casualty risk (Welford, 1958; Cherns, 1962): it has been shown that a doubling of light intensity is required every thirteen years to maintain threshold vision. Although adults over the age of sixty represent only 18% of the total population, they account for 68% of pedestrian fatalities, and adults over the age of eighty have a risk of accident thirty five times as great as those between the ages of twenty and thirty (Smeed, 1968b, p.261).

The magnitude of the problem can be seen in the number of fatal and serious casualties occurring in each age group. The accident rates are dramatised when they are more realistically compared on a 100 thousand population grouping; this comparison is shown for 1968 in Diagram 2.3. It can be clearly seen that the vulnerable age groups are children, adolescents and elderly persons. On the basis of projected forecasts of car ownership and road casualties, it has been estimated that more than half the children born each year will be injured in road accidents, and one in fifty killed during an average lifetime (Ministry of Transport, 1967a, para.3).

2.3.2. Main Causes of Road Accidents

There are three main causes of road accidents: mechanical failure, dangerous road conditions, and human fallibility.

Mechanical Failure. The Government has made efforts to reduce the likelihood of accidents due to vehicle defects by the introduction of safety certificates for private cars and commercial vehicles, in the Road Safety Act of 1960. Compulsory testing of the braking, steering and lighting systems of cars aged five years or more is required annually; regulations regarding the thickness of tyre treads have also been made.

Nevertheless, 48% of vehicles examined in 1967 were found defective (Her Majesty's Chief Inspector of Constabulary for the Year 1967, 1968, p.57), and one hundred thousand persons prosecuted for vehicle testing offences (Offences Related to Motor Vehicles, 1968, pp.4-5, Table 1).

Dangerous Road and Weather Conditions. Traffic accidents are also a function of the design and condition of roads. Cohen and Preston (1968, p.104) feel that drivers perform to the limit of their capabilities in present conditions and any improvement must come from other factors which contribute to the incidence of road accidents. Mackay (1967, pp. 11-27) has isolated these factors as parked vehicles, reduced visibility, poor road surface, badly designed traffic intersections, and badly sited pedestrian crossings. Conflicts arise between the needs of pedestrians and those travelling by car: pedestrian crossings conveniently sited at road junctions are particularly dangerous for drivers who have multiple visual and hand duties to perform in these situations (Austin, 1966, p.121); traffic engineers seek to make an economical use of road space by keeping traffic moving at as high a speed as possible, thus posing greater hazards to pedestrians attempting to cross roads.

Bad weather conditions increase accidents as evidenced by high rates during fog or on icy roads: the risk of skidding on wet roads is twice as great as on dry roads, and the fatal and serious injury rate per vehicle mile in darkness is almost twice the daytime rate (Munden, 1968, pp.13, 15, Table 7, 10.).

Human Fallibility. Human factors causing accidents are numerous and varied: they tend to result from boredom, inattention, anxiety, impatience or aggression. Most accidents happen to 'normal' drivers at times of mental aberration or when the required mental interaction exceeds

their capabilities (Brown, 1969); the incidence of sudden illness in drivers as a cause of road accidents is negligible (Grattan and Jeffcoate, 1967, p.1). This suggests that most drivers are accident prone for brief periods, and this appears to be substantiated by the two hundred and forty thousand persons found guilty of exceeding speed limits (Her Majesty's Chief Inspector of Constabulary for the Year 1967, op.cit., p.54).

In surveys in the United States, 80-90% of road accidents were judged to result from the driver's failure (McFarland and Moore, op.cit., p.793); in a Birmingham survey, human error was found present in 85% of road accidents, yet well over three quarters were described as being in a normal state at the time of the accident (de Fonseka, 1967b); in a study of 653 motor accidents, the majority were considered to be the responsibility of those involved - some had dangerous personality traits, whilst others showed evidence of ruthless self-interest (Willetts, 1964, p.300); poor standards of driving were considered to be the cause of over half the traffic accidents in Stevenage New Town (Claxton, 1967, Section 1.11).

Fatigue and boredom affect skilled performance adversely and lead to errors. Cohen, Hansel and Sylvester (1956) have shown that these conditions interrupt focal concentration. It has also been demonstrated that a driver's efficiency is affected by temperature, humidity, ventilation, noise or vibration (McFarland and Moore, op.cit., p.890). Motor responses are disturbed in conditions of emotional stress, and this also contributes to the risk of accidents (Hobbs and Richardson, 1967, p.27). Paradoxically, lack of anxiety is equally significant: it has been observed that concentration is best when the task performed is demanding (Antrobus, 1967). This may partly explain why fatal and serious casualties per vehicle mile are far higher in rural rather than in urban areas (Royal Society for the

Prevention of Accidents, 1969; Ministry of Transport, 1968a).

Attitudes to accidents further reflect human fallibility, since motorists' estimate of their ability tends to be exaggerated by the number of miles driven without accident (McFarland and Moore, op.cit., p.895). The vast majority of persons convicted of serious driving offences do not consider themselves guilty of criminal negligence (Willett, op.cit., p.302); in a recent survey, 70% of motorists professed that they could never have an accident (Parry, op.cit., p.5). In young drivers under hypnosis, no concern about danger in driving was detected, and an element of bravado and a feeling that further risks could be taken when safety standards were raised, was noted (Black, 1966).

Storr (1968, pp.9-11) believes that aggression is a biological necessity and evidence suggests that driving serves as an outlet for this aggression. Cherns (op.cit., p.252) quoted Freud's studies in motivation which detected the unconscious desire to precipitate accidents. Studies have confirmed that the two main psychological characteristics which transform the personality of drivers are aggression and anxiety (Parry, op.cit., pp.97-108).

Accident proneness as a fairly stable function is implied in several surveys: motorists with previous convictions for careless driving took more risks than a random group (Quenault, 1968); a second motoring offence was recorded amongst 20% of offenders examined (Willett, op.cit., p.304); drivers involved in 58% of recorded fatal accidents were probably suffering from some certifiable mental illness at the time of accident (Street and Elliott, 1968). Studies in the United States have shown that drivers who have repeated accidents were seven times as likely to have records with legal courts or credit and collection agencies

(McFarlane and Moore, op.cit., p.794); in Great Britain, criminology research shows that crimes of violence, sexual crimes, and dangerous driving offences are often committed by persons with similar psychological characteristics (Willetts, op.cit., p.299).

Chanoit (1969) quotes two studies of ten thousand traffic delinquents in the United States in which low intelligence and psychoneurosis were often found among the driving offenders; in the other study, there was a significantly lower accident rate amongst intelligent and educated people. In this country, lower socio-economic groups include a far higher percentage of motoring offenders (Willetts, op.cit., p.303), and one in five of the population has an 'I.Q.' below 80, rendering them less capable of driving a car safely (Times, 1968a).

A large number of persons have minor ailments or are taking drugs, and this can affect their reaction time (Hobbs and Richardson, op.cit., pp.10-25). A medical commission on accident prevention emphasised the danger to drivers of taking many common drugs (Camps and Laurence, 1968): in England and Wales in 1968, fifteen million prescriptions were issued for tranquillisers, over five million for anti-histamines, and nearly five million for stimulants or appetite suppressants (Ministry of Health, 1968). Side effects attributed to these drugs are drowsiness, dizziness, blurred vision, loss of muscular co-ordination, and impairment of judgement (Hoffman, 1969; Payne, 1969); a recent survey of motorists found that over 13% had taken pills or medicine in the twenty-four hours before driving. It is also disturbing that research has shown the effect of some drugs to be cumulative (Rushton et alia, 1968).

Lack of driving experience and ignorance of the Highway Code also contribute to accidents: more than 17% of a sample of newly qualified

drivers were involved in an accident within a year of passing the driving test (Skelly, 1968); recent surveys have revealed that half the motorists cannot identify the simplest and most crucial road signs (Times, 1968c), and that a high proportion of children are unable to distinguish left from right when checking before crossing roads (Pratt, 1970).

Accidents clearly stem from a variety of causes, but the relative consistency of accident figures over the last twenty five years seem to reflect a basic danger increasingly attributable to human fallibilities than to the condition of roads or vehicles.

2.3.3. Prevention of Road Accidents

Austin (op.cit., p.195) has referred to the common pattern of measures to promote safer driving: improvement occurs for one or two years, but by the third year standards have drifted back to their previous level. The number of effective safety measures is limited; even the recent Government White Paper (Ministry of Transport, 1967a, para.2) states that it is unduly optimistic to hope that travel on the roads will become much safer. Whilst the number of traffic accidents could almost certainly be reduced by improving the design of roads and vehicles, it appears that human behaviour can only be improved nominally as a result of higher standards of training, propaganda or further safety legislation.

Street and Elliott (op.cit., p.53) have questioned the principle that one short driving test, when candidates are likely to be at the peak of their mental and physical powers, gives them the right to drive without further examination for the rest of their lives. Cohen and Preston (op.cit., pp.33-34) have pointed out that driving tests neglect

both the emotional and sensory capacity to process information, and concentrate solely on skill; Parry (op.cit., pp.54-57) has commended the inclusion of a psychiatric assessment in driving tests. Visual tests are also considered inadequate since there is no test of judgement of distance at speed. In a survey of twenty thousand drivers, 40% needed their eyes testing, and it was suggested that one hundred thousand drivers in Great Britain have insufficient eye-sight to be fit to drive (Shearer, 1969). In view of declining visual acuity with age, an appropriate time to retest the eye-sight of car drivers is between the ages of fifty five years (Richards, 1966).

The deterrent effect of fines is arguable: the average fine for careless driving in England and Wales in 1967 was £11; drivers found guilty of causing death by dangerous driving were fined on average only £40 (Offences Related to Motor Vehicles, op.cit., pp.4-5, Tables I and I.). Such leniency is paradoxical when compared with the punishment in other spheres of criminal and anti-social behaviour.

The compulsory fitting of safety belts in new cars should reduce road accidents, for it has been found that an unrestrained car occupant is twice as likely to sustain serious injury and four times as likely to be killed, than if he is held by a safety belt (Miller and Starks, 1968); however, less than 10% of drivers on urban roads wear their belts (Ministry of Transport, 1969f, p.XIII). Permanent headrests and non-shatter windcreens are additional optional safety equipment designed to lessen the severity of injury to car travellers; the incidence of pedestrian casualties may be reduced by improved braking systems.

The current breathalyser legislation against drinking alcohol excessively before driving has many deficiencies, for it has been shown

that most people can drink about ten whiskies or five pints of beer and still not reach the legally defined level of intoxication (British Medical Association, 1965a). Furthermore, the Medical Research Council's investigation found that even 50 mg. of alcohol per 100 millilitres of blood can impair many people's ability to drive safely (Fairley, 1968), whereas the permitted level is 80 mg. (Road Safety Act, 1967, Part I); in Sweden it is only 35 mg. Although 40% of the fifty five thousand breathalyser tests reported in England and Wales in the first year of their application were positive (Times, 1968b), there has been a marked improvement in road safety since their introduction; there is, however, evidence that the initial dramatic effect is beginning to wear off. It is also possible that the reduction in accidents not involving injury may be partly attributable to the fact that drivers have been reporting them to the police less frequently (Guardian, 1968).

A theory that accidents are directly related to biological cycles during which there are high and low periods of physical fitness and intellectual capacity, has been applied to the drivers of a large Japanese bus company: as a result, a reduction of one third of the previous accident rate has been recorded (Tatai, 1969).

The effectiveness of legislation to limit speeds has been questioned: surveys both in this country and in the United States show that its imposition has little effect on the number of road accidents. This may be because drivers tend to maintain a constant probability of accident. Nevertheless, the proportion of serious injuries to total injuries is much higher on roads not subject to speed limits (Ministry of Transport, 1968d, Table 7).

The separation of vehicular and pedestrian routes is an effective

method of reducing accidents. In some New Towns this has been partially achieved: in Stevenage, over the preceding ten year period for which records were available, the accident rate was 25% below the National average (Claxton, 1966, p.31, para.135); in Cumbernauld, the figures for the years 1962-1968 are 78% below the National average (Cumbernauld Development Corporation, 1969).

A further measure to reduce accidents would be to reduce the need for motorised movement. whilst the accident rate per vehicle mile has declined fairly consistently with the increase in motor vehicles on the roads, people are just as likely to be killed or injured as previously. Since there is a positive relationship between the number of accidents and the vehicle mileage travelled (Royal Society for the Prevention of Accidents, 1969) any reduction in vehicular traffic will lower the number of road accidents.

2.3.4. Road Safety by Methods of Travel

Safety of Journeys by Car. Accident statistics show clearly that urban car movement is the prime cause of injuries and fatalities on the roads: consistently over the last decade, approximately three quarters have occurred in built-up areas (Royal Society for the Prevention of Accidents, 1967), although only 48% of all vehicle miles are driven in them (Ministry of Transport, 1968a). Nevertheless cars have a lower accident rate per mile than most other vehicles (Ministry of Transport, 1969f, p.XIX).

Higher powered cars, even excluding sports model, have the worst accident rate (Austin, op.cit., p.64), the degree of severity being related to the square of the impact speed (Garwood, 1962; de Fonseka, 1966a).

In this respect, technology devoted to improving performance, both in the design of vehicles and road networks, may be questioned.

The motorist takes increasing care of his own safety by means of safety belts, padded head-rests, laminated glass windscreens, side impact protective devices, and collapsible steering columns; the vulnerable people are pedestrians and cyclists, and even car passengers whose risk of injury is greater than car drivers (vide Diagram 2.4.).

Safety of Journeys by Motor-Cycle. The lack of protection of the rider of powered two-wheel vehicles explains to a large extent why travel by this mode is so dangerous: casualty rates in urban areas are about twenty times as high as for car drivers (Johnson, 1969). Declining mileage and rates of ownership (Ministry of Transport, 1969a) and the greater use of safety helmets in the last decade - it is estimated that two thirds of riders wear them - has however considerably reduced the number of accidents of persons travelling by this mode (Ministry of Transport, 1969f).

Safety of Journeys by Bus. The casualty rate per passenger mile on buses is considerably lower than that by car; furthermore, serious injuries represent only one eighth of total casualties by this mode (Royal Society for the Prevention of Accidents, 1969). This is probably due to the fact that drivers are trained to high standards, the bus travels at low speeds, and passengers are better protected in large vehicles. However, public transport operators intend to improve the speed of their vehicles both for the convenience of passengers and to reduce operating costs and fares (woolsgrove, 1966, p.2.) and this may increase casualty rates.

Safety of Journeys by Taxi. No separate statistics are available of the casualty rate of those travelling by taxi (Commissioner of Police, op.cit.). The rate is probably lower than that by car in view of the fact that drivers are professionally qualified.

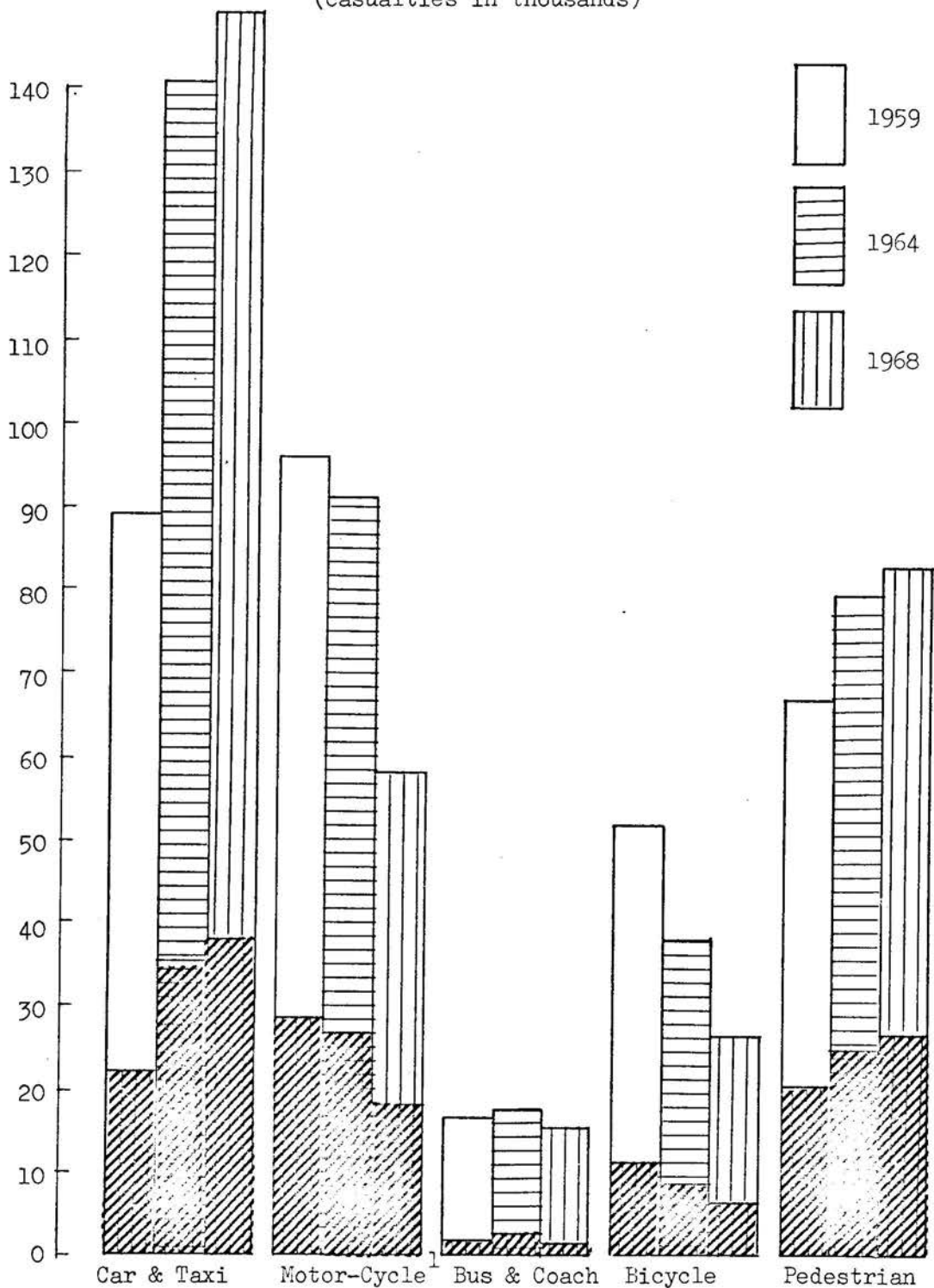
Safety of Journeys by Bicycle. Cyclists are particularly vulnerable on motor roads, and it is only in towns with separated routes that the accident rate is negligible (Claxton, 1967a, para.1.28). In spite of a reduction in the estimated vehicle mileage to one third of its level ten years ago, total fatalities have only been reduced to two thirds of the previous numbers (Royal Society for the Prevention of Accidents, 1969).

Safety of Journeys by walking. Pedestrians represent the largest single group of road users killed in traffic accidents. Their vulnerability is apparent from the fact that they are twice as likely to be killed as other road users (Ministry of Transport, 1969f, p.XXI). This may be aggravated by breathing air polluted by traffic, lowering ability to act quickly (Consumers Association, 1969, p.365). Pedestrian accidents are, of course, much less likely to occur in traffic separated areas: Smeed (1968b) cited a study of two residential districts in Gothenburg in which there were six times the number of accidents in the one without separation of pedestrian and vehicular traffic.

2.3.5. Comparative Safety by the Six Methods of Travel

A comparison of fatal and serious casualties in 1968, according to age, by class of road user was set out in Diagram 2.3 (vide 2.3.1). Diagram 2.4. shows the number of casualties in each category of road user in which it can be seen that casualties to motorists and their passengers have been rising and are far greater than other methods of travel.

Diagram 2.4. Casualties According to Method of Travel
(casualties in thousands)



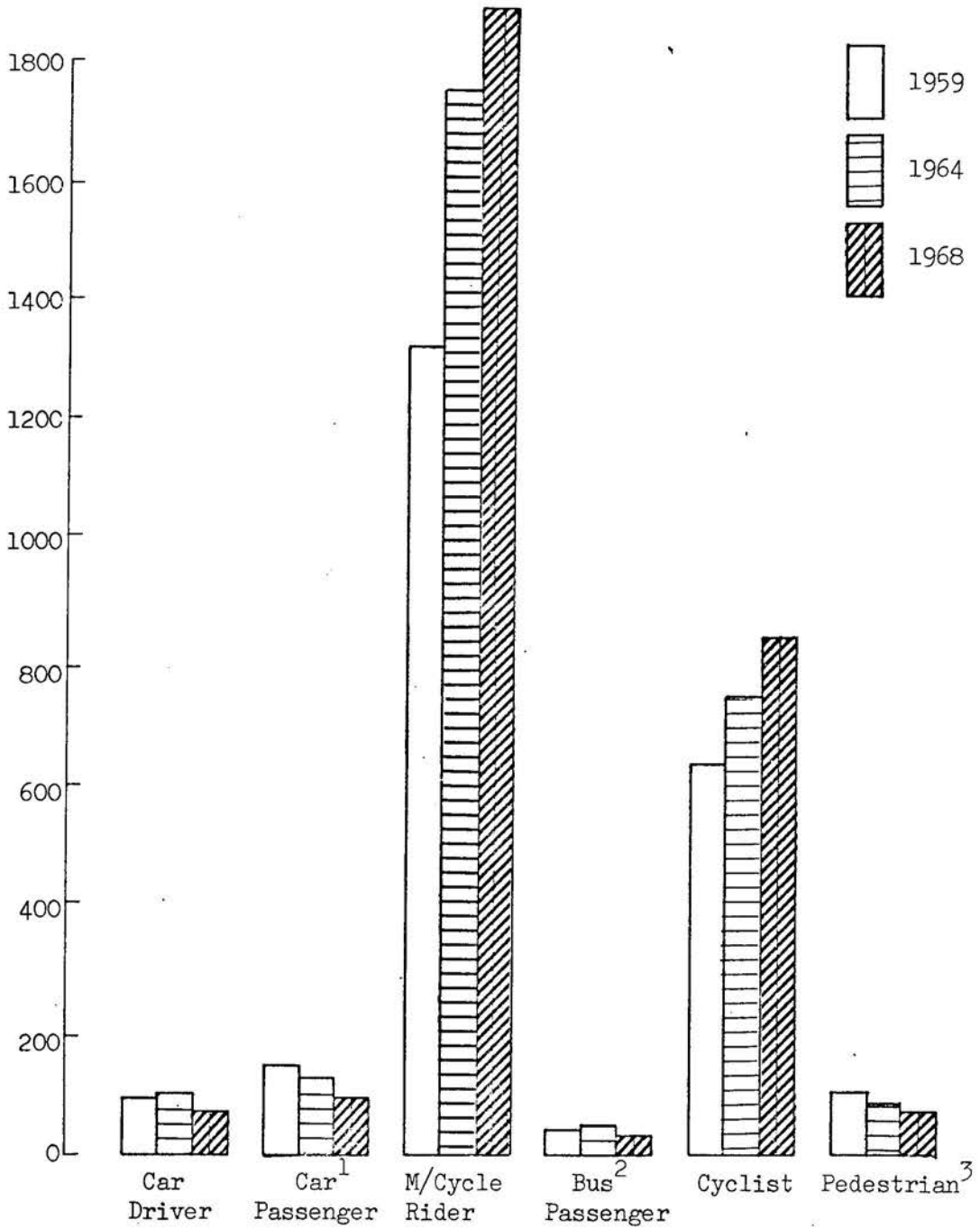
Darkened areas represent fatal or serious casualties.
1. Includes moped and scooter

Source: Royal Society for Prevention of Accidents (1969)

However, a comparison of casualty rates per mile travelled for each class of vehicular road user is more realistic, and some of these have been rising consistently: for the decade to 1967, the rate for cars and taxis increased by 26% and for motor cyclists by 66% (Taylor, 1969). Diagram 2.5. shows this comparative analysis; it can be seen that in 1968 the casualty rate for travel by motor-cycle was over forty times as high as travel by bus, cycling twenty times as high and travel by car twice as high. It is obvious that casualty rates of cyclists and pedestrians would be minimal on traffic separated routes (vide 2.3.4).

In view of the consistency with which road accidents occur, the fact that they are usually attributable to human fallibility, and in view of the resulting high cost to the community, and the personal suffering (vide 4.2 and 4.3), their prevention merits a re-appraisal of the means by which people travel in towns.

Diagram 2.5. Casualty Rates According to Method of Travel
(casualties per hundred million miles travelled)



1. includes occupants of all other vehicles involved in accident
2. estimate based on calculated passenger mileage in Great Britain
3. related to total vehicle mileage

Source: Ministry of Transport (1969a, Table 8)

2.4. COMFORT AND EFFORT

Comfort during a journey and the effort involved in making it, are clearly considerations which affect choice of travel mode, and may even override other factors. Although their importance cannot easily be quantified, they are closely related to basic physiological needs; indeed, man has been said to be motivated by the 'Principle of Least Effort' which applies to the movement of persons within a community (Zipf, op.cit., p.404).

These considerations are most relevant to journeys during which one may be exposed to unpleasant weather conditions, overcrowding, air pollution or noise; they are aggravated when heavy shopping or hand luggage is being carried, when there are many changes of level, and when long distances are involved. The relevance of comfort and effort to travel is also influenced by age: mothers with young children, push-chairs and shopping will obviously be more affected than will teenagers; elderly persons with lower physical capabilities are more likely to take these factors into account.

Comfort and effort can play an important role in encouraging or discouraging journeys. If a method of reaching one's destination without undue discomfort and effort is not easily available, some journeys may be deferred or never taken solely for these reasons; furthermore, in unpleasant conditions, greater mental effort is required to override obvious drawbacks. The character of the natural and urban environment can strongly influence the choice of travel mode. Distance is probably the most significant element (vide 5.3) but its importance is greatly affected by the extent to which urban design can mitigate inconveniences of journeys.

Finally, psychological or 'mental comfort' factors such as attitudes to particular methods of travel may also affect choice, and clearly play a role in the preferences of some individuals for high powered vehicles.

2.4.1. Comfort and Effort in Travel by Car

In present circumstances it is obvious that the car is a most comfortable method of travel, in view of the protection from unpleasant weather, a well-upholstered and assured seat, and the personal control of heating and ventilation. Furthermore, the opportunity of travelling in comparative quiet and privacy is an added virtue, which for some represents rare moments that cannot be enjoyed at home or at work. For family outings, journeys can be made in a more relaxed way than by public transport, as parents are free of the necessity of ensuring conventional behaviour by children. On the other hand, driving involves a high degree of mental concentration (Antrobus, op.cit.), and may cause tension and frustration (vide 4.3).

Shoppers are likely to use a car, if available, for even short trips, in view of the effort involved in carrying goods. The trend towards less frequent journeys accentuates these difficulties as the average weight of goods per trip is thereby increased; at present, households consume about 112 lbs. of goods weekly (Powell, 1969). The possible frustration of parking is only likely to discourage shoppers from using their cars in traffic congested large towns; however, multi-storey car parks are disliked because of the effort involved in handling shopping, and occasionally push-chairs (Consumers Association, 1969a, p.340).

It is also very apparent that cars fulfill a psychological function as status and prestige symbols (Morris, 1969), and this clearly motivates the choice of some adults.

2.4.2. Comfort and Effort in Travel by Motor-Cycle

The main discouragement for most would-be-users of motor-cycles is the gross discomfort experienced in cold, wet or windy conditions. More effort is required to start them than the car. On the other hand they have similar advantages with regard to the small effort involved in driving; they also afford riders a very direct experience of speed, and for some serve as symbols of potency (Menzies, 1969).

2.4.3. Comfort and Effort in Travel by Bus

Bus passengers are obliged to walk at both ends of a journey, and to wait at bus stops, during which times they may be exposed to inclement weather; the deterrent effect of this is evident from research which shows that passengers value trip end times at twice the time spent on buses (Quarmby, 1967). These inconveniences are aggravated when transfers to alternative routes are necessary. The bus may be crowded and stuffy, frequent acceleration and deceleration could be disturbing, and the passenger may be obliged to stand. Some elderly and disabled persons have difficulties in climbing onto the bus, and, with the introduction of one-man buses, there are no conductors to help them. The unreliability of services may be a psychological deterrent to the use of buses.

However, the passenger's compensations include the opportunity to read, or watch the changing urban scene at ease, and freedom from the strains of driving and the problems of parking.

2.4.4. Comfort and Effort in Travel by Taxi

The taxi ride is particularly convenient: it has the advantage of

the car for comfort and minimisation of effort, and of the bus for the compensations just listed.

2.4.5. Comfort and Effort in Travel by Bicycle

The cyclist is particularly exposed to inclement weather; it has been noted that both weather and season affect their proportion of the total volume of traffic, though it does not vary substantially (Claxton, 1966, para.29; Lunn and Sheppard, 1968).

The bicycle is a very efficient form of movement; the effort involved in cycling for regular journeys only appears to prove a disincentive for distances over one and a half miles (Claxton, 1966, p.23). At speeds between 7 m.p.h. and 15 m.p.h. the effort is considered equal to that of a brisk walk (Chambers, op.cit.) The high proportion of cyclists in regions with flat terrain reflect the deterrent effect of gradients; in Cambridge, half of the total journeys are by bicycle (Perraton, 1968, p.150). Cycling on motor roads is aggravated by the 'drag' effect of overtaking vehicles.

2.4.6. Comfort and Effort in Walking

Pedestrians are also exposed to unpleasant weather conditions. The disincentives of low temperature, rain and high wind, are evidenced by empty pavements in these conditions. For these reasons it is generally accepted that new shopping centres should be enclosed (Capital and Counties Property Co.Ltd., 1969, p.15). On the other hand, it should be borne in mind that rainfall and high winds are comparatively rare in this country: on average, the likelihood of rainfall during a

ten minute walk in south east England is only one in a hundred (calculated from Brooks, 1954).

Recent travel surveys show a preference for walking to destinations within half a mile radius because little time and effort are involved; acceptable walking distance in most New Town planning proposals are based on this figure (vide 5.3). Gradients and changes of level also play an important role in encouraging or discouraging walking. The progressive reduction in speed on gradients steeper than 1 in 20 was recorded in a survey: it declined by one third on a gradient of 12° (Ministry of Transport, 1965). Although the effort of climbing vertically as opposed to walking horizontally is not a constant, a study has revealed that between four and five times more energy is expended in climbing stairs than walking an identical distance on the level (Bruce, Floyd and Ward, 1967); in this context, footbridges or underpasses must have a deterrent effect on pedestrian movement. Property developers have difficulty in letting the upper levels of multi-storey shopping centres because of the unwillingness of pedestrians to indulge in unnecessary physical effort (Capital and Counties Property Co. Ltd., op.cit., p.21).

On traffic separated routes, pedestrians do not have to be constantly vigilant, and are free of the anxiety associated with vehicular movement (vide 4.3).

2.4.7. Comparative Comfort and Effort by the Six Methods of Travel

Comfort was the second most important reason given by travellers for preferring the car to public transport (Travers Morgan and Partners, 1968, pp.175-176), and it is anticipated that this preference will be emphasised as standards of living rise (Travers Morgan and Partners, 1969, p.128). A promotional scheme in the United States to encourage car

commuters to travel on buses, by the use of hostesses and the provision of free coffee, doughnuts and papers was unsuccessful (Burns, 1967, p.45)!

Journeys by car or taxi have considerable advantages over other methods of travel, in terms of comfort and lack of effort; however, the choice of people limited to travel by public transport, cycling or walking is determined by weather conditions, distance and gradients involved, and by the possible inconveniences associated with changing vehicles. On shopping expeditions the amount of goods that can be reasonably carried home may be a consideration favouring the bus.

2.5. VISUAL INTEREST OF JOURNEY

Choice of method of travel may be influenced by the visual interest and amenity of a route since people tend to seek ways of achieving novelty and stimulation (Lee, 1966). A well designed urban environment can provide more enjoyable journeys although this is difficult to assess since perception cannot easily be quantified. However, the importance of urban design in this context is now widely recognised. Visual interest appears to affect the choice of travel mode of one age group more than another, and its importance relative to other influences seems to depend on the purpose for which journeys are made. The relevance of visual stimulation on the development of children, and the desire of elderly persons to interest themselves in activity on the street, has already been referred to (vide 1.2 and 1.5); the interest of the route may be of little concern for the work journey, whereas shopping trips can be made more enjoyable in shopping precincts where there is much to engage one's attention.

2.5.1. Visual Interest in Travel by Car

In existing urban environments, journeys by car are visually satisfying when drivers and passengers can observe a constantly changing scene of pedestrian activity, vehicles, and shop windows; moreover, the car itself is often attractive to look at. However, appreciation of detail declines sharply as speed increases (Lee, 1967a). Where there is separation of pedestrians and vehicles, or where design is poorly conceived, travel by car may be boring.

2.5.2. Visual Interest in Travel by Motor-Cycle

Journeys by motor-cycle are similar to the car in this respect, with the added benefit of unobstructed all-round vision.

2.5.3. Visual Interest in Travel by Bus

Journeys by bus may also be satisfying, and have the further advantage that other people may be observed at fairly close quarters, which is considered by many people to be a pleasurable occupation!

2.5.4. Visual Interest in Travel by Taxi

Journeys by taxi may be more satisfying visually than those by car, since the passenger does not have to devote his attention to driving; however the passenger's field of vision is rather restricted.

2.5.5. Visual Interest in Travel by Bicycle

The visual interest of the route is obviously of greater significance to cyclists, since spaces and details are more likely to be appreciated at slow speeds (*ibid.*). Moreover, textures, patterns, nature and people can be readily observed.

2.5.6. Visual Interest in Travel on Foot

The design and activity along pedestrian routes encourages people to walk for they are able to visually explore urban detail and to observe human activity at a self-directed pace. Indeed, pedestrians do not necessarily prefer the shortest routes, but often choose ones

with many people, and along which they feel instinctively relaxed (Parr, 1965; 1966). 'Brennan's Law' of shopping behaviour, which states that people are prepared to walk longer distances to shops on the 'down-town' side of residential areas (Lee, 1962), appears to confirm these observations since in these circumstances, the density of activity is likely to be greater.

2.5.7. Comparative Interest on Journeys by the Six Methods of Travel

.

"Identity depends on scarcity, slowness and familiarisation" (Blee, 1966); in this respect, walking provides the best opportunity for enjoying and appreciating the visual scene. However, design methods to improve the convenience of travel by motor vehicle, such as the inclusion of large planes of road surface and parking areas, elevated roads, street furniture, and signs out of scale with human beings (Buchanan et alia, op.cit., para.35) may interfere with the visual enjoyment of pedestrians, and thus make walking a less satisfying experience. Separation of pedestrian and vehicular routes is therefore likely to make walking more attractive.

2.6. PURPOSE OF JOURNEY

Consideration of the relative importance of the factors analysed in the previous sections may greatly influence the choice of travel made for particular types of journey. These are generally classified into 'essential' regular ones to work, shopping and education, which are usually made during the week, and the 'optional' ones which are mainly for social, recreational and entertainment purposes, during leisure hours in the evenings and at weekends (Buchanan et alia, op.cit., para.143).

2.6.1. Journeys to Work

Journeys to work are considered to be the most important of all trips since they create by far the highest level of vehicular movement in all transportation studies. They may also be given priority inadvertently, as they are regularly made by working adults, the group from which the policy makers are drawn. Several surveys agree that they account for almost half the journeys made by vehicles (Wilbur Smith and Associates, 1961, p.80; Freeman, Fox, Wilbur Smith and Associates, op.cit., p.105, Fig. 9.3; Jamieson and Mackay, 1969); they also account for about 40% of all car mileage (Ministry of Transport, 1967b. Work journeys are usually undertaken during the morning and evening at fixed times, thereby causing the 'rush hour'. The attention of transport planners has therefore been mainly focused on this type of journey (vide Kain, 1962; Warner, 1962; Traffic Research Corporation, 1962; Sneed, 1963, p.280; Williams and Robertson, 1965, pp.668-671; Crompton, 1966; Quaraby, 1967, p.273; Wilson, 1967; Thomas, 1968; Eyles and Spiller, 1969; Horton and Wittick, 1969; Clark and Roeske, 1969; Mackay, 1969); the Sample

Census in 1966 gives data only for this trip, which is also the most straightforward trip to analyse in terms of origin and destination (Meyer, Kain and Wohl, op.cit., p.142). As a result, it has increasingly influenced the reshaping of existing cities and the form of new towns; it is also the largest single element determining urban road investment (Thomas, 1968, p.335).

Although the working population is increasing, and the current 10% of men with two jobs is rising (Rodgers, 1969, p.369), other trends may reduce the total number of rush hour work journeys. Developments in telecommunications and computer technology will result in 'activities' being taken to people instead of the costly current arrangement; it is anticipated that the present labour force in manufacturing industry will with the use of computers, be reduced by 50% by 1980 (Times, 1969d). Some professional people are already following the American pattern of working at home several days a week (Tetlow and Goss, 1965); it is also anticipated that the working week will be cut for many workers (Abrams, 1968b). In addition, as the cost of machinery rises, so will the economy of working round the clock become apparent; the number of shift workers had already risen by 50% between 1954 and 1964 (Ministry of Labour, 1965).

All these considerations represent significant changes in working habits, which could substantially reduce the volume of traffic during traditional 'rush hours', thereby lowering the high public costs of accommodating it at these times.

The journey to work over long distances and in comparative comfort has been made possible by the improved mobility afforded by mechanical transport, particularly the car. This has enlarged the area within which the worker can seek employment, or reduced the time that he had previously

devoted to travel. Usually it has brought about a separation of home and place of work, and increased travel time, with the result that potential leisure hours are reduced (Rodgers, *op.cit.*, para.2.19).

The most influential factors determining choice of travel mode for work journeys are probably speed and comfort; the former arises from the need for punctuality in most jobs, and the latter from the need to reduce the risk of exposure to inclement weather. Travel surveys demonstrate that the car is at present the preferred choice of the majority of adults for these journeys. In the United States, the choice is hardly influenced by alterations in costs of travel (Meyer, Kain and Wohl, *op.cit.*, p.107). Although about one third of commuters in British towns exceeding populations of two hundred thousand persons travel by bicycle or on foot, a striking correlation between household car ownership and the use of a car for work journeys has been noted (Eyles and Spiller, *op.cit.*, p.228). Nevertheless, a survey of commuters recorded that only 4% considered the car essential for their journey (Thomson, 1968).

2.6.2. Shopping Journeys

These journeys are the most frequent trips of the housewives, and are usually their only regular excursion outside the home. There are two types of shopping journeys: those for the daily needs of the household for 'convenience' goods, and the less frequent journeys for the purchase of durable goods. The distinction between these two categories is rather blurred: as a result of the growth of supermarkets, increasing acquisition of refrigerators and deep-freeze equipment, and the high rate of car ownership, the American trend of less frequent shopping for 'convenience' goods may occur in this country.

With more packaged and branded goods at standard prices, traditional personal shopping for the identification of quality purchases with good value for money, is becoming unnecessary. Furthermore, as discretionary incomes rise, the public are increasingly shopping by mail order and by telephone (Reynolds, 1966, p.127; Byron, 1967, p.28). As a result, it has been forecast that by 1977, only two to three shopping expeditions will be made per week (Lintas, 1968, p.11). Nevertheless, at present the majority of housewives go shopping several times a week (Times, 1969b); their journeys are usually short and made on foot (Ambrose, op.cit.; Gallup, 1968).

Considerations of effort and comfort are perhaps paramount for shopping, in view of the need to carry purchases. It has been noted that shoppers prefer covered pavements, no changes of level, protection from the wind and traffic-free precincts (Consumers Association, 1969, pp.338-341). Whilst a survey of shopping habits concluded that the possession of a car did not appear to influence the number of shopping trips made (Ambrose, 1968), there can be little doubt that in general, shopping is a less arduous and inconvenient task in these circumstances. A further important factor is the social aspect of the shopping expedition, since it may be made to alleviate boredom and loneliness, particularly of housewives and elderly people (vide 1.4.2. and 1.5.2.).

2.6.3. Journeys to School

Children go to school forty weeks in the year; some also return home for lunch daily. Journeys to nursery or primary schools are usually short, and children can easily undertake them on foot. In New Towns, schools are located to enable journeys to be safely made unaccompanied. Secondary schools normally have larger catchment areas, so that

longer journeys by bicycle or public transport are usually necessary.

Schoolchildren represent approximately 16% of the total population; and will increase to 18% as a result of the planned raising of the school leaving age to sixteen years in 1971 (calculated from Central Statistical Office, 1969, Table 14). School journeys therefore constitute a substantial proportion of total daily journeys.

Safety and time have been found to be the main considerations influencing choice of travel mode for this journey (Levin and Bruce, op.cit., p.58), no doubt in view of the impulsive nature of children, and the need for punctuality. In ideal circumstances, journeys are undertaken on foot or by bicycle along routes separated from motorised traffic, so that they can be made unaccompanied by adults.

2.6.4. Journeys for Leisure

These journeys are undertaken by all members of a household, and represent a significant component of the total number of urban trips; activities as varied as golf, bingo, theatre, football, evening classes and wandering about, clearly appeal to individuals with widely differing backgrounds, and at particular phases in the life-cycle (vide 1.1.4 - 1.6.4). Older children and adolescents generally prefer to spend their leisure time independent of their families; a survey in London in 1964, found that children between the ages of eleven and fifteen used open spaces far more frequently than adults (Benjamin, 1968).

Rising affluence and the growth of car ownership and leisure time are increasing the frequency of leisure journeys: for instance, traffic projections in a Scottish transportation survey show an increase of 125% in the number of these trips over the twenty year period from 1965 (Freeman, Fox, Wilbur Smith and Associates, op.cit., p.232).

These journeys constitute an irregular pattern of travel activity: trips for social purposes are diffused since friends and relatives tend to be spread geographically; places of entertainment are more likely to be centrally located, whilst recreation is increasingly spent out-of-town, due to the rapid rise in the popularity of participation sports (Rodgers, op.cit., Table 4.4), which require large areas of land or water. Where opportunities exist, children make random journeys in their free time, as an expedition of discovery; adults and elderly persons often enjoy a walk in pleasant urban surroundings, if only to window shop.

Three functions of leisure have been described as relaxation, entertainment, and personal development (Dumazedier, 1967). Paradoxically recreational activities such as skiing, sailing, camping, climbing and swimming, which may expose participants to discomfort and physical effort, are very much on the increase, although it is just these conditions that the individual seeks to avoid in his daily life. Nevertheless, it would seem that, of the factors analysed previously, the most important considerations motivating choice of travel mode for leisure journeys are those of maximum comfort and minimum effort. For these reasons, cars are the preferred travel mode for these journeys, other than to destinations within reasonable walking distance.

2.6.5. Comparison of Proportion of Journeys for Different Purposes

In assessing the proportion of journeys made daily for different purposes, surveys tend to concentrate on work journeys and other vehicular trips of adults, since these are the ones which determine the efficiency of road networks, and are simplest to identify. The percentages in several transportation surveys are set out in Table 2.4; estimates of

vehicular trips in the next twelve to twenty years in three of these studies is set out in Table 2.5. They reveal a considerable decline in the proportion of work journeys and a rise for all other purposes, particularly those associated with leisure activities.

However, these surveys have distinct disadvantages as they conceal certain aspects of urban movement: data is collected on motorised journeys only and neglect those by bicycle or on foot, which represent a very high proportion of short trips; furthermore, no differentiation is made between the journeys of individuals and families as calculations are made of 'household trips'. The results are therefore weighted in favour of adults and all persons in car-owning households.

Although it has been concluded that travel by car is preferred for most journeys, an analysis of the travel needs and mobility of individuals derived from Chapter 1, suggests that most trips are not, and are unlikely in the future to be possible by this means.

Table 2.4. Vehicular Trips According to Purpose of Journey

Study	work	shopping	school	leisure	other	total
National Travel Survey 1964	38.0	17.5*	8.8	23.4	12.3	100.0
London Travel Survey 1966	50.0	8.0	5.0	25.0	12.0	100.0
Ministry of Transport 1967	48.0	20.0*	5.0	14.0	13.0	100.0
Greater Glasgow Transport.Study 1967	44.0	7.0	8.0	15.0	26.0	100.0
East Central Scotland Transport.Study 1968	45.5	16.8*	9.9	14.4	13.4	100.0

* includes journeys for personal business

Table 2.5. Estimates of Future Vehicular Trips According to Purpose of Journey

Study	work	shopping	school	leisure	other	total
Ministry of Transport 1981	36.0	28.0*	7.0	16.0	13.0	100.0
East Central Scotland 1986	29.9	22.5*	11.5	20.6	15.5	100.0
Greater Glasgow Transport.Study 1990	32.0	9.0	13.0	22.0	24.0	100.0

* includes journeys for personal business

2.7. LIMITATIONS ON CHOICE OF TRAVEL MODE

The choice of method of movement by which the majority of the population are able to satisfy their travel needs is limited to varying degrees. In urban situations, the choice ranges from pedestrian movement to a variety of vehicular modes. The latitude of adult choice depends to a large extent on whether they are healthy enough to walk or travel by public transport, wealthy enough to run a private car, or wise enough to ensure that someone will take them to and from their intended destination. At the other ends of the economic and age scales are those for whom there is little choice: they have no access to cars, and often have to rely on the availability of a public transport service; in the extreme condition of being housebound, they require the help of others to deputise for their travel needs. Between these conditions there is a wide range of limiting factors which renders individuals 'dependent', primarily by virtue of circumstances beyond their control. Finally, there are those who do not wish to drive or own a car, because of the disadvantages outlined earlier in this Chapter.

The mobility of individuals may be affected by age, condition, possession of a driving licence, or the availability of alternative methods of transport.

2.7.1. Age and Condition

The relative importance of the influences on modal choice is largely determined by age: as has been seen in the examination of varying travel needs during the life-cycle, for instance, considerations of time saving may be less cogent for elderly persons, for whom safety could be more influential; comfort may not have the same priority for

children as for adults, though safety is clearly a dominant consideration of those responsible for them. However, age, physical ability and mental capacity are much more likely to limit choice.

Persons below the age of sixteen years are not legally entitled to drive motor-cycles, and below the age of seventeen to drive cars. It is thought that approximately half the number of elderly persons are unable to drive due to temporary or permanent physical deterioration or impairment of their physiological reactions (Tanner, 1965), and certain categories of disabled persons cannot drive as a result of their handicaps.

Bus travel represents a hazard to very old and many disabled persons who find it difficult to mount the bus platform; the difficulties of handling a push-chair, baby and shopping, can present problems to mothers of young children. Furthermore, in present urban conditions, parents feel apprehensive about young children travelling by bus on their own.

An indication of any physical limitation on cycling for the general population can be gained from the ownership rate of bicycles in Stevenage New Town, since this town has a simple network of cycle ways, particularly to school and to work: about one third of the population has a bicycle (Bunker, 1967). There is no evidence to suggest that cycling is a harmful form of exercise in middle age (vide 4.3).

The vast majority of the population are able to walk reasonable distances. The exceptions include very young children up to the age of about four years of age, a small proportion of elderly persons, and the majority of severely disabled persons. Reference has already been made to surveys of elderly persons which show that increasing incapacity and, therefore, the distance they are prepared to walk, reduces with advancing years (vide 1.5.5); the influence of changes of levels has been demonstrated in

a survey which showed that their average speed of ascent was only half that of young adults (ward, 1968).

These limitations on choice of travel mode due to age and condition suggest that about half the population could drive a car or cycle, and the vast majority travel by bus or walk reasonable distances (vide 5.3).

2.7.2. Possession of Driving Licence

A further category of persons who cannot drive cars includes those unable to hold a driving licence. The number of licences issued in this country has increased from eight million in 1957 to nearly seventeen million in 1968 (Ministry of Transport, 1969a, p.73, Table 57). If persons below the age of seventeen are excluded they represent about 40% of the population (calculated from Central Statistical Office, 1969, Table 14). Whilst the proportion of licence holders is increasing, there is likely to be a significant number of adults unable to pass the driving test: in the United States, 20% of the adult population over the age of seventeen cannot drive, some because they have no necessity or wish to, but many because of physical disabilities or advancing age (Myers, 1968); in this country, it is thought likely that 25% of the adult population below the age of seventy will be incapable of holding a licence (Buchanan et alia., op.cit., para.50). Two million tests were taken in 1968, of which 53% were failures (Ministry of Transport, 1969d). These tests may become more stringent as a result of increasing concern over dangerous driving.

There is a clear sex differentiation in car licence holders, which can be primarily related to car ownership. Three surveys have shown that men were more than four times as likely to hold driving licences as

women (Atkins, 1964, Fig.20; Gray, op.cit., p.58, Table 4.2); the National Travel Survey (Ministry of Transport, 1967b) found that in the United Kingdom as a whole, 56% of men and only 13% of women held driving licences. Whilst the main explanation for this may be due to the predominant use of the car by working members of households for work journeys (Atkins, op.cit., p.36), it may also be related to the technical nature of driving, which is likely to be more difficult for women to comprehend. It is no doubt further accentuated by the high proportion of widows in the community for whom the problems of driving and the responsibility of running a car are too great (vide 1.5.5.).

Disqualification from driving is a further limitation on car use; in 1967, sixty thousand motorists were disqualified (Offences Related to Motor Vehicles, 1968, Table 1), in most cases temporarily. There is also the small proportion of drivers whose cars are out of service for maintenance or repair, which typically puts them out of use two or three times a year (Ministry of Transport, 1969c). In the latter case, delays may result from waiting for insurance clearance, availability of service mechanics as well as for the repair itself. Finally, it could be suggested that a proportion of the population who do hold a licence, should not hold one, "because of deficiencies in their behaviour" (vide 2.3.2).

2.7.3. Vehicle Ownership

Most adults who do not have vehicles for their exclusive use cannot afford one; this is usually due to inadequate income which may be affected by earlier age of retirement and greater longevity, or increasing survival of disabled persons.

Over ten million persons are earning less than £10 a week after tax

(Department of Employment and Productivity, 1968a). The average weekly earning before tax of men in Great Britain is under £24, of women working full-time under £13, and of households under £30 (Department of Employment and Productivity, 1969). Abel-Smith and Townsend (1965, p.61) calculated that nearly 18% of households containing about 15.2% of the population, had incomes of less than 140% of the basic National Assistance scale; it has been suggested that these percentages are seriously underestimated (Bagley, 1969). Moreover, the proportion of the population below the poverty line has not declined in the last decade (Townsend, 1969), and it has been forecast that in 1983, one third of all households will be managing on income provided by one wage-earner in the family and that most of these will cope only by being constantly in debt (Abrams, op.cit.).

Taking into account sources of private income, Townsend and Wedderburn (1965, p.95) found income levels of the retired population one half or more below those of the population generally; 23% of old couples, 29% of single men, and 50% of single women are living below the poverty line (Shanas, Townsend et alia, 1968, pp.373, 438). Current pensions are £4.10. Od. per week for a single person, and £7. 6. Od. for a couple (Ministry of Social Security, 1968) - the former figure is less than 20% of the average wage in manufacturing industry. The new Government Pension Scheme will provide a maximum benefit of £12. 2. Od per week in 1992 (Ministry of Social Security, 1969).

Reference has already been made to the increasing survival of disabled persons (vide 1.6). Their numbers are likely to include a high proportion with low income levels: from a survey in South-East England, it was found that 60% had a total of less than £10 per week, and 86% less than £20 (Townsend, 1967). The Government make no tax concessions to disabled persons owning cars.

Both the number of trips and car ownership per household has been shown to be a direct function of income (Wilbur Smith and Associates, op.cit., p.70; Crowther, op.cit., para. 7; Greater London Council, 1969a, pp.29-31). A National survey showed that the car ownership rate in households of upper socio-economic groups was over five times as high as that of lower groups (Automobile Association, 1967a). There were similar findings in the London Traffic Survey which showed that car ownership was four times as high amongst those with incomes of £2000 per annum as of £1000 (Freeman, Fox and Partners, op.cit., pp.157-158); a study in Coventry recorded almost identical figures (Wilson, 1967, p.151); a recent survey in Scotland recorded that 72% of the non car-owning households had estimated annual incomes under £1000 per annum (Freeman, Fox, Wilbur Smith and Associates, op.cit., p.41).

The overall costs of car ownership were set out earlier (vide 2.2.1). When these are related to earnings, it is clear that incomes in many households are inadequate; they are likely to remain so for even a modest standard of living, let alone the ownership of a car which entails a continuing heavy financial liability. The influence of household size and income in this context is very clear from the analysis made by the author of the 1966 Sample Census, which shows that people in two person households were twice as likely as those in six person households to own a car, and four times as likely as those in eight person households (General Register Office, 1967a, Table 21).

There are of course, people who do not wish to own a car, in spite of being able to fulfil all requirements for driving and ownership; Rodgers (op.cit., Table 4.1) recorded 21% of households with incomes of £1950 and over which had no car.

Car Ownership. The net effect of these factors on car ownership is reflected in the most recent National survey for 1966 which showed that 48.9% of households owned one car, and 10.3% owned two or more (Registrar General, 1967). However, Abrams (1968) has predicted a doubling or trebling of the standard of living in the United Kingdom by the end of the century, and a progression towards a far higher level of car ownership is almost certain. A detailed forecast up to the year 2010 was made by Tanner (1965). This was based on the present and future age distributions of the population of Great Britain, and assumed that 10% of adults between the ages of seventeen and sixty four would be unable or unwilling to drive, and that 50% of those aged sixty five and over will be unable to do so; the potential driving population was thereby reduced to 62% of the population at present, and 59% by the year 2000. By analysing the ownership level in the United States, now 40% of the population (World Almanac, 1968, p.573), and the lower rate in urban areas, he projected the ultimate saturation level in Great Britain at 0.45 cars per head in the year 2010 (Tanner, op.cit., pp.7-8); he subsequently revised his forecast (1967) slightly and predicted the figures set out in Table 2.6. A more recent study has confirmed the saturation level at between 0.40 and 0.45 cars per head (Tulpule, 1969).

Table 2.6. Estimate of Future Car Ownership in Great Britain

Year	Cars/Head
1966 (actual)	0.18
1980	0.36
2000	0.44
2010 (saturation level)	0.45

Source: Tanner, 1967, p.5, Table 2.

It may be seen that the 1966 percentage of the population without the exclusive use of a car was 82%. On projected trends, by 1980 it will reduce to 64%, and by the year 2000 to 56%. Even excluding children below the age of five, in the year 2000, over half the population (and two fifths of the adult population) are likely to be without a car for their exclusive use (vide 2.7.4).

Motor-Cycle Ownership. This is also dictated by age and income; it has already been noted that those below the age of sixteen are not permitted to drive. Although licenced vehicles in this category have declined to three quarters of the level in 1959 (Ministry of Transport, 1969a), the current ownership level of 0.02 per head of population is predicted to remain static until the end of the century (Tanner, 1967, p.7.).

Bus Services. There were seventy three thousand buses on the roads in 1968 (Ministry of Transport, 1969f, p.xx), representing an average of 0.0017 per head of population; the number has hardly varied during the last decade (Tulpule, op.cit.) in spite of its declining use.

Taxi Services. There are less than fifteen thousand taxis in Great Britain, representing an average of 0.0003 per head of population; this is only about one quarter of the level twenty years ago (Young, Maltby and Constantine, 1969).

Bicycle Ownership. No detailed figures are available of the number of bicycles in Great Britain. The National Travel Survey of 1964 estimated an ownership level of 0.15 per household; in Peterborough the level is 0.44 per person (Goss, 1969) and in Stevenage New Town where specific provision for its use has been made, the level is 0.30 per person (Bunker, op.cit.). Its declining use is, however, evidenced by the estimated annual mileage in 1968 which was about one third of the figure in 1959 (Ministry of Transport, 1969b).

2.7.4. Availability of the Six Methods of Travel

The availability of a convenient form of movement has a significant influence on participation in a wide range of activities outside the home. In particular, the acquisition of a car results in a sharp rise in trips for such purposes. Table 2.7. illustrates the variation recorded in the London Traffic Survey (Freeman, Fox and Partners, 1964, p.50, Table 13.4).

Table 2.7. Daily Trip Generation Rates by Basic Trip Purpose

Trip Purpose	Car-owning Household	Non car-owning Household
work	2.34	1.50
personal business	0.97	0.17
social	0.44	0.17
shopping	0.33	0.16
school	0.35	0.08
other home based purposes	0.66	0.25
non home based purposes	0.96	0.14
all purposes	6.06	2.47

However, the figures in this survey distort the apparent effects of car ownership, since they only refer to the number of trips per household and to movement by motorised means, as do most traffic studies (vide Williams and Robertson, 1965, pp.137-140; Wooton and Pick, 1967b; Atkins, 1968; Freeman Fox Wilbur Smith and Associates, 1968, p.231; Jamieson and Mackay, 1969). Furthermore, surveys of activities and attitudes rely predominantly on adult respondents (British Broadcasting Corporation, 1965; Sillitoe, 1969, p.20; Centre for Environmental Studies, 1969; Ministry of Housing and Local Government, 1969); on rare occasions adolescents are included (vide Rodgers, op.cit., p.2; Lichfield and Associates,

op.cit., Appendix E1). The Result is to neglect many of the real issues of individual travel needs.

A brief review of some literature on this subject reveals an almost total disregard of the fact that human beings who are too young to drive are 'people', and suggests ignorance of the fact that the family as a composite unit has relatively few travel needs (vide 3.1.3).

Characteristics of Urban Travel - "Car has become the primary mode of urban travel" (Wilbur Smith and Associates, 1961, pp.61-62).

Hook New Town - "Private cars will be the main means of personal transport" (London County Council, 1961, p.78).

Factors Affecting Urban Growth - "The automobile has freed the family..." (Vorhees, 1962, p.90).

Living with the Motor Car - "... problem of adapting our cities and towns to the universal use of private motor transport" (Day, 1963, p.5).

Traffic in Towns Steering Group - "We are approaching the crucial point when the ownership of private motor vehicles, instead of being the privilege of a minority becomes the expectation of the majority" and "The most recent estimate of the Registrar General is that in 30 years' time the total population will be 25% higher than now. These additional millions will want to own cars (Crowther, 1963, paras. 6, 13).

Traffic in Towns - Limit to size of town "at which full motorisation of the population is possible" and "... in none of the first batch of new towns commenced after the war did the designers consciously say to themselves 'nearly all people living here are going to demand motor cars in the foreseeable future and the right to use them, so what sort of a town ought we to design to enable them to do so?'" (Buchanan et alia, pp.165, 167).

Skelmersdale New Town - "Anyway the increase of car ownership has resulted in people becoming more mobile" (Wilson and Womersley, 1964, p.8).

On New Urban Structures - "The enlarged freedom to communicate outside one's place community that the emerging technological and institutional changes promise, coupled with an ever increasing mobility and ever greater degrees of specialisation will certainly mean that urbanites will deal with each other over greater and greater distances" ... "the individual spends more and more of his time in the non-place urban realm as a member of a national or international set or community and less of his life in an urban 'place'" (Webber, 1964, p.146).

Demand for Public Transport - "Up to a third of families in a major city may not own a car" and "might be cheaper to provide these families (non car-owning) with used cars" (Keefer, 1966, p.21).

Runcorn New Town - "Public Transport must be provided for the people unable to use cars, although they are relatively few in number (Ling and Associates, 1967, para.8.13).

When Car Saturation is Reached - "at least 15% of journeys within a town will still require some form of urban transport, as this percentage of the population will be without the use of a car" (Ling, 1967, p.11).

Greater London Development Plan - "Londoners, like people elsewhere in the country, are becoming increasingly mobile... more time and opportunity to spend time and money in leisure activities" (Greater London Council, 1967, p.167).

Washington New Town - "bringing the benefits of motor car ownership within reach of the whole population (Llewelyn-Davies Weeks and Partners, 1967, p.13).

Public Transport and Traffic - "without doubt, in fifteen to twenty years time, the majority of the travelling public will want to use their own private transport" (Ministry of Transport, 1967d, p.113).

Recreational Influence of Car Ownership - "Complete personal mobility has revolutionised our use of leisure time" (Rodgers, 1967, para.4.1).

Milton Keynes Interim Report - "the free-wheeling dynamic and mobile society which the planners expect to inhabit Milton Keynes" ... "Freedom of choice between public and private methods of transport" (Llewelyn-Davies, Weeks, Forestier-walker and Bor., 1968).

Road Congestion - "Londoners want to own a car and enjoy all the benefits that a car brings" (British Road Federation, 1968a).

Trends in Transportation - "But the public just doesn't generally agree with this concept.. to keep a lot of activities within walking distance of people's homes" (Vorhees, 1968)

Town Design - "the increased mobility of the population... with full car ownership" (Llewelyn-Davies, 1968).

Mosbrough Master Plan - "to devise an urban structure which... needs to be extendable to accommodate almost universal car ownership" (Culpin and Partners, 1968).

Forecast for the Year 2000 - "Britain will be a nation of car-owners with about eight families out of ten running at least one vehicle" (Flowerdew, 1969).

Milton Keynes - "will be a car-owning community" (Cowan, 1969).

Planning Your Environment - "Universal personal mobility is something we all value (Ashworth, 1969).

Movement in London - "... the coming of an age in which the overwhelming majority of citizens will have access to motor cars" (Greater London Council 1969a, p.9).

Tomorrow's London - "People have more money to spend and, thanks to the shorter working week, domestic gadgetry and cars for housewives, they have more time in which to make their choices"... "but people own cars" (Greater London Council, 1969, pp.11,28).

Shaping Force of the Environment - "Conferment by the motor car of personal mobility upon the ordinary person" (Ash, 1969, pp.42-43).

Where Public Transport is Uneconomical - "Cars could be made available to ... the carless poor" (Webber and Angel, 1970).

The effect of these misleading published statements is to lend credence to calculations in which it is assumed that children and old people's travel time is valueless (Tanner, 1961), bus users' travel time is worth half that of car users (Dawson, 1969), and pedestrians' travel time worth half that of vehicle occupants (Inwood, op.cit., p.5); it is even suggested that no special provision for cycles is necessary in view of the decline in their use (Wilson and Womersley, 1967, p.209). Planners have become predominantly concerned with the prediction of volumes of traffic resulting from increasing car ownership, and have focused their attention on the needs of car owners so that facilities can be planned to accommodate them.

Although many car trips are made by people in car-owning households, a high proportion of journeys have to be made individually by other means: a survey in Newcastle showed that 46.2% of trips in one car households, and 25.4% of trips in two car households were by bus or on foot (Burns, 1967); in London, 55% of total trips are by cycle or on foot (Greater London Council, 1967, p.79).

Priority use of a car depends on ownership, occasional use typically applying to the wife in a one car family; a recent survey in several urban areas of the United States recorded the husband as being between five and

fifteen times as likely to be the principal user in a one car family (Transportation Research Institute, op.cit.). Alternatively, the wife is obliged to assume the role of a chauffeur for her husband and children. Naturally this situation is not fully resolved for adults until each has a car for his or her own exclusive use; the financial burden of this is clear from the analysis of the costs of car ownership (vide 2.2.1). As far as the author is aware, no surveys have been undertaken into the influence of household car ownership on the travel activity of the individuals within households, and it would seem, therefore, that research is clearly exigent (vide Chapter 3).

The implications of analyses of car ownership by households rather than by persons is particularly apparent in the comparison of levels of ownership in different sized households in the 1966 Sample Census, as set out in Table 2.8. It can be seen that people in larger households were far less likely to have the use of a car; on the basis of predictions of similar household size and composition up to the turn of the century (Beckermann et alia, op.cit., p.371; Roskill et alia, 1964, pp.35,37, Tables 2.12, 2.14), it may be assumed that the implied limitation on their relative mobility will only be partially removed. References to the need to accommodate 1.2 cars per household by 1980, and 1.4 by the year 2000 are not very meaningful in the context of individual mobility.

Table 2.8. Car Ownership According to Household Size

	1p.	2p.	3p.	4p.	5p.	6p.	7p.	8p.+	All
Persons in Households %	5.2	20.5	21.4	23.8	14.5	8.0	3.2	3.4	100.0
Cars per Household %	12	41	56	61	66	54	48	39	45
Cars per Person %	13	22	22	18	14	11	9	6	18

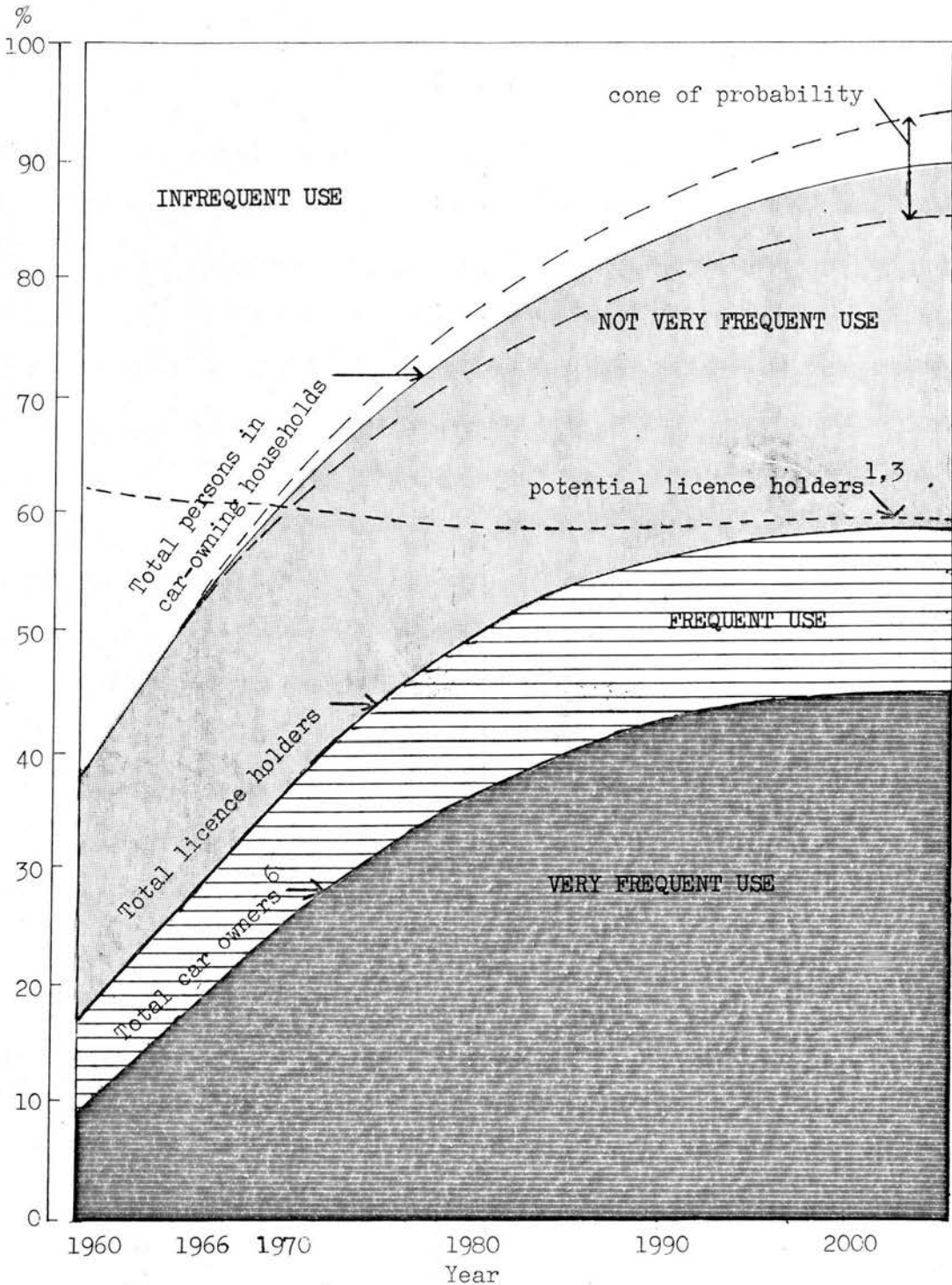
Source: 1966 Sample Census (General Register Office, 1967a, Table 21).

There are basically three levels of car use in car-owning households: primary use of the car owner, secondary use of adults who can drive when a car is available, and tertiary use of non-licence holders, including children, who are only able to travel as passengers. From predictions of population and car ownership rates over the next thirty years, an assessment can be made of the proportion of people who are likely to enjoy these three levels of car use. This is set out in Diagram 2.6. It can be reasonably assumed that adults with 'secondary use' of a car will also make use of public transport, and that people with 'tertiary use' will be fairly dependent on it. When account is taken of the proportion of persons in households without cars, the essential need for an efficient public transport service for the majority of the population is apparent, even when the 'car saturation' level is reached.

The convenience of public transport is directly related to the proximity to the user and the frequency of service; this aspect becomes most apparent during off-peak hours when they are often curtailed (Scottish Bus Group, op.cit.); yet it is at these times that many of the leisure activities of those dependent on public transport take place.

The desirability of a cycle or pedestrian network, albeit integrated with vehicular traffic, is rarely disputed, except perhaps in some of the most car-orientated communities in the United States. Although the proportion of journeys made on foot and particularly by bicycle has declined substantially during the last decade (Ministry of Transport, 1968b, Table 33), this may be as much a consequence of management measures and a general deterioration in environmental conditions which discourage these forms of movement, as the rise in car ownership.

Diagram 2.6. Predicted Levels of Car Use According to Total Population of Great Britain (1960-2000)



1. Tanner (1965, Table IV)
2. Based on author's survey (vide Chapter 3)
3. Central Statistical Office (1969, Table 14)
4. Ministry of Transport (1969a, Table 57)
5. Sample Census 1966, Transportation Tables (1967, Table 21)
6. Tulpule (1969, p.14, Table 5)

2.7.5. Discussion

The analysis of the travel needs of each age group and the availability of various forms of movement, underline the relationship between the diversity of individual needs and life patterns on the one hand, and the restricted range of choice of the majority of the population on the other. References therefore to "freedom of choice between the use of private and public transport" or to "modal split" (Llewelyn-Davies, 1967; Derbyshire, 1967; Llewelyn-Davies, Weeks, Forestier-Walker and Bor, op.cit., p.25; Rubinstein and Speakman, 1969; Greater London Council, 1969a, p.91; Brenikov, 1969, p.28), give a misleading impression as the choice can only apply to adults with an available car. However, in their case, the car is almost invariably used, except in the central areas of congested towns or cities (Greater London Council, 1969a, pp.90-91), and the bus primarily by non-car owners; in other words, availability is the crucial factor in modal choice (ibid.). Wilson (op.cit.) recorded that only 65% of car owners had a real choice between using their car or travelling by public transport, since 20% needed the car for work, 10% had no suitable bus service available, and 5% had to leave the car at home. Furthermore, it should be noted that the term 'modal choice' applies only to motorised movement and ignores the real 'modal choice' of the majority of the population which is between public transport and walking.

Traditional family outings now occur far less often than hitherto, and are largely being replaced by informal individual outings (vide 1.7.4). In such circumstances personal mobility is, and will continue to be limited by the availability of a driver for most urban journeys. In the case of journeys by car, mobility is determined by the need for concurrence in time and inclination of driver and passenger; in the case of journeys by public

transport, it is dependent on the immediacy, frequency and reliability of the service. These factors may act as psychological deterrents to what may superficially appear to be inessential journeys, since prior knowledge of availability is an essential pre-condition of many leisure journeys.

This aspect of dependency is most influential on the activities of children, teenagers, mothers with young children, and elderly persons, and the majority of disabled persons. Pahl (1968) has expressed this paradoxical situation as one in which the least mobile are those for whom it is socially desirable to be the most mobile.

The majority of the population need to be as independent as possible in their mobility, as social, and even psychiatric problems may be caused if individuals are unable to travel when they choose, and at their own speed. In a study of family dependency, it was stated to be unwise, and in the long run, unkind and inefficient, to make people more dependent than absolutely necessary (Bremner, 1968); dependency on others is considered to be directly connected with aggression in view of the restrictive influence that the dependent feels (Storr, op.cit., pp.43-44). These statements apply also to freedom of movement (vide 1.7.5).

It is reasonable to argue that a welfare society should give priority to those individuals with limited mobility, for the same reasons that persons who fall ill are protected by the State from financial penalty, through National Insurance. A more equitable basis for satisfying the travel requirements of all groups of society would be established if needs were to determine priorities.

2.8. SUMMARY AND CONCLUSIONS

The main influences affecting the individual's choice of the six methods of travel are summarised in Table 2.9.

Cars are the preferred method of travel - except for short journeys - since they are fast, dependable, relatively cheap and relatively safe; they are comfortable, and require little effort to drive. On the other hand, only a minority of the population are able to enjoy the benefits of the sole use of a car, because of limitations of age, income and ability.

Motor-cycles are fast, easy to ride and economical, but their appeal is limited to young adults, who are hardly concerned about comfort and safety.

Taxis are advantageous in that they combine most of the benefits of car and bus. Their main disadvantages are their high immediate cost, and the uncertainty of the service.

Buses provide the only real alternative to cars for most journeys in towns. However, passengers may be exposed to inclement weather at either end of the journey. Moreover, they are unsuitable for journeys of less than about one mile, are relatively slow, and are often infrequent and unreliable.

Bicycles have similar characteristics to motor-cycles. On the other hand, although effort is involved in cycling, there is no age limit on their use, and accidents are rare on routes separated from motorised traffic.

Walking has the advantage of cheapness, is entirely safe on traffic separated routes, provides an opportunity for visual appreciation of the environment and requires little skill. The main disadvantages are its limited range, and exposure to bad weather.

Although buses are usually inferior to cars as a method of travel, the

majority of the population must rely on them. On the basis of this summary, hopes that they can be made sufficiently attractive to compete with the car by raising speeds, reducing fares, or by improving standards of comfort, appear to be unrealistic. This suggests that, in congested cities, it is parking restrictions rather than the attractions of buses, that persuade car owners to transfer to buses. In New Towns where priority in planning has been given to car travellers, those with cars are very likely to use them and those without cars travel by bus on journeys that they cannot make by bicycle or on foot. It may be concluded that only a minority of the population - the car users - has any real choice.

Table 2.9. Summary of Relative Advantages of Six Methods of Movement According to Major Factors Affecting Personal Choice

Factor Affecting Personal Choice	CAR	MOTOR-CYCLE	BUS	TAXI	BICYCLE ²	WALKING ²	notes
TRAVEL TIME							Number of asterisks indicates the relative advantage of each method of travel assessed as a conclusion from the author's consideration of evidence in this chapter.
measured by door-to-door distance travelled in:							
four minutes	*	***		**** ¹	****	***	
eight minutes	***	****		***	***	*	
twelve minutes	****	****	*	***	**		
range of movement	****	****	***	***	**		
punctuality in travel	***	****		*	****	****	** represents the mean - represents inapplicable 1 if hailed in the street 2 on traffic separated routes
TRAVEL COST							
measured by:							
total costs	*	**	*		****	****	
fuel and occupancy	***	***	-	-	-	-	
value attached to time	****	****	*	***	***		
ROAD SAFETY							
measured by:							
years of life lost	*		***	***	****	****	
accidents per mile	***		***	***	****	****	
accidents per capita			***	***	****	****	
accidents to other users		*	**	**	****	****	
COMFORT AND EFFORT							
measured by:							
quality of seating	****	**	***	****	*	-	
degree of privacy	****	***	*	***	**		
weather protection	****		**	****			
physical effort involved	****	***	**	****	*		
mental effort involved	*		***	***	**	****	
carrying capacity	****	**	**	****	*	**	
reliability of service	***	***	*		-	-	
personal prestige	****	***		****	**	*	
VISUAL INTEREST							
measured by:							
appreciation of detail	*	**	**		****	****	
sensory modalities	*	****	***	*	****	****	
PURPOSE OF JOURNEY							
suitability for:							
work	****	***	**	***	***	**	
shopping	****	**	**	****	*	**	
school			**		****	****	
social	****	*	**	***	*	***	
other leisure	****	**	***	***	**	**	
LIMITATION ON CHOICE							
according to:							
age			***	***	**	****	
ability			***	****	**	****	
income		**	***	*	****	****	

3. STEVENAGE TRAVEL SURVEY: 1969

3.0.	INTRODUCTION	137
3.0.1.	Aim of Survey	138
3.0.2.	Selection of New Town for Survey	138
3.0.3.	Type of Survey	140
3.0.4.	Design of Questionnaire	141
3.0.5.	Selection of Sample and Questionnaire Collection	142
3.0.6.	Response Rate	144
3.0.7.	Characteristics of Respondents	145
3.0.8.	Method of Analysis	147
3.0.9.	Limitations of the Survey	148
3.1.	ANALYSES OF DATA: TRAVEL ACTIVITIES	150
3.1.1.	Frequency of Journeys	150
3.1.2.	Independence of Movement	153
3.1.3.	Method of Travel and Influence of Car Ownership	155
3.1.4.	Comparison with Earlier Surveys	165
3.1.5.	Method of Travel Within Stevenage	166
3.1.6.	Distance and Travel Time	171
3.2.	ANALYSES OF DATA: ATTITUDES TO INFLUENCES AFFECTING MODAL CHOICE	183
3.2.1.	Method of Analysis	183
3.2.2.	Analysis of Attitudes	184
3.3.	DISCUSSION OF SURVEY	188
3.3.1.	Frequency of Journeys	188
3.3.2.	Independence of Movement	189
3.3.3.	Method of Travel and Influence of Car Ownership	190
3.3.4.	Distance and Travel Time	193
3.3.5.	Attitudes to Influences Affecting Modal Choice	195
3.4.	CONCLUSIONS	198

3.0. INTRODUCTION

This chapter covers the author's survey of the travel activities of the population in a New Town. The survey was concerned with journeys of individuals rather than with motorised journeys generated by households - the conventional method in traffic studies. It provides data which can be quantified and used to measure the validity of evidence on individual mobility and travel needs, and on influences affecting modal choice which were examined in Chapters 1 and 2.

The author's research has not revealed any reference to comprehensive studies of the travel needs of the various age groups, in spite of its obvious significance to optimising movement systems. On the few occasions when some details of children's travel activities have been solicited, parents have usually provided information, and in some instances when this has been investigated, significant differences have been noted between the data supplied by parents and that given by children themselves (de Lauwe, 1960; Stevenage Development Corporation, 1969, pp. 6, 9).

Travel surveys, with few exceptions, are directed towards studying work journeys by adults and to estimating future traffic arising from increased car ownership. The author considers that an adequate understanding of the problems of mobility in towns can only be achieved by analysing the travel activities of all age groups by all methods of travel.

3.0.1. Aim of Survey

The survey was designed to elicit information about the frequency of the main types of journeys, the frequency of accompanied journeys, the influence of car ownership within the household on method of travel, distances travelled and the attitudes to factors influencing the modal choice of different age groups. The main findings of the survey regarding mobility have been used to assess the relative advantages of movement systems for New Towns (vide 5.5 and 5.6), and to support proposals for a totally integrated and optimised system (vide 6.3).

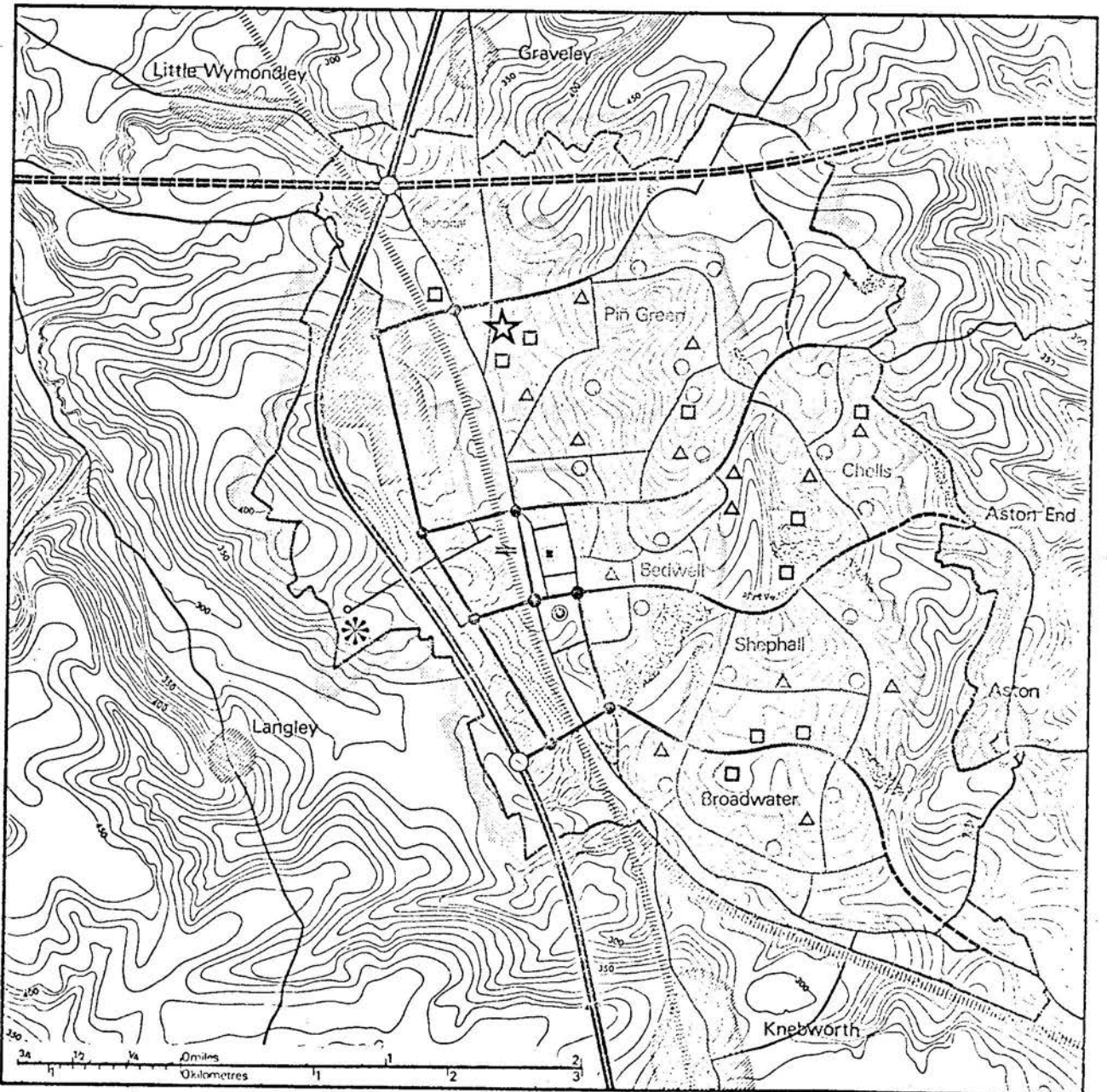
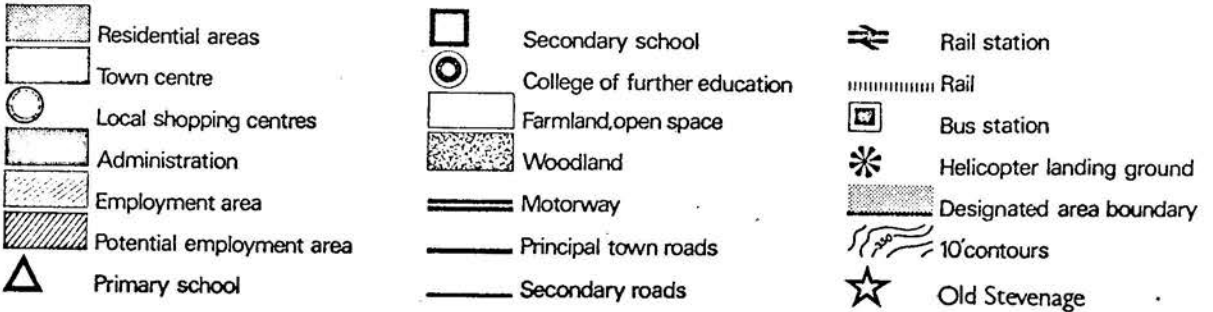
3.0.2. Selection of New Town for Survey

Stevenage New Town (see Map 3.1) was chosen for the survey for the following reasons:

It was the first New Town designated under the New Towns Act of 1946, and has already passed its target population of sixty thousand persons; 49% are employed as compared with the National figure of 51% (Report of the Development Corporation, 1969, p.444) It was assumed therefore, that responses from the population of a well-established town with a fairly balanced age structure would be less biased than those from a 'younger' New Town. Moreover, it is one of the most 'self-contained' of the New Towns: in 1966, 85% of the working population were employed within the town (Thomas, 1969, p.394). As a result, respondents' views would be less likely to be distorted by temporary occupational situations necessitating an abnormal proportion of work journeys outside the town.

The population's socio-economic structure is very similar to the National average; the only atypical feature, as with all post-war

Map 3.1. Plan of Stevenage New Town



Source: Stevenage Master Plan, 1955 (Vincent, 1967)

New Towns, is its age structure which shows a disproportionately high percentage of children (Thomas, *ibid.*, pp.417, 448).

Stevenage is the only New Town with a comprehensive cycleway system with a total length of 18.7 miles (Report of the Development Corporation, *op.cit.*, p.445), a high ownership rate of 1.05 cycles per household (Bunker, 1966, p.23), and a defined pedestrian network. Respondents to the questionnaire could be expected to relate their travel activity to the extensive range of available methods of travel. There is also a considerable amount of survey data already available. Two travel surveys have been undertaken in Stevenage in the last eight years: the 10% Household Survey in 1962 (Bunker, 1966) and the Development Corporation Survey in 1965 and 1966 (Claxton, 1967). The author's study could be compared with these to observe possible trends in travel movement, and to detect distortions which might result from the modest size of his survey.

3.0.3. Type of Survey

Time and resources for the survey were very limited. It was therefore necessary to post the questionnaires and to enlist the services of a voluntary organisation for their collection (*vide* 3.0.5). The postal survey made it possible to increase the sample since this method is quicker, more efficient and less costly than a personal interview survey.

Response to postal questionnaires in certain types of survey are considered to be as valid and as accurate as those conducted by a home interviewer (Scott, 1961; Moser, 1967, p.176). In this survey, the

administrative problems associated with organising personal interviews with all members of households would have been considerable, unless they were arranged at inopportune hours, such as at meal-times. This might have reduced the response rate; alternatively, it could have irritated those interviewed, thereby increasing the likelihood of biased results which reflected more the opinions of 'considerate' people than those of a representative cross-section of the community (ibid., p.177). Furthermore, one of the purposes of the survey was to obtain attitudinal responses requiring time for consideration, so that an interviewer's presence may have prejudiced their quality.

3.0.4. Design of Questionnaire

The questionnaire was simplified to permit its completion by children. All questions were limited to one sheet and phrased for answer by ticks in appropriate boxes. An analysis of the previous Stevenage surveys revealed that over 90% of journeys were covered by five main categories: work, shopping, school, social and recreation and entertainment (Bunker, 1966, p.36; Claxton, 1967), and these were used in the questionnaire so as to provide a basis for comparison. Six main methods of travel: car, motor-cycle and moped, train, bus, bicycle, and walking, were used as they would cover the great majority of journeys of respondents. Four alternative columns for distances of journeys under four miles were listed, with another for those in excess of this distance: this enabled analyses of journeys undertaken within and outside Stevenage to be made, since it was calculated that nearly all destinations within a four mile radius of home would be within the designated area of the town. The six relevant influences on modal

choice: time, cost, safety, comfort, effort, and visual interest (vide 2.1 - 2.5) were listed against the five types of journey.

Respondents were asked to record the following details for each type of journey: journeys made during the previous seven days; journeys made accompanied by one or more members of their household; typical distance from home to destination; relative importance of the six main influences affecting modal choice; age, status and sex of the respondent, and car ownership within the household.

A pilot survey was undertaken in Edinburgh (Appendix 3.A). Questionnaires were given to fifty individuals, covering all age groups and representing a socio-economic cross-section. In addition to recording details of travel activity, respondents were asked to state whether they had any difficulties in interpreting questions and these were subsequently modified to accord with their comments. It transpired that the only necessary amendment to the wording was the inclusion in half the questionnaires, of the words 'FROM' work and 'FROM' school, since some respondents had been unsure of their replies when the method of travel differed on the outward and return journeys; this made it possible to take into account any variation in the method of travel to and from work or school. A copy of the final questionnaire used in the survey is included in Appendix 3.B.

3.0.5. Selection of Sample and Questionnaire Collection

Five hundred Stevenage households were chosen from the October 1968 Electoral Register. The sampling, carried out for the author by the Social Relations Department of the Development Corporation of Stevenage, was a random selection of individuals from the Register, for

the six wards: Broadwater, Old Stevenage, Chells, Shephall, Bedwell and Pin Green.

Copies of the questionnaires were sent for every member of selected households, irrespective of age: six copies were enclosed since an analysis of the 1966 Sample Census for Stevenage New Town established that only 3% of households contained more than six persons (General Register Office, 1967, Table 7A. It was therefore assumed that the coverage resulting from this would be very representative and would not exclude any significant group.

The survey was conducted during term-time, when there were no local holidays and when extreme weather conditions would be unlikely to bias responses. Fortunately, weather conditions in the area during the period of the survey were normal for that time of year, with no rainfall on half of the days, heavy rainfall on one day, and slight rainfall on the remainder (Meteorological Office, 1969).

Since it was hoped that prior Press publicity would increase the response, the Editor of the local newspaper, the Hertfordshire Express and Stevenage Gazette, was approached, and helpfully consented to publish an article on the purpose of the survey (Appendix 3.C.). The local Scouts Association very kindly agreed to co-operate in the survey collection, being encouraged by a contribution to their club funds.

The six questionnaires, a covering letter explaining the purpose of the survey (Appendix 3.D.), and a printed return envelope (Appendix 3.E), were posted to the selected households on the first weekend of May 1969. On the following Monday week, the Scouts, each with a letter of credential, called to collect the completed questionnaires. If there was no reply, they returned, as instructed, on the following two evenings. A letter of

appreciation for the help given by the Scouts was published in the local newspaper (Appendix 3.C.).

3.0.6. Response Rate

The household response to the questionnaires is shown by ward in Table 3.1. Thirty-eight of the posted packets were returned by the Post Office since the persons named on the envelopes were either not known at the address, or had gone away this is fairly consistent with the figure of 5% of households recorded in the Stevenage Master Plan as changing homes each year (Vincent, op.cit., p.22). It should be noted that the Electoral Register from which the sample was selected, was published in the previous year.

The collectors were unable to contact a small number of householders on the three evenings that they called. They were given the following reasons by householders for not handing over the questionnaires: they had already returned them by post; they had not received them; they could not find them; for various reasons they were not prepared to co-operate. When account is taken of postal packets returned by the Post Office, the response rate is over 43%.

Table 3.1. Household Response by Ward

	Sample	Returned	Respondent
	no.	Postal Pkts. no.	Households no. %
All Wards	500	38	200 (43.3)
Broadwater	87	9	42 (48.3)
Old Stevenage	86	4	33 (38.4)
Chells	86	5	33 (38.4)
Shephall	105	6	48 (46.7)
Bedwell	73	7	12 (16.5)
Pin Green	63	7	18 (28.6)
Unclassified	-	-	14 -

Details of the total number of completed questionnaires are set out in Table 3.2. Twenty two of them were not satisfactorily completed or gave insufficient information and were therefore excluded from subsequent analyses.

Table 3.2. Person Response by Ward.

	Returned no.	Spoiled no.	Usable no.
All Wards	600	22	578
Broadwater	142	8	134
Old Stevenage	95	4	91
Chells	105	1	104
Shephall	157	6	151
Bedwell	28	3	25
Pin Green	53	0	53
Unclassified	20	0	20

3.0.7. Characteristics of Respondents

The age and sex composition of respondents replying to questionnaires, together with the equivalent percentages from the 1966 Sample Census for Stevenage, are given in Tables 3.3. and 3.4. With the exception of the 0-4 year olds, there is a strong similarity between the figures for the survey and the Sample Census.

The number and percentage of respondents in non car and car-owning households is set out in Table 3.5. and the car ownership rate per household together with the figures for the two previous travel surveys in Stevenage and the Sample Census are shown in Table 3.6. A consistent trend in the acquisition of cars over the seven year period 1962-1969 is revealed.

Table 3.3. Age Composition of Population

Age		0-4	5-11	12-17	18-24	25-44	45-64	65+
Sample Census	1966							
	%	(13.4)	(15.9)	(10.0)	(8.9)	(32.4)	(15.6)	(3.8)
Author's Survey	1969							
	%	(7.9)	(15.9)	(10.7)	(9.3)	(34.6)	(18.0)	(3.6)
	no.	45	92	62	54	200	104	21

Table 3.4. Sex Composition of Population

		male	female	unknown	Total
Sample Census	1966				
	%	(50.6)	(49.4)	-	(100)
Author's Survey	1969				
	%	(52.5)	(47.3)	(0.4)	(100)
	no.	303	273	2	578

Table 3.5. Respondents According to Car Ownership in Household

	Unspecified	0 car	1 car	2 cars	Total
no.	1	155	372	50	578 ^f
%	(0.2)	(26.7)	(64.6)	(8.6)	(100)

Table 3.6. Respondent Households According to Car Ownership

	Bunker's Survey 1962	Claxton's Survey 1965	Sample Census 1966	Author's Survey 1969
	%	%	%	%
0 car	(52.0)	(38.6)	(38.0)	(34.0)
1 car	(45.0)	(56.6)	(56.0)	(56.5)
2 cars	(5.0)	(4.9)	(6.0)	(9.0)

These tables show that the respondent sample, though small, is fairly representative of the Stevenage population in terms of age structure, sex composition and car ownership. 55% of respondents travelled to work compared with 49% recorded in the 1969 Report of the Development Corporation (p.444).

The 43% response rate to a postal survey of the general population is encouraging, especially as no direct benefit was to be gained by completing the forms (Moser, op.cit., p.179). Two specific points should also be mentioned: Stevenage Development Corporation were not enthusiastic about the survey "in view of the number of surveys which the townspeople of Stevenage are asked to deal with from time to time" (letter to the author, dated 21st March 1969), and this may explain the low response rate of 16.5% in Bedwell, the first ward to be built, and of 28.6% in Pin Green, the subject of several recent studies. In addition, the difficulties of householders explaining the survey to all members of their family, and arranging for the questionnaires to be completed on time, may have acted as a deterrent to their completion.

3.0.8. Method of Analysis

Data on the completed questionnaires were converted to numerical codes. The staff of the Social Science Research Centre of Edinburgh University kindly co-operated by transferring the coded sheets to standard punch cards, and then processed them on an I.C.T. counter and I.C.L. tabulator.

Non-responses were excluded from the analyses since there were few, and their inclusion might have unnecessarily confused interpretations. All figures, including small samples, were recorded, although some

information about journeys of respondents in two-car households was considered too sparse to permit conclusions to be drawn. 'Ten or more' journeys and 'seven or more' accompanied journeys were treated as ten and seven respectively. For analyses of distance, the mid-point in each column was taken, i.e. 1-2 miles was taken as $1\frac{1}{2}$ miles, and 2-4 miles as 3 miles.

A dash (-) is used in the Tables to represent inapplicable data, and an asterisk (*) in place of data which is statistically unreliable, and to which obviously little validity can be attached. All calculations of percentages are shown between brackets in the Tables. The word 'recreation' and the abbreviated version 'recrtn.' is used to refer to all leisure journeys other than social visits. Data on journeys by motor-cycle are combined with journeys by moped.

3.0.9. Limitations of the Survey

In interpreting the results of this survey, the author is aware of factors affecting its accuracy and acceptability, and the important ones are noted below:

Respondents were asked to recall journeys covering the previous seven days, in order to rule out data biased in favour of weekend rather than weekday activities or vice-versa; a survey undertaken in Stevenage recorded that respondents remembered 11.9% more trips made 'yesterday' than 'the day before' (Claxton, 1970)!

Although respondents were asked to make their own assessment of distance, which would therefore not necessarily be entirely accurate, it was anticipated that the data would provide useful relationships between method of travel and distance; moreover, the author considered that 'perceived

distance' was perhaps a preferable measure to actual distance as a factor in modal choice.

Finally, multi-purpose journeys were excluded to simplify procedure, and respondents were only able to record data on journeys to and from home.

3.1. ANALYSES OF DATA: TRAVEL ACTIVITIES

Analyses of the survey were made primarily to obtain data on the travel activity of all age groups according to frequency, independence of movement, method of travel, household car ownership, and distance travelled.

3.1.1. Frequency of Journeys

With the exception of the journeys of the 0-4 years age group, and of those of the over 65 years age group, the frequency of journeys of all age groups was almost identical at eleven trips per week. There was a close similarity in the proportion of essential journeys made to school, shopping and work, and of optional journeys for leisure purposes: the frequency of the latter journeys rose steadily from early childhood until the mid-twenties; in the 18-24 years age group - the period of few familial responsibilities and of relatively high affluence - the frequency of leisure journeys was almost double the number made by the subsequent age groups.

(see Table 3.7 and Diagram 3.1).

Children in non car-owning households made about one quarter more journeys than those in car-owning households, for both school and leisure purposes. There was a close similarity between the total number of journeys of adolescents in car and in non car-owning households. People in car-owning households in the 18-24 and 45-64 years age groups made journeys much more frequently: the marked increases occurred in journeys for leisure purposes, and to a lesser extent for work journeys. The frequency of journeys of the 25-44 years age group differed only marginally.

(see Table 3.8 and Diagram 3.2).

Table 3.7. Mean Frequency of Weekly Journeys According to Age and Purpose of Journey

Purpose	0-4	5-11	12-17	18-24	25-44	45-64	65+	All Ages
work	0.0	0.0	1.3	5.3	5.5	5.9	1.9	3.7
shop	4.5	1.1	1.1	2.3	2.8	2.8	1.8	2.4
school	1.0	6.7	5.4	0.3	0.3	0.0	0.0	1.9
social	2.0	1.1	1.7	2.4	1.6	1.4	1.3	1.6
recrtn	0.7	2.2	2.1	2.3	1.3	1.3	0.3	1.5
All Purposes	8.2	11.1	11.6	12.6	11.5	11.4	5.5	11.1

Diagram 3.1. Mean Frequency of Weekly Journeys According to Age and Purpose of Journey

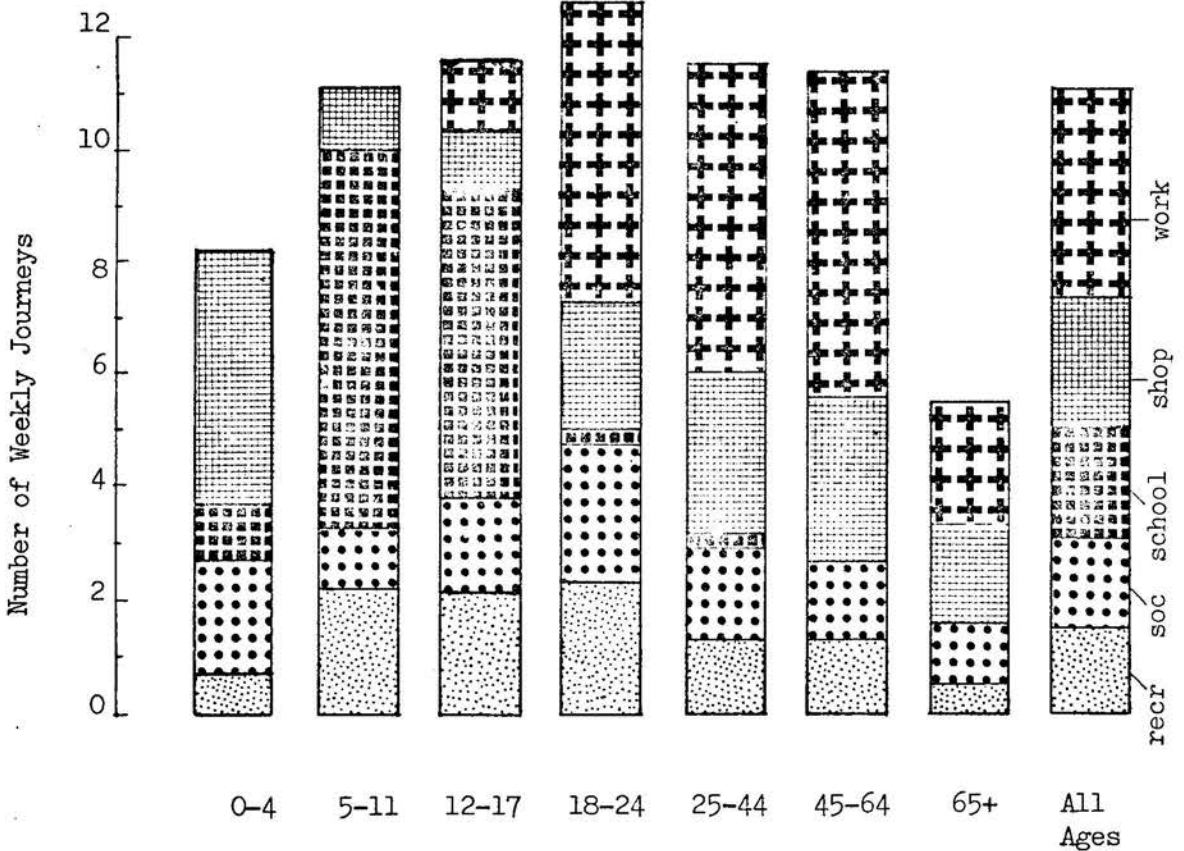
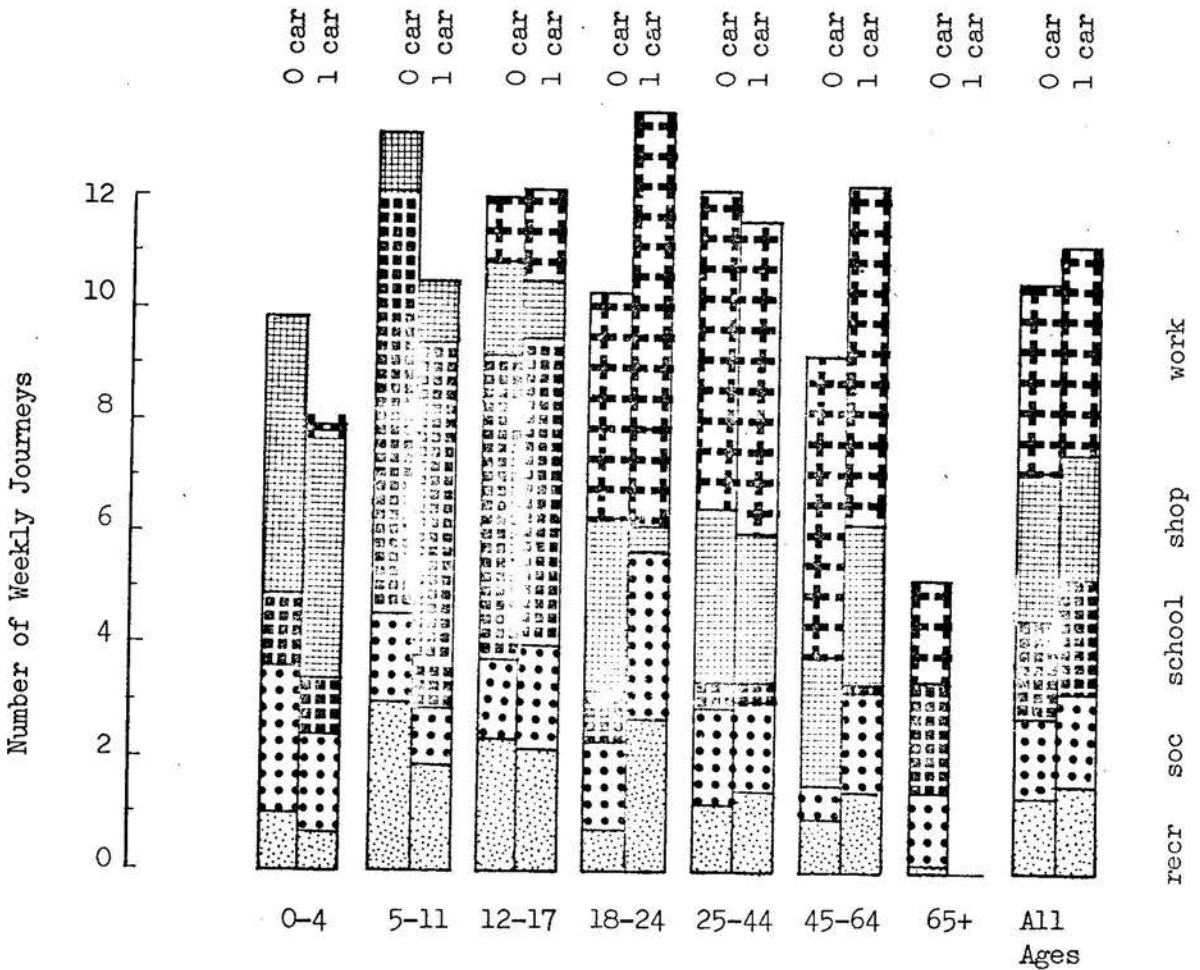


Table 3.8. Mean Frequency of Weekly Journeys According to Age, and Household Car Ownership

Purpose		0-4	5-11	12-17	18-24	25-44	45-64	65+	All Ages
work	0 car	0.0	0.0	1.5	4.1	5.7	5.4	1.7	3.4
	1 car	0.1	0.0	1.6	5.6	5.6	6.1	*	3.7
shop	0 car	5.0	1.6	1.3	3.0	3.1	2.3	2.0	2.6
	1 car	4.4	1.1	1.0	1.8	2.7	2.8	*	2.2
school	0 car	1.3	7.7	5.5	0.9	0.4	0.0	0.0	1.8
	1 car	1.0	6.5	5.5	0.4	0.3	0.1	*	2.0
social	0 car	2.6	1.6	1.4	1.6	1.7	0.6	1.3	1.4
	1 car	1.7	1.0	1.9	3.0	1.6	1.8	*	1.6
recrtn	0 car	1.0	3.0	2.3	0.7	1.2	0.9	0.1	1.3
	1 car	0.7	1.9	2.1	2.7	1.4	1.4	*	1.6
All Purposes	0 car	9.9	13.7	12.0	10.3	12.1	9.2	5.1	10.5
	1 car	7.9	10.5	12.1	13.5	11.6	12.2	*	11.2

Diagram 3.2. Mean Frequency of Weekly Journeys According to Age, and Household Car Ownership



3.1.2. Independence of Movement

The proportion of accompanied journeys varied substantially both by age group and by the purpose of journeys: the vast majority of the trips of the 0-4 years age group and all of those undertaken for leisure purposes were accompanied; three quarters of school journeys and over half the leisure journeys of the 5-11 years age group, and nearly all the journeys of adolescents were unaccompanied. In the four stages of adult life, the proportion of accompanied journeys appears to depend upon family needs: a peak was reached in the 25-44 years age group, when almost half of the journeys were accompanied, gradually declining to only one quarter of those made by elderly persons.

One seventh of work journeys, one quarter of school journeys, and just over one half of shopping journeys, were made accompanied by another member of the household. Only two fifths of the total number of journeys made by respondents were accompanied; fewer journeys for leisure purposes were accompanied than unaccompanied.

(see Table 3.9 and Diagram 3.3).

In discussing the design of the questionnaires, it was pointed out that half of the journeys were described as 'TO' and half as 'FROM' work and school. The percentage of accompanied work journeys differed little in either instance; however, in over one quarter of journeys to school, children were accompanied by another member of the household, whereas less than one fifth of them were accompanied on the journey home. The probable reason for this discrepancy is the coincidence of times of the parent travelling to work and the child to school, but not on the return journey.

(see Table 3.10).

Table 3.9. Percentage of Unaccompanied Journeys According to Age and Purpose of Journey

Purpose	0-4	5-11	12-17	18-24	25-44	45-64	65+	All Ages
	%	%	%	%	%	%	%	%
work	(0.0)	(0.0)	(90.5)	(78.8)	(85.3)	(82.4)	(100)	(84.1)
shop	(14.4)	(36.6)	(71.7)	(56.7)	(47.2)	(61.7)	(65.8)	(46.6)
school	(7.8)	(73.8)	(93.0)	(0.0)	(0.0)	(0.0)	(0.0)	(76.8)
social	(10.3)	(57.4)	(88.5)	(60.8)	(33.5)	(37.4)	(55.6)	(45.5)
recrtn	(0.0)	(51.8)	(83.3)	(76.0)	(43.2)	(50.7)	(100)	(51.1)
All Purposes	(11.0)	(63.2)	(88.5)	(70.6)	(62.7)	(67.8)	(77.8)	(60.1)

Diagram 3.3. Percentage of Unaccompanied Journeys According to Age and Purpose of Journey

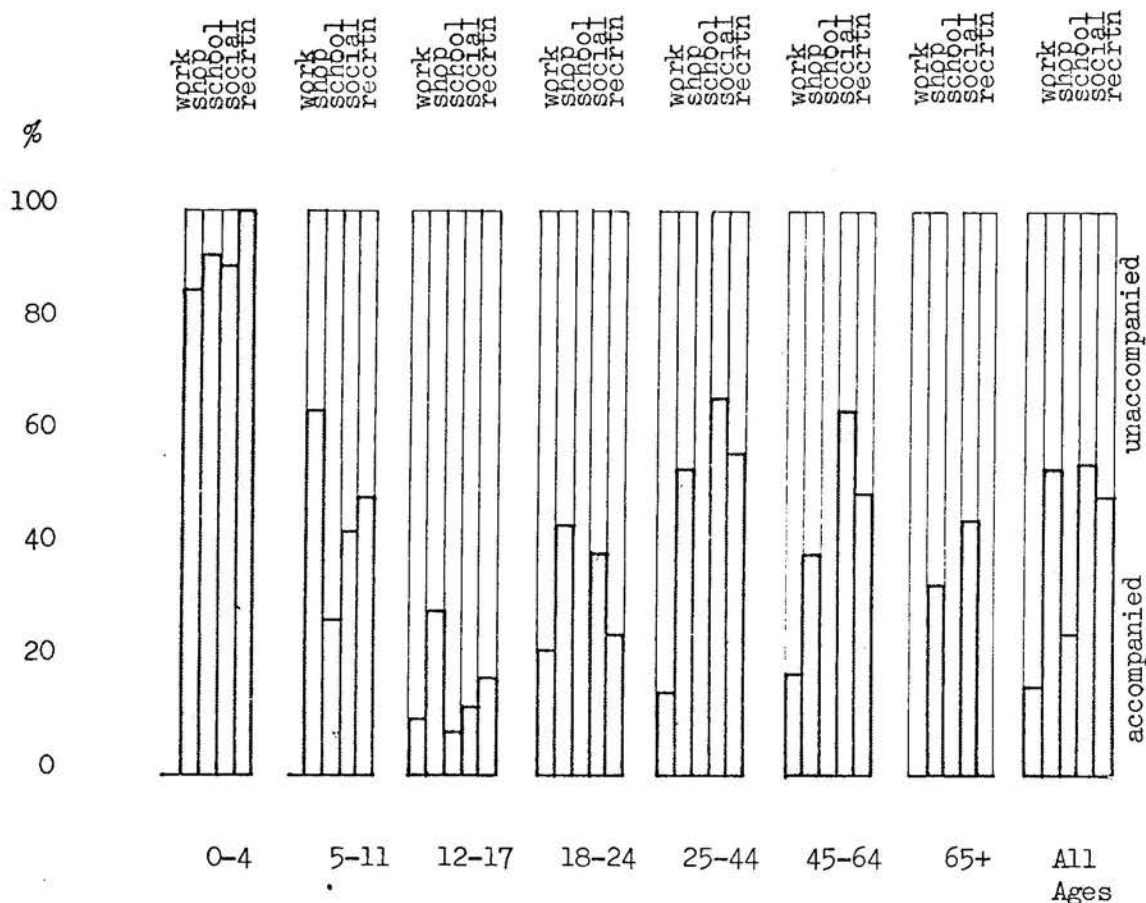


Table 3.10. Accompanied Journeys To and From Work and School

	no.	%
Journey TO work	129	(13.5)
Journey FROM work	188	(15.5)
Journey TO school	124	(27.0)
Journey FROM school	150	(18.0)

3.1.3. Method of Travel and Influence of Car Ownership

The total number of bicycle and walking journeys exceeded the total number by car; public transport was used consistently by all age groups, and for nearly all types of journeys. Approximately three quarters of the journeys of children and adolescents were made on foot or by bicycle; the number of bicycle journeys increased with age, concurrent with a decline in the number of car journeys and a rise in the use of public transport.

Bicycle and walking journeys by adults accounted for about one quarter of all their journeys, the number of car journeys for about one half, and the number of bus journeys for about one seventh. The method of travel of adults also appears to reflect the distinct family changes previously referred to: in the 18-24 years age group, there was a dramatic increase in the proportion of vehicular trips at the expense of those previously undertaken by bicycle or on foot; people between the ages of 25 and 44 years walked slightly more often, and travelled by bus less frequently than those in the previous and subsequent age groups. A high proportion of leisure journeys were by car, and a low proportion on foot. Over two fifths of the journeys of elderly persons were made by bicycle or on foot - a higher proportion than those made by car.

(see Table 3.11 and Diagrams 3.4 and 3.5).

Table 3.11. Method of Travel According to Age

		0-4	5-11	12-17	18-24	25-44	45-64	65+	All Ages
Total Sample	no. %	45 (7.8)	92 (15.9)	62 (10.7)	54 (9.3)	200 (34.6)	104 (18.0)	21 (3.6)	578 (100)
car	no. %	54 (14.5)	143 (14.0)	63 (8.8)	318 (46.5)	1123 (48.7)	706 (59.2)	22 (19.8)	2429 (37.9)
m/cycle	no. %	3 (0.8)	0 (0.0)	5 (0.7)	4 (0.6)	49 (2.2)	15 (1.3)	0 (0.0)	76 (1.2)
train	no. %	1 (0.3)	1 (0.1)	35 (4.9)	24 (3.5)	53 (2.3)	14 (1.2)	0 (0.0)	128 (2.0)
bus	no. %	27 (7.3)	80 (7.8)	116 (16.2)	155 (22.7)	348 (15.1)	235 (19.7)	19 (17.1)	980 (15.3)
cycle	no. %	1 (0.3)	103 (10.0)	204 (28.7)	42 (6.1)	161 (7.0)	97 (8.1)	20 (18.0)	630 (9.8)
walk	no. %	286 (76.8)	698 (68.1)	292 (40.7)	141 (20.6)	574 (24.7)	125 (10.5)	50 (45.1)	2166 (33.8)
All Methods	no. %	372 (5.8)	1025 (16.0)	715 (11.2)	684 (10.7)	2308 (36.0)	1192 (18.6)	111 (1.7)	6407 (100)

Diagram 3.4. Method of Travel According to Age

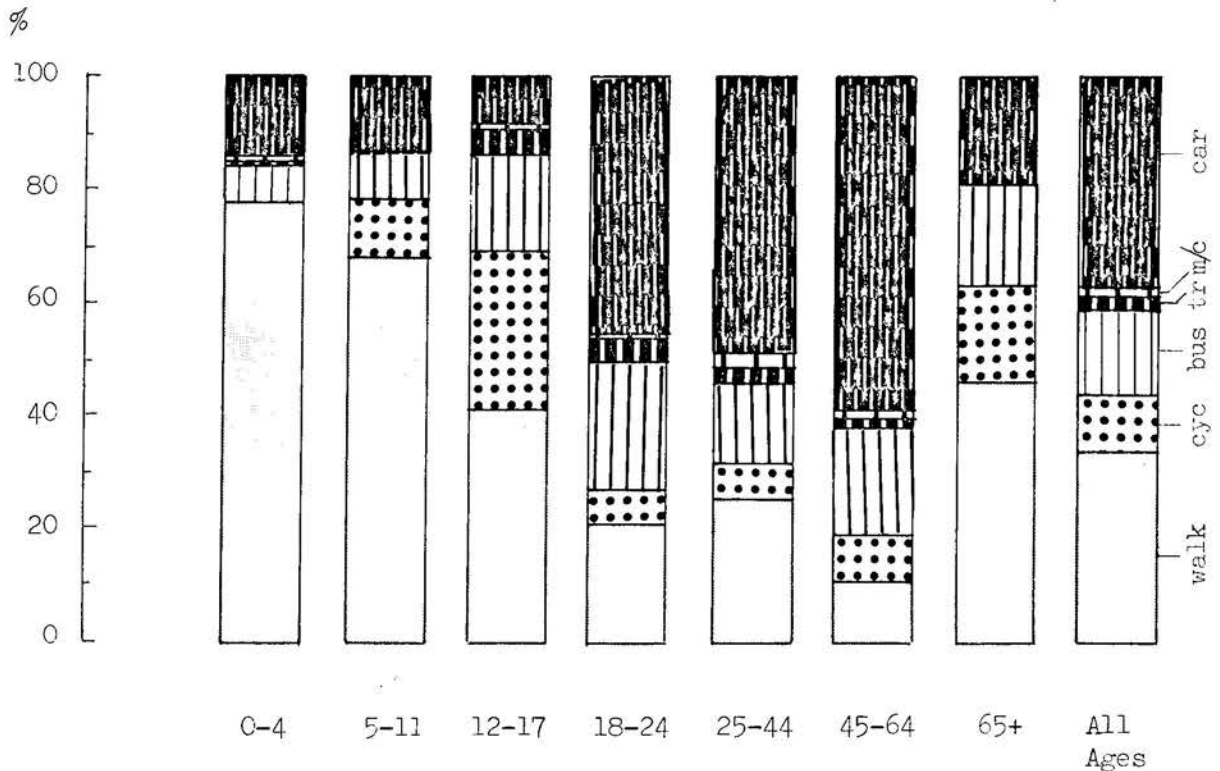
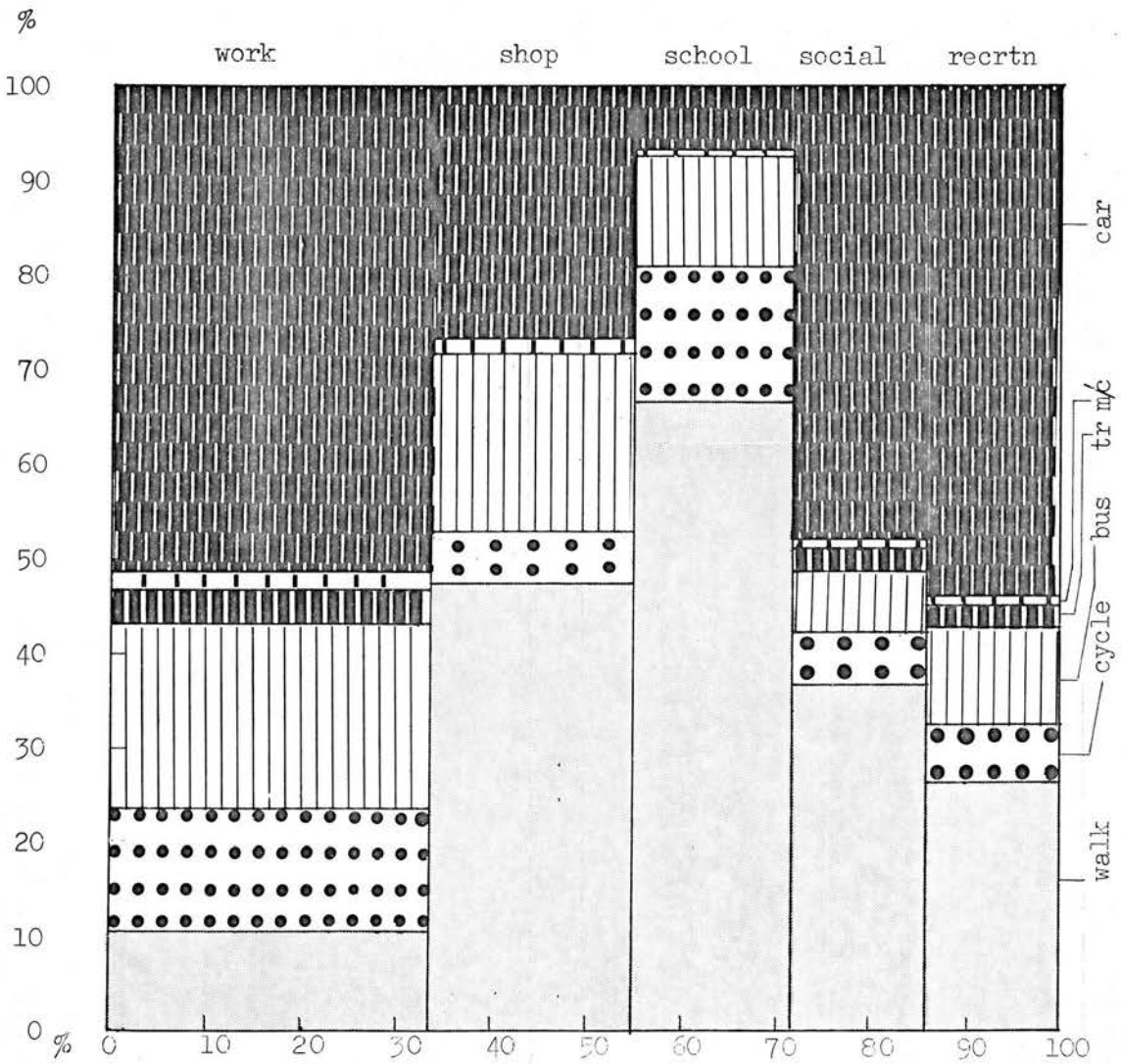


Diagram 3.5. Method of Travel According to Purpose of Journey



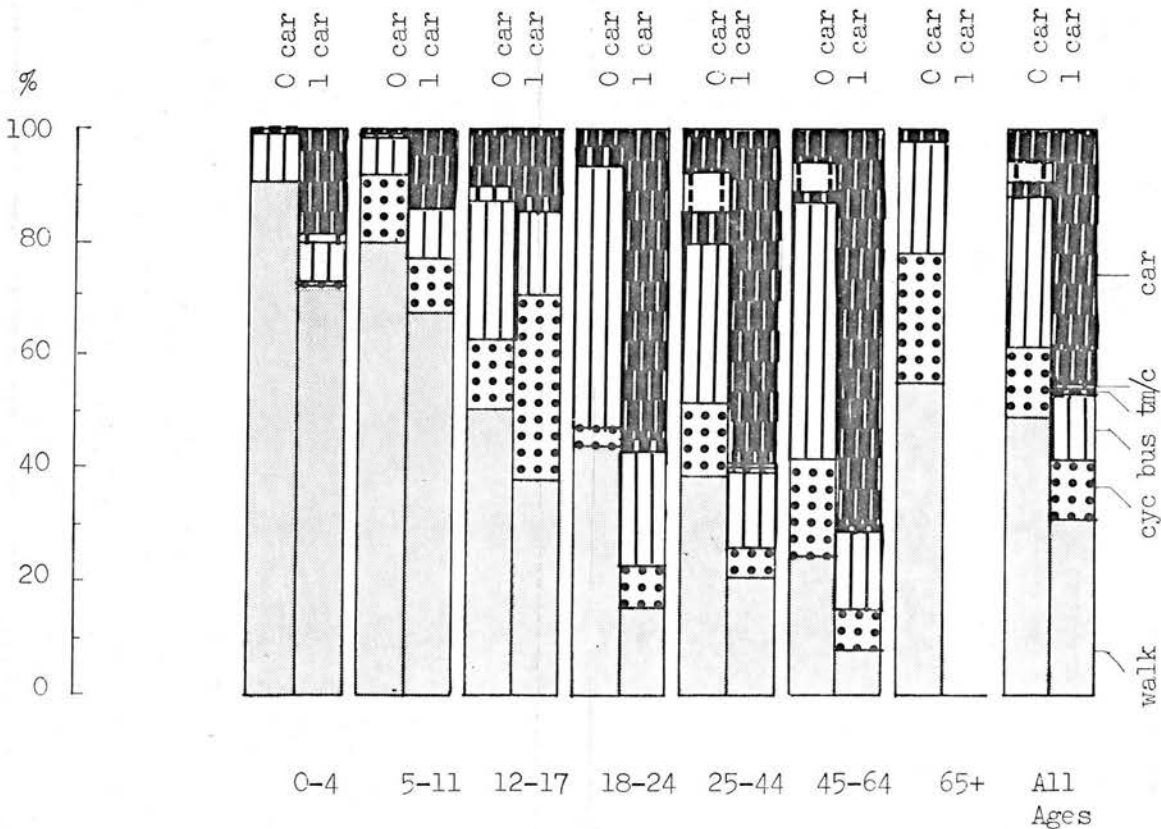
By comparing Table 3.12 and Diagram 3.6. with Table 3.8. and Diagram 3.2., which represent journey frequency, several interesting results emerge regarding journeys of persons in households with and without cars: children's method of travel for the majority of their journeys was not significantly affected by the ownership of a car within their household; however, adults made more work journeys, slightly fewer shopping journeys and far more leisure journeys; persons in households with no car made a higher proportion of journeys by all other methods of travel than persons in car-owning households.

(see Table 3.12 and Diagram 3.6).

Table 3.12. Method of Travel According to Age, and Household Car Ownership

		0-4	5-11	12-17	18-24	25-44	45-64	65+	All Ages
Total	0 car	12	21	14	12	48	30	18	155
Sample	1 car	32	64	48	30	135	62	1	372
car	0 car	(0.0)	(0.7)	(10.3)	(3.3)	(8.4)	(5.9)	(2.3)	(5.5)
	1 car	(18.3)	(14.4)	(12.4)	(56.3)	(59.3)	(70.3)	*	(45.0)
m/cycle	0 car	(0.0)	(0.0)	(3.1)	(0.0)	(7.4)	(5.5)	(0.0)	(3.9)
	1 car	(1.3)	(0.0)	(0.0)	(0.0)	(0.5)	(0.0)	*	(0.3)
train	0 car	(0.9)	(0.4)	(0.0)	(3.3)	(4.9)	(2.2)	(0.0)	(2.5)
	1 car	(0.0)	(0.0)	(2.7)	(1.8)	(1.3)	(1.1)	*	(1.2)
bus	0 car	(8.5)	(7.4)	(24.3)	(46.3)	(28.0)	(45.1)	(20.5)	(26.4)
	1 car	(7.7)	(8.9)	(14.9)	(19.1)	(12.1)	(13.9)	*	(12.4)
cycle	0 car	(0.0)	(11.9)	(12.2)	(4.2)	(13.0)	(17.3)	(22.8)	(12.4)
	1 car	(0.4)	(10.4)	(32.6)	(6.8)	(6.3)	(6.8)	*	(10.3)
walk	0 car	(90.6)	(79.6)	(50.1)	(42.9)	(38.3)	(24.0)	(54.4)	(49.3)
	1 car	(72.3)	(66.3)	(37.4)	(16.0)	(20.5)	(7.9)	*	(30.8)
All	0 car	118	286	165	121	572	273	88	1623
Methods	1 car	247	668	565	398	1548	742	*	4167

Diagram 3.6. Method of Travel According to Age, and Household Car Ownership



Male adults travelled twice as frequently to work by car as female adults: in households with no car, only one seventh of the males travelled to work by car whereas in one-car households three quarters, and in two-car households six sevenths travelled by car.

(see Table 3.13.)

Table 3.13. Method of Travel for work according to Sex and Household Car Ownership

Household Car Ownership	Male		Female	
	no.	%	no.	%
0 car	46	(15)	28	(7)
1 car	128	(72)	70	(39)
2 cars	22	(86)	13	(54)
Total for ALL Households	196	(60)	111	(32)

Half the car journeys were to work and over one third for leisure purposes; two thirds of train journeys were to work, with leisure journeys accounting for most of the remainder; the majority of bus journeys were for work and shopping trips and only one seventh were for leisure purposes; bicycle journeys were primarily to work and school, and only about one tenth were for shopping and leisure; one third of walking journeys were to school, and just under one third for shopping.

(see Table 3.14 and Diagram 3.7.)

Over three quarters of work journeys were by motorised means; just over half the shopping journeys were by bicycle or on foot; over four fifths of the school journeys were by bicycle or on foot; half of the leisure journeys were by car and only about one tenth by public transport.

(see Table 3.15 and Diagram 3.8).

Table 3.14. Purpose of Journey According to Method of Travel

Purpose		car	m/cycle	train	bus	cycle	walk	All Methods
work	no.	1083	39	80	419	287	221	2129
	%	(44.6)	(51.3)	(62.5)	(42.8)	(45.6)	(10.2)	(33.2)
shop	no.	362	24	0	270	69	654	1379
	%	(14.9)	(31.6)	(0.0)	(27.6)	(11.0)	(30.2)	(21.5)
school	no.	69	0	5	131	158	723	1086
	%	(2.8)	(0.0)	(3.9)	(13.4)	(25.1)	(33.4)	(17.0)
social	no.	440	5	22	62	53	333	915
	%	(18.1)	(6.6)	(17.2)	(6.3)	(8.4)	(15.4)	(14.3)
recretn	no.	475	8	21	98	61	235	898
	%	(19.6)	(10.5)	(16.4)	(9.9)	(9.9)	(10.8)	(14.0)
Total Journeys	no.	2429	76	128	980	630	2166	6407
	%	(100)	(100)	(100)	(100)	(100)	(100)	(100)

Diagram 3.7. Purpose of Journey According to Method of Travel

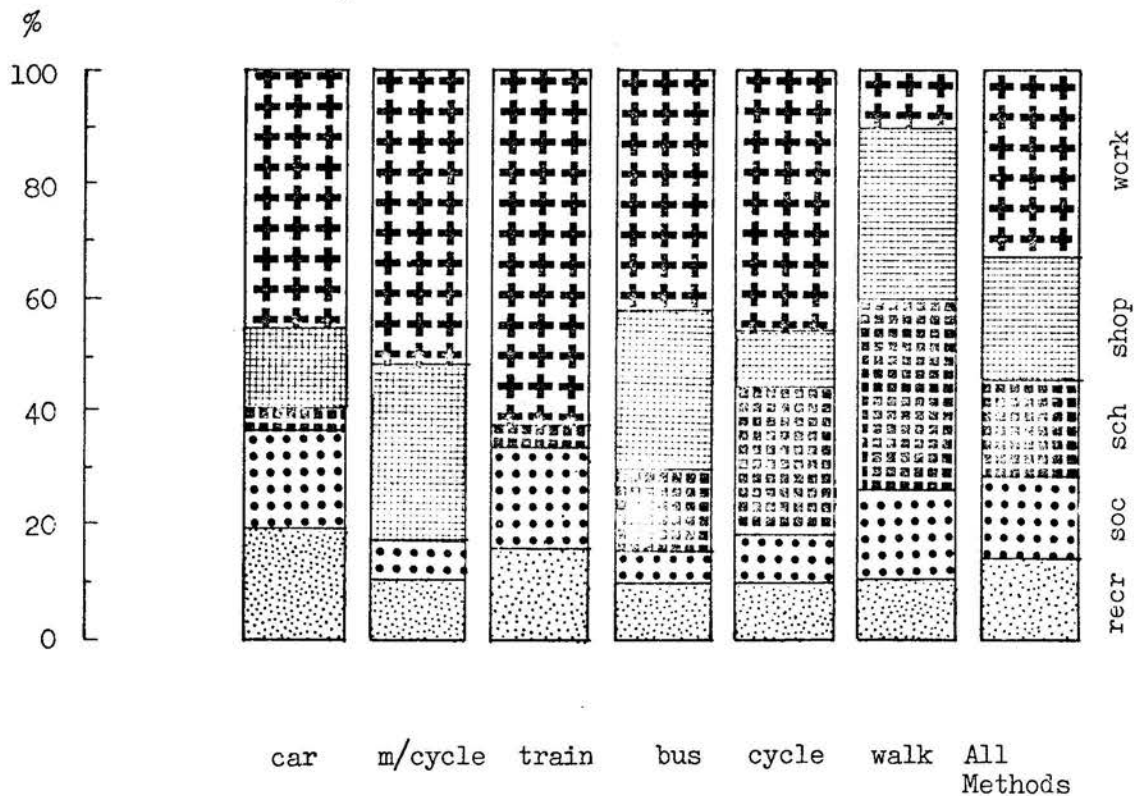
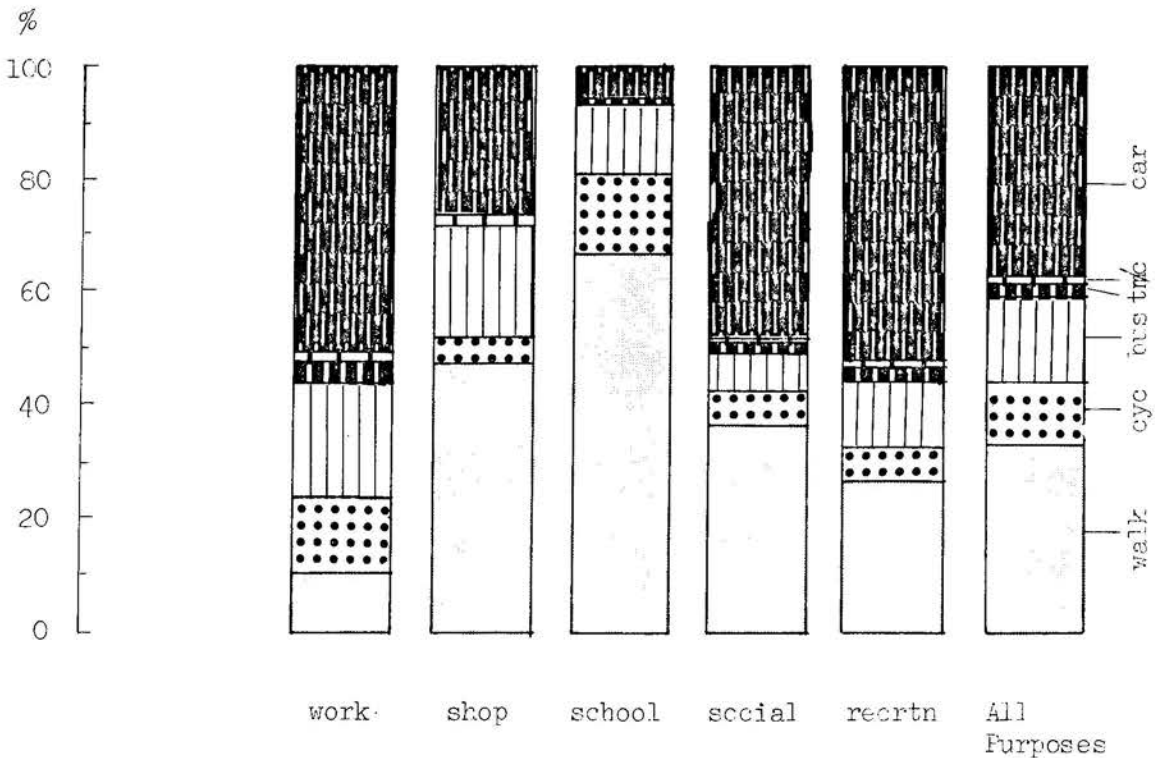


Table 3.15. Method of Travel According to Purpose of Journey

Method		work	shop	school	social	recrtn	All Purposes
car	no.	1083	362	69	440	475	2429
	%	(50.9)	(26.3)	(6.4)	(48.1)	(52.9)	(37.9)
m/cycle	no.	39	24	0	5	8	76
	%	(1.8)	(1.7)	(0.0)	(0.5)	(0.9)	(1.2)
train	no.	80	0	5	22	21	128
	%	(3.8)	(0.0)	(0.5)	(2.4)	(2.3)	(2.0)
bus	no.	419	270	131	62	98	980
	%	(19.7)	(19.6)	(12.1)	(6.8)	(10.9)	(15.3)
cycle	no.	287	69	158	53	61	630
	%	(13.5)	(5.0)	(14.5)	(5.8)	(6.8)	(9.8)
walk	no.	221	654	723	333	235	2166
	%	(10.3)	(47.4)	(66.5)	(36.4)	(26.2)	(33.8)
All Methods	no.	2129	1379	1086	915	898	6407
	%	(100)	(100)	(100)	(100)	(100)	(100)

Diagram 3.8. Method of Travel According to Purpose of Journey

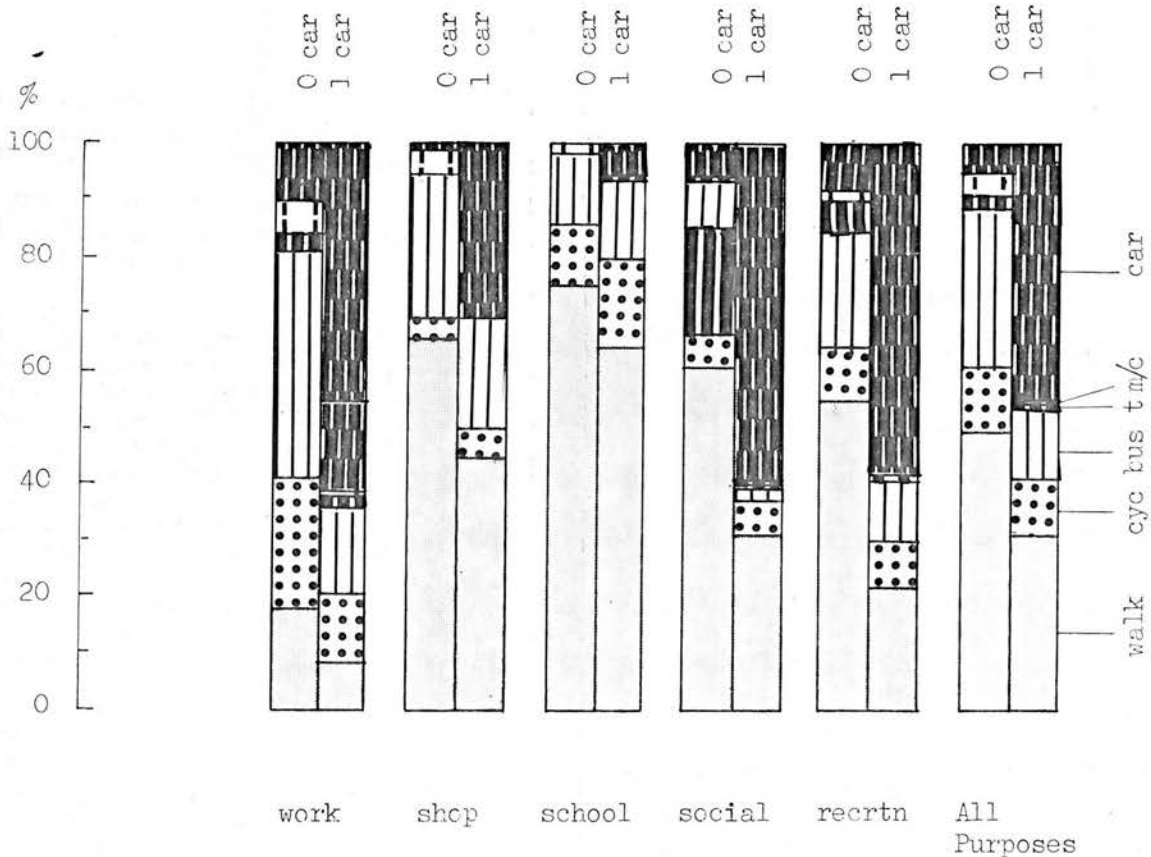


In households with one car, over three fifths of work journeys were by car, one half of shopping journeys were by bicycle or on foot, and nearly two thirds of leisure journeys were by car. In households with no car, over two fifths of work journeys were by bicycle or on foot, and two fifths by bus; over two thirds of shopping journeys were by bicycle or on foot; nearly two thirds of leisure journeys were by bicycle or on foot. The method of travel for school journeys did not vary significantly between one car and non car-owning households. (see Table 3.16 and Diagram 3.9).

Table 3.16. Method of Travel According to Purpose of Journey and Household Car Ownership

Method		work %	shop %	school %	social %	recretn %	All Purposes %
car	0 car	(10.2)	(1.0)	(0.0)	(6.4)	(8.6)	(5.5)
	1 car	(62.0)	(31.0)	(6.3)	(59.0)	(58.8)	(45.0)
m/cycle	0 car	(6.1)	(4.8)	(1.8)	(0.5)	(2.6)	(3.9)
	1 car	(0.6)	(0.0)	(0.0)	(0.5)	(0.0)	(0.3)
train	0 car	(2.9)	(0.0)	(0.0)	(7.3)	(4.6)	(2.5)
	1 car	(2.6)	(0.0)	(0.7)	(0.4)	(1.4)	(1.2)
bus	0 car	(39.7)	(24.6)	(12.7)	(19.7)	(20.7)	(26.4)
	1 car	(14.2)	(19.0)	(13.2)	(2.7)	(9.9)	(12.4)
cycle	0 car	(23.5)	(4.6)	(10.9)	(5.1)	(8.1)	(12.4)
	1 car	(11.9)	(6.0)	(16.8)	(6.4)	(7.7)	(10.3)
walk	0 car	(17.6)	(65.0)	(74.6)	(61.0)	(55.4)	(49.3)
	1 car	(8.7)	(44.0)	(63.0)	(31.0)	(21.2)	(30.8)
Total	0 car	(100)	(100)	(100)	(100)	(100)	(100)
No.		532	397	277	219	198	1623
Journeys	1 car	(100)	(100)	(100)	(100)	(100)	(100)
		1370	837	762	607	590	4167

Diagram 3.9. Method of Travel According to Purpose of Journey and Household Car Ownership



3.1.4. Comparison with Earlier Surveys

Trends in methods of travel may be detected by comparing data in two Stevenage surveys: Bunker's in 1962, and the author's in 1969. In the seven year period covered by the surveys, the proportion of car journeys has risen substantially at the expense of motor-cycles, cycle and walking journeys, and the proportion of bus journeys has risen slightly. (see Table 3.17).

Table 3.17. Method of Travel in Two Stevenage Surveys

Method	Bunker's Survey 1962		Author's Survey 1969	
	no.	%	no.	%
car	33,767	(28.1)	2,429	(37.9)
m/cycle	5,722	(4.8)	76	(1.2)
bus	16,610	(13.8)	980	(15.3)
train	1,343	(1.1)	128	(2.0)
cycle	15,071	(13.4)	630	(9.8)
walk	48,232	(38.5)	2,166	(33.8)
unspecified	475	(0.4)	-	(-)
Total	129,220	(100)	6,407	(100)

The main point of interest in a comparison of the purposes of journeys is the decline in the proportion of work journeys in favour of those for shopping and leisure purposes. This appears to confirm the difference in travel activity resulting from household car ownership. (see Table 3.18).

Table 3.18. Purpose of Journey in Two Stevenage Surveys

Purpose	Bunker's Survey 1962		Author's Survey 1969	
	no.	%	no.	%
work	25,800	(40.7)	2,129	(33.2)
shops	11,340	(17.9)	1,379	(21.5)
school	13,000	(20.5)	1,086	(17.0)
recrtn	13,259	(20.9)	1,813	(28.3)
Total	63,399	(100)	6,407	(100)

N.B. The calculations shown for the 1962 Survey have been determined from the comparable types of journeys, but include a correction, suggested by Bunker (1967, p.217) for both work and school journeys, in view of the time of year in which his survey was made.

More detailed trends can be noted by comparing the changes in method of travel for different types of journey in Bunker's survey in 1962, the Development Corporation's survey in 1966, and the author's in 1969. Over the seven year period, there was a substantial increase in the proportion of car trips, and decline in the proportion of those by motor-cycle, cycle and walking; there was a small increase in the proportion of walking trips; there was a very large increase in the proportion of car trips for leisure purposes, and decline in the proportion of trips by all other methods. (see Table 3.19).

3.1.5. Method of Travel within Stevenage

A comparison of Table 3.20 and Diagrams 3.10 and 3.11, representing journeys within Stevenage, with Table 3.15 and Diagrams 3.5 and 3.8, representing all journeys within and outside Stevenage, reveals that there was a decline in the proportion of all work and leisure journeys from three fifths of the total journeys to just over one half of those only within Stevenage; only a very small proportion of school and shopping journeys were to destinations outside Stevenage. There was a decline in the proportion of all journeys by car from two fifths to just over one quarter of those only within Stevenage, and a decline in the proportion of all work journeys from half to two fifths of those only within Stevenage (38% recorded in the 1966 Sample Census, p.496, Table 17); there was also a decline in the proportion of all leisure journeys from half to less than one third only within Stevenage.

Table 3.19. Method of Travel according to Purpose of Journey.

Travel Survey	Bunker's Survey 1962		Claxton's Survey 1966		Author's Survey 1969	
	no.	%	no.	%	no.	%
Work Journey						
car	8946	(39.5)	1348	(48.8)	1083	(50.9)
m/cycle	1880	(8.3)	150	(5.4)	39	(1.8)
bus	3755	(16.6)	524	(19.0)	419	(19.7)
train	420	(1.8)	52	(1.9)	80	(3.8)
cycle	4581	(20.2)	278	(10.2)	287	(13.5)
walk	3063	(13.5)	409	(14.8)	221	(10.3)
unspecified	50	(0.2)	-	-	-	-
Total	22695	(100)	2761	(100)	2129	(100)
Shopping Journey (Saturday only)						
car	1616	(14.3)	724	(39.5)	362	(26.3)
m/cycle	178	(1.6)	-	-	24	(1.7)
bus	1795	(15.8)	313	(17.0)	270	(19.6)
train	13	(0.1)	-	-	5	(0.5)
cycle	970	(8.6)	-	-	60	(5.0)
walk	6730	(59.3)	799	(43.5)	654	(47.4)
unspecified	38	(0.3)	-	-	-	-
Total	11340	(100)	1836	(100)	1379	(100)
School Journey						
car	225	(3.0)	71	(4.9)	69	(6.4)
m/cycle	-	-	2	(0.1)	-	-
bus	750	(10.0)	180	(12.3)	133	(12.1)
train	-	-	13	(0.9)	5	(0.5)
cycle	900	(12.0)	162	(11.0)	158	(14.5)
walk	5650	(75.0)	1041	(70.8)	723	(66.5)
unspecified	-	-	-	-	-	-
Total	7525	(100)	1469	(100)	1086	(100)
Leisure Journey						
car	3909	(30.7)			915	(50.4)
m/cycle	639	(5.2)			13	(0.7)
bus	1368	(10.7)			160	(8.7)
train	194	(1.5)		not available	43	(2.4)
cycle	1310	(10.3)			114	(6.3)
walk	5314	(41.7)			568	(31.3)
unspecified	-	-			-	-
Total	12743	(100)			2313	(100)

All train journeys were to destinations outside Stevenage since there is no intra-urban service; only a small proportion of bus journeys were to destinations outside Stevenage. With the exception of a few work journeys, all bicycle journeys were to destinations within Stevenage; there was a substantial increase in the proportion of journeys on foot from one third of all journeys to over two fifths of those made only within Stevenage.

(see Table 3.20 and Diagrams 3.10 and 3.11).

Table 3.20. Method of Travel within Stevenage According to Purpose of Journey

Method		work	shop	school	social	recrtn	All Purposes
car	no.	639	313	67	174	201	1394
	%	(42.4)	(24.4)	(6.4)	(27.6)	(34.1)	(27.5)
m/cycle	no.	29	17	5	3	2	56
	%	(1.9)	(1.3)	(0.5)	(0.5)	(0.3)	(1.1)
train	no.	0	0	0	0	0	0
	%	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
bus	no.	382	242	96	70	96	885
	%	(25.3)	(18.8)	(9.2)	(11.1)	(16.2)	(17.5)
cycle	no.	245	69	158	53	61	586
	%	(16.3)	(5.4)	(15.1)	(8.4)	(10.2)	(11.6)
walk	no.	213	644	721	331	231	2140
	%	(14.1)	(50.1)	(68.8)	(52.4)	(39.2)	(42.3)
Total Journeys	no.	1507	1285	1047	631	591	5061
	%	(100)	(100)	(100)	(100)	(100)	(100)

Diagram 3.10. Method of Travel within Stevenage According to Purpose of Journey

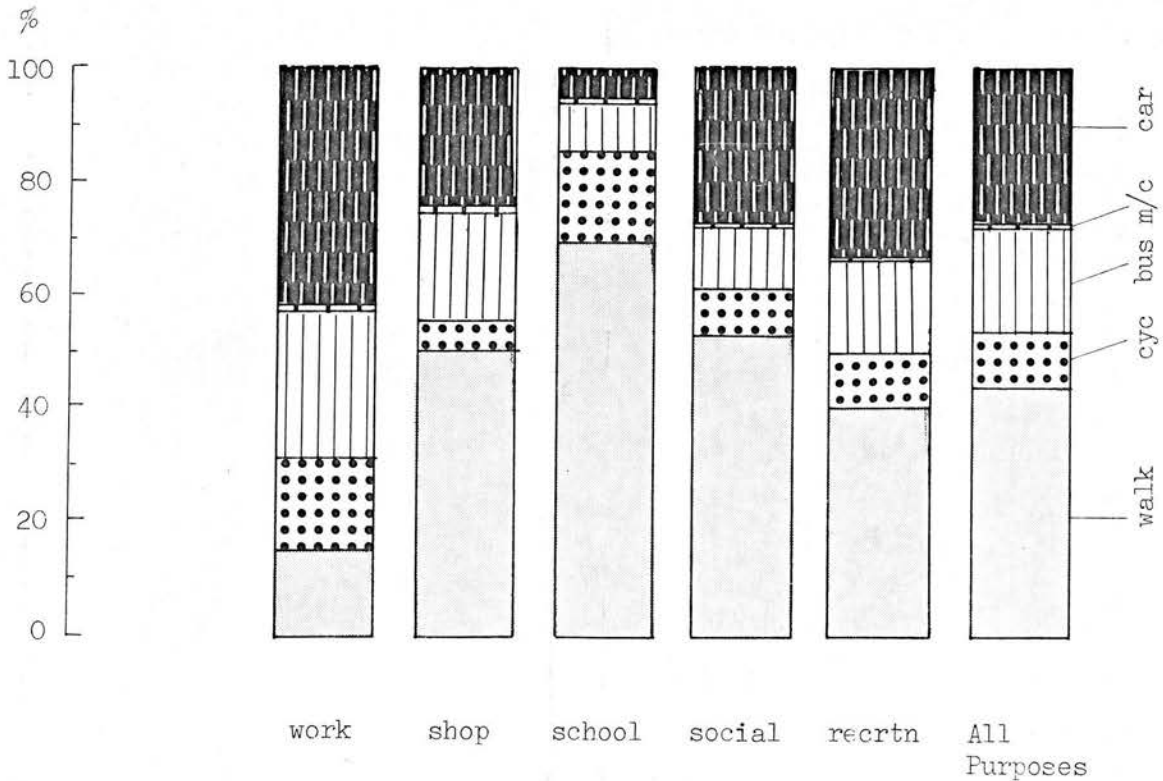
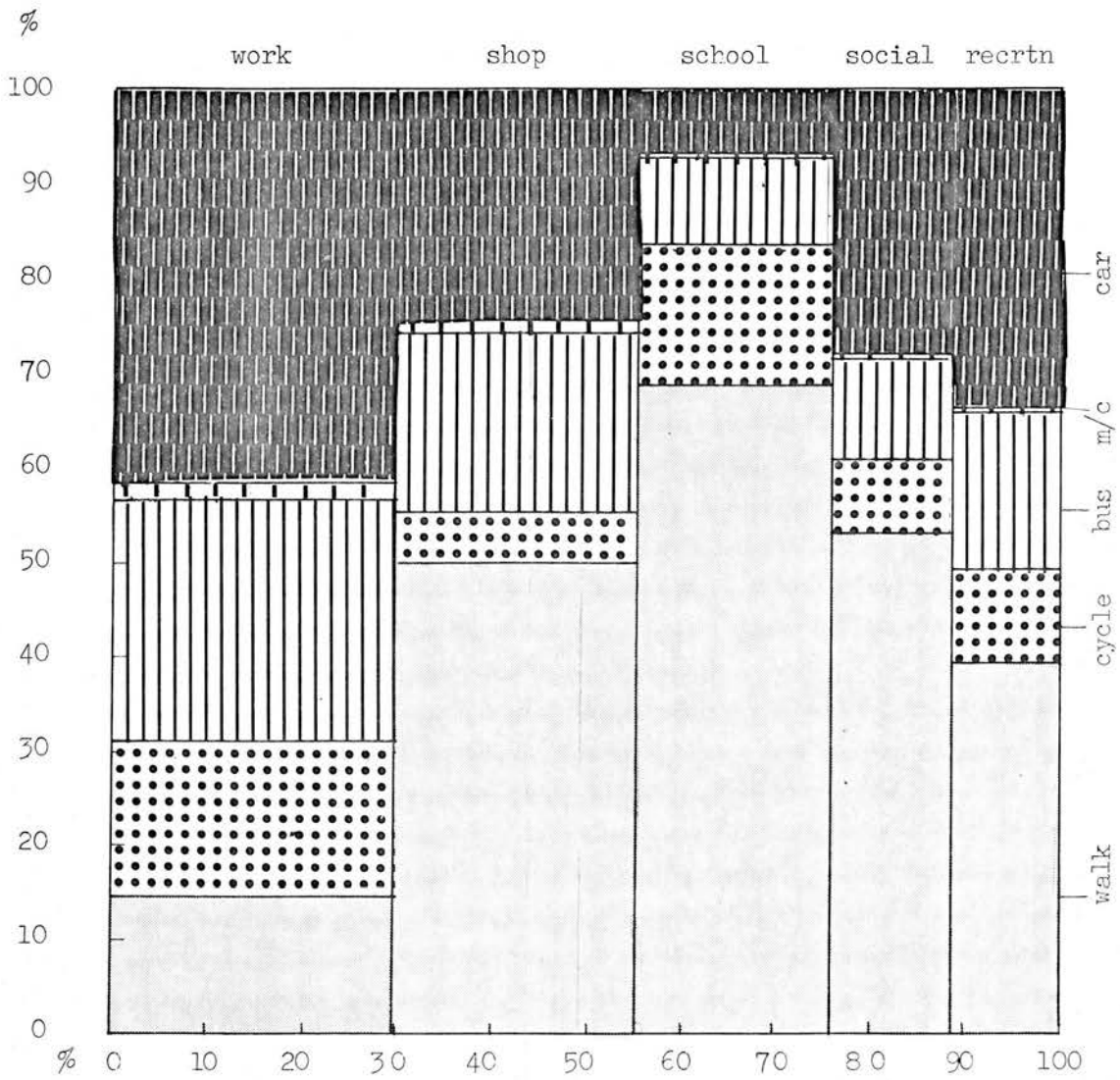


Diagram 3.11. Method of Travel According to Purpose of Journey in Stevenage



3.1.6. Distance and Travel Time

Analyses were made to establish the relationship between distance and time spent travelling, and method of travel, purpose of journey and car ownership.

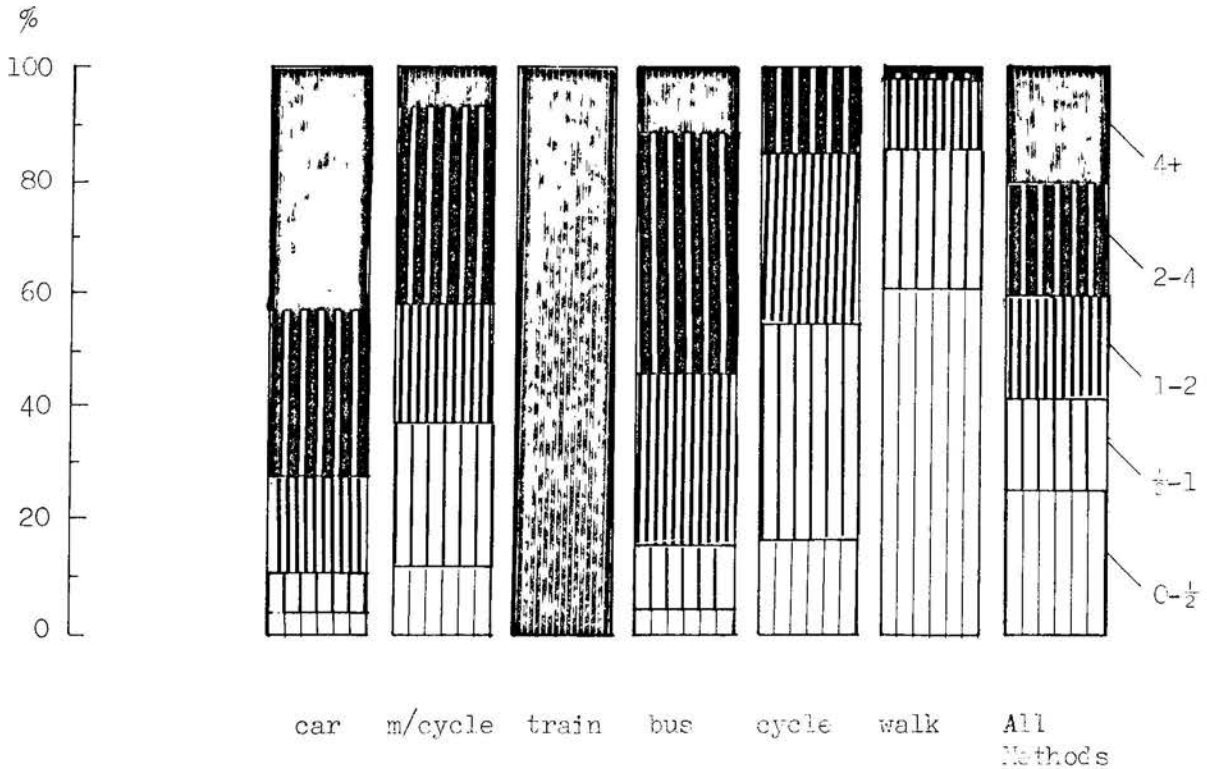
Cars were used primarily for longer journeys - only one tenth of the total were to destinations within one mile, and only one thirtieth within half a mile; all train journeys were to destinations between a radius of one and four miles; four fifths of bicycle journeys were to destinations within two miles; over three fifths of journeys on foot were to destinations within half a mile, and nearly nine tenths within one mile.

(see Table 3.21 and Diagram 3.12).

Table 3.21. Typical Distances Travelled According to Method of Travel

Distance in Miles		car	m/cycle	train	bus	cycle	walk	All Methods
4+	no.	1041	4	111	116	0	11	1283
	%	(42.6)	(6.8)	(100.)	(11.6)	(0.0)	(0.5)	(20.2)
2-4	no.	720	22	-	436	95	25	1298
	%	(29.7)	(35.6)	-	(43.6)	(16.2)	(1.2)	(20.3)
1-2	no.	425	12	-	296	176	269	1178
	%	(17.5)	(20.9)	-	(29.6)	(30.1)	(12.5)	(18.7)
$\frac{1}{2}$ -1	no.	164	15	-	114	219	533	1045
	%	(6.7)	(25.1)	-	(11.5)	(37.4)	(24.8)	(16.6)
0- $\frac{1}{2}$	no.	85	7	-	39	96	1313	1540
	%	(3.5)	(11.6)	-	(3.8)	(16.3)	(61.0)	(24.2)

Diagram 3.12. Typical Distances Travelled According to Method of Travel



Mean distances travelled by alternative methods of travel to destinations within Stevenage demonstrate a steady increase in miles corresponding to the change in method of travel from walking to bicycle to motorised transport.

(see Table 3.22).

Table 3.22. Mean Distances Travelled for Journeys within Stevenage

	car	m/cycle	bus	cycle	walk	All Methods
Miles	2.1	1.7	2.0	1.3	0.6	1.3

The typical distance covered for all methods of travel reflects a rate of decline in the proportion of journeys as distance increased: one quarter of all journeys were to destinations within half a mile, two fifths within one mile, three fifths within two miles, and four fifths within four miles; the remaining fifth were to destinations outside Stevenage. Excluding school journeys, less than one third of journeys were to destinations within one mile of home.

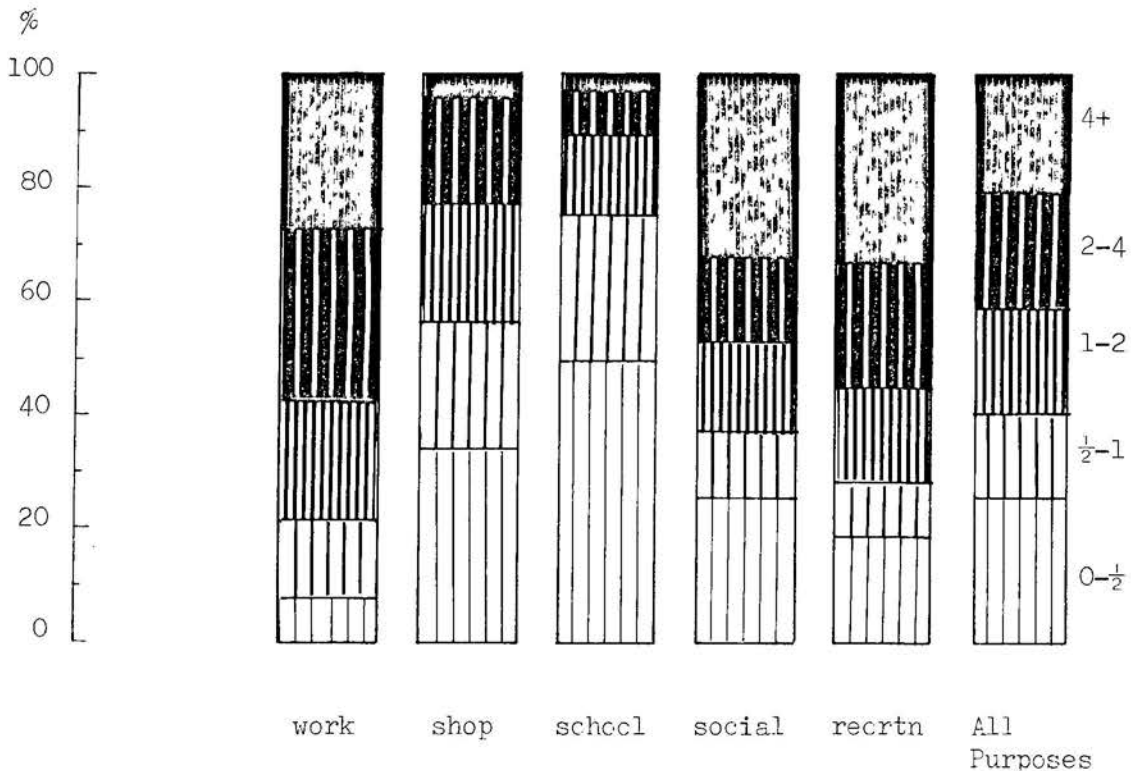
Three quarters of work journeys were to destinations within the town; only one fifth were within a one mile radius of home, and just over two fifths within a two mile radius. More than half the shopping journeys were to destinations within one mile of home, probably to neighbourhood centres; a further two fifths did not exceed four miles. Over three quarters of school journeys were to destinations within one mile of home, and over nine tenths did not exceed two miles. Over one third of leisure journeys were to destinations outside Stevenage, primarily due to the considerable use of cars in car-owning households.

(see Table 3.23 and Diagram 3.13).

Table 3.23. Typical Distances Travelled According to Purpose of Journey

Distance in Miles		work	shop	school	social	recrtn	All Purpses
4+	no.	576	63	36	303	305	1283
	%	(27.8)	(4.7)	(3.3)	(32.4)	(33.6)	(20.2)
2-4	no.	632	246	77	141	202	1298
	%	(29.0)	(18.2)	(7.1)	(15.1)	(22.3)	(20.3)
1-2	no.	434	294	154	146	140	1178
	%	(22.4)	(21.8)	(14.2)	(15.6)	(16.2)	(18.7)
$\frac{1}{2}$ -1	no.	283	289	282	114	77	1045
	%	(13.7)	(21.4)	(26.1)	(12.2)	(7.8)	(16.6)
0- $\frac{1}{2}$	no.	148	456	534	230	172	1540
	%	(7.1)	(33.9)	(49.3)	(24.7)	(19.0)	(24.2)
Total Journeys	no.	2073	1348	1083	934	906	6344
	%	(100)	(100)	(100)	(100)	(100)	(100)

Diagram 3.13. Typical Distances Travelled According to Purpose of Journey



Mean distances cited by respondents for journeys to work and school are almost identical to those measured in the 1965 Stevenage Travel Survey, giving further confidence in the use of their estimate of distances travelled for all purposes.

(see Table 3.24)

Table 3.24. Comparison of Mean Distances Travelled Within Stevenage According to Purpose of Journey in Two Surveys

	Distance in Miles					All Purposes
	work	shop	school	social	recrtn	
Claxton's Survey 1966	1.8	-	0.8	-	-	-
Author's Survey 1969	1.9	1.2	0.8	1.2	1.6	1.3

A more detailed examination was made of the influence of the car on length of journeys: the mean distance travelled by respondents in car-owning households on all journeys within Stevenage, excepting those for school, was about one third of a mile longer than that by respondents in non car-owning households.

(see Table 3.25)

Table 3.25. Mean Distances Travelled Within Stevenage According to Household Car Ownership and Purpose of Journey

	Distance in Miles					All Purposes
	work	shop	school	social	recrtn	
Non Car Households	1.6	1.0	0.8	1.2	1.5	1.2
Car Households	1.9	1.4	0.8	1.5	1.7	1.5

The main function of the car in extending the range of travel opportunity can be seen from the proportion of all journeys made to destinations outside Stevenage, by persons in car-owning households; this represents a far greater percentage than that made by persons in non car-owning households.

(see Table 3.26).

Table 3.26. Percentage of Total Journeys Made Outside Stevenage According to Household Car Ownership

Car Ownership		work	shop	school	social	recrtn	All Purposes
Non Car Households	%	(13)	(1)	(2)	(21)	(16)	(11)
Car Households	%	(33)	(6)	(5)	(40)	(42)	(27)

There is strong evidence from the analysis of typical distances travelled to conclude that car ownership significantly influences the length and purpose of trips. The main difference in typical distances travelled by those in non car and in car-owning households occurred in journeys outside Stevenage: about one ninth were cited by people in non car-owning households, whereas about one third were cited by people in car-owning households. The most pronounced difference can be seen in typical distances travelled for leisure purposes.

(see Table 3.27 and Diagram 3.14).

Diagram 3.14. Typical Distances Travelled According to Purpose of Journey and Household Car Ownership

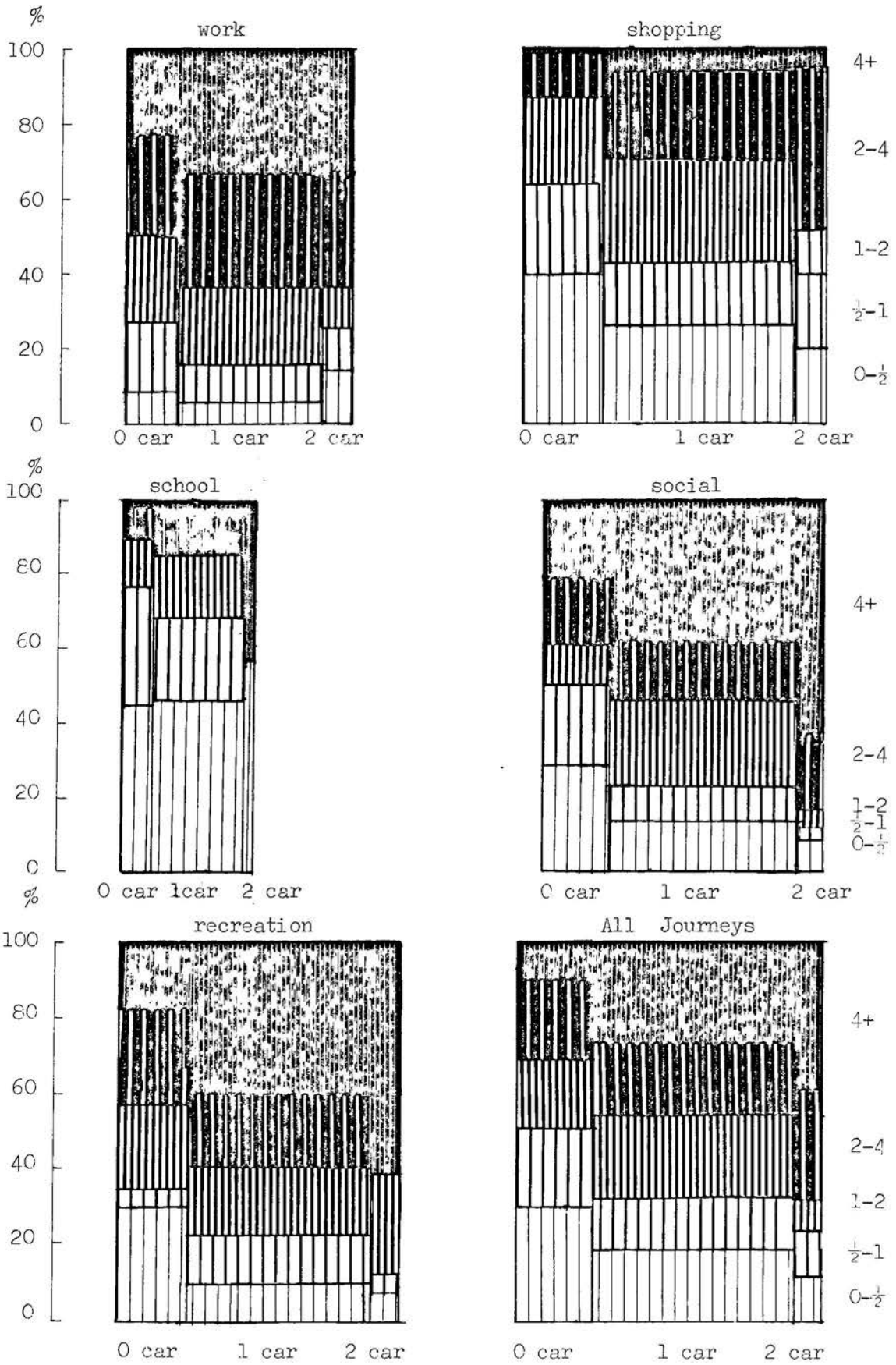


Table 3.27. Typical Distances Travelled According to Purpose of Journey and Household Car Ownership

Distance in Miles		0- $\frac{1}{2}$	$\frac{1}{2}$ -1	1-2	2-4	4+	All Respondents
work	0 car	no. (6	20	17	19	9	71
		% (8.5)	(28.2)	(23.0)	(26.8)	(12.6)	(100)
	1 car	no. 11	19	43	57	64	194
		% (5.7)	(9.8)	(22.2)	(29.3)	(33.0)	(100)
	2 car	no. 5	4	4	11	11	35
		% (14.3)	(11.4)	(11.5)	(31.4)	(31.4)	(100)
shop	0 car	no. 42	25	24	13	1	105
		% (40.0)	(23.8)	(22.9)	(12.4)	(0.9)	(100)
	1 car	no. 69	42	72	60	16	259
		% (26.6)	(16.2)	(27.8)	(23.2)	(6.2)	(100)
	2 car	no. 8	8	5	17	2	40
		% (20.0)	(20.0)	(12.5)	(42.5)	(5.0)	(100)
school	0 car	no. 19	13	6	3	1	42
		% (45.2)	(31.0)	(14.3)	(7.1)	(2.4)	(100)
	1 car	no. 58	26	22	11	7	124
		% (46.8)	(21.0)	(17.7)	(8.9)	(5.6)	(100)
	2 car	no. 4	3	*	*	*	7
		% (57.1)	(42.9)	*	*	*	(100)
social	0 car	no. 26	20	10	16	19	91
		% (28.6)	(22.0)	(11.0)	(17.6)	(20.8)	(100)
	1 car	no. 35	24	59	37	91	246
		% (14.2)	(9.8)	(24.0)	(15.0)	(37.0)	(100)
	2 car	no. 3	1	2	7	22	35
		% (8.6)	(2.9)	(5.7)	(20.0)	(62.8)	(100)
recretn	0 car	no. 27	4	19	22	14	86
		% (31.4)	(4.7)	(22.1)	(25.6)	(16.2)	(100)
	1 car	no. 25	32	43	49	94	243
		% (10.3)	(13.2)	(17.7)	(20.2)	(38.6)	(100)
	2 car	no. *	3	2	11	24	40
		% *	(7.5)	(5.0)	(27.5)	(60.0)	(100)
All Purposes	0 car	no. 120	82	76	73	44	395
		% (30.4)	(20.8)	(19.2)	(18.5)	(11.1)	(100)
	1 car	no. 198	143	239	214	272	1056
		% (18.6)	(13.4)	(22.4)	(20.1)	(25.6)	(100)
	2 car	no. 20	19	13	46	59	157
		% (12.7)	(12.1)	(8.3)	(29.3)	(37.6)	(100)

It is interesting to note that, whilst men travelled to work by car far more frequently than women (see Table 3.13), women generally travelled shorter distances; only one eighth of women travelled to work outside Stevenage, compared with over one third of men.

(see Table 3.28)

Table 3.28. Work Journeys According to Sex and Typical Distance Travelled

Distance in Miles		0- $\frac{1}{2}$	$\frac{1}{2}$ -1	1-2	2-4	4+	Total
male	no.	6	22	38	56	70	192
	%	(3.1)	(11.5)	(19.8)	(29.2)	(36.4)	(100)
female	no.	16	21	26	31	14	108
	%	(14.8)	(19.4)	(24.1)	(28.7)	(13.0)	(100)

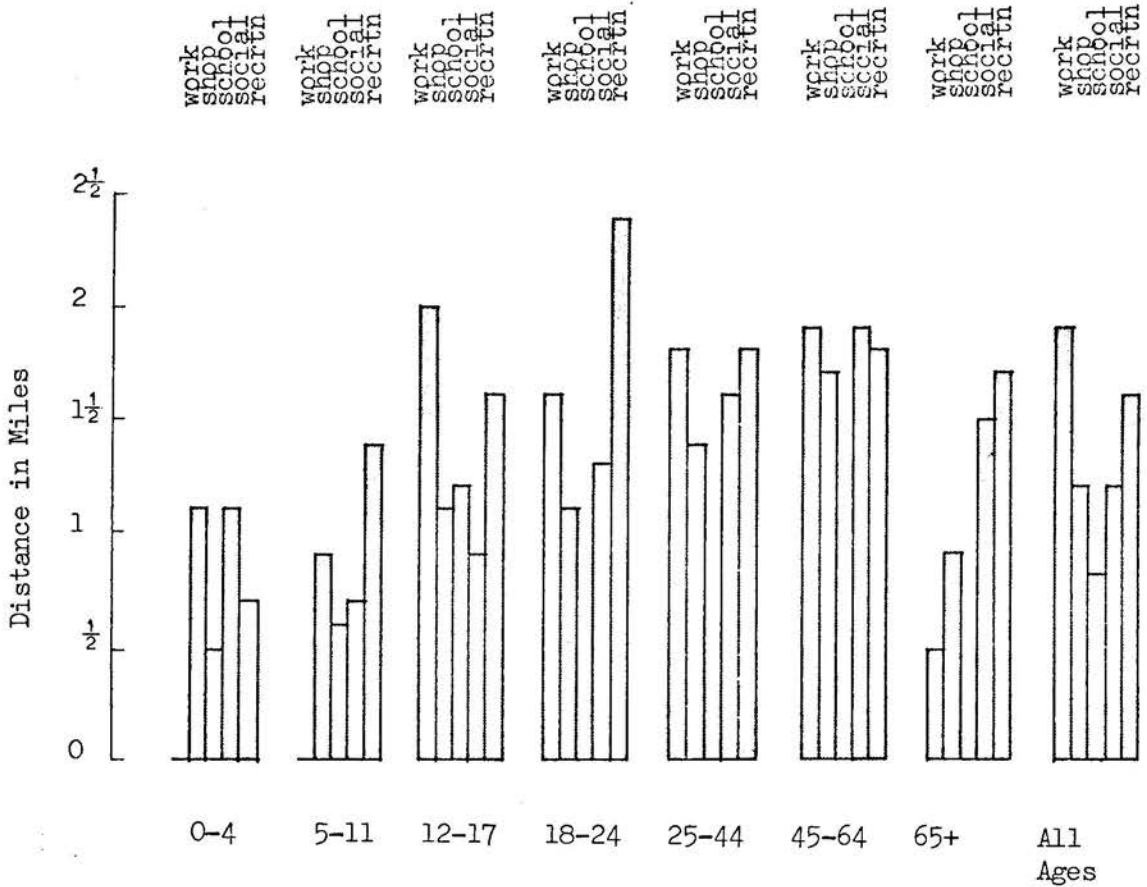
A consistent increase in the mean distance travelled for most journeys, up to the age of retirement was recorded; there was a particularly sharp rise in the mean distance travelled for leisure purposes.

(see Table 3.29 and Diagram 3.15).

Table 3.29. Mean Distances Travelled within Stevenage According to Age and Purpose of Journey

Purpose	0-4	5-11	12-17	18-24	25-44	45-64	65+	All Ages
work	-	-	2.0	1.6	1.8	1.9	0.5	1.9
shop	1.1	0.9	1.1	1.1	1.4	1.7	0.9	1.2
school	0.5	0.6	1.2	*	*	-	-	0.8
social	1.1	0.7	0.9	1.3	1.6	1.9	1.5	1.2
recrtn	0.7	1.4	1.6	2.4	1.8	1.8	1.7	1.6

Diagram 3.15. Mean Distances Travelled within Stevenage According to Age and Purpose of Journey



Analyses of mean round trip times for journeys within Stevenage were made to correlate age and car ownership with travel activities. The mean time taken was calculated from survey data on distances travelled, and is based on speeds by each method of travel in Stevenage recorded in a recent survey; these are detailed in Appendix 3.F. The table of travel time according to distance, method of travel and purpose of journey, which was employed for these analyses is set out in Appendix 3.G.

There was a fairly consistent, though surprisingly small reduction in the travel times of people in two car households as compared with those in one car and in no car households. The greatest travel time per trip was spent by the 18-24 years age group, and the least by elderly persons. The mean round trip by all respondents, irrespective of car ownership, was twenty two minutes.

Journeys for recreation and work occupied the most time in households with and without cars; in all households, journeys for social purposes were the least time consuming. The most marked difference in travel times of persons in households with and without cars occurred with journeys for recreation and entertainment.

(see Tables 3.30 and 3.31).

Table 3.30. Mean Round Trip Times for all Journeys within Stevenage According to Age and Household Car Ownership

	Time in Minutes							All ages
	0-4	5-11	12-17	18-24	25-44	45-64	65+	
0 car	24	20	28	30	25	24	16	24
1 car	22	18	19	27	23	23	*	21
2 cars	*	14	*	23	21	21	*	20

Table 3.31. Mean Round Trip Time According to Household Car Ownership and Purpose of Journey Within Stevenage

	Time in Minutes				
	work	shop	school	social	recretn
0 car	25	21	22	18	33
1 car	23	22	18	20	24
2 cars	22	20	12	16	21
Mean Time	24	21	19	19	26

By analysing the total distances covered and the total time spent travelling, a mean speed for journeys within Stevenage was determined for each age group. There was a steady increase in average speed on journeys both by increase in age and household car ownership: the latter influence was most pronounced on leisure journeys.

(see Tables 3.32 and 3.33).

Table 3.32. Mean Speed for Journeys Within Stevenage According to Age and Household Car Ownership

	Miles per Hour						
	0-4	5-11	12-17	18-24	25-44	45-64	65+
0 car	2.7	3.6	5.7	5.6	6.7	7.8	5.3
1 car	4.6	4.9	7.1	7.1	8.7	10.4	*
2 cars	*	7.2	*	7.9	9.4	12.6	*

Table 3.33. Mean Speed for Leisure Journeys Within Stevenage According to Age and Household Car Ownership

	Miles per Hour						
	0-4	5-11	12-17	18-24	25-44	45-64	65+
0 car	2.7	4.5	4.4	6.1	7.4	5.9	5.9
1 car	2.9	7.1	5.9	8.0	9.4	11.4	*
2 cars	*	11.6	*	10.0	12.3	15.4	*

3.2. ANALYSES OF DATA: ATTITUDES TO INFLUENCES AFFECTING MODAL CHOICE

The secondary purpose of the survey was to elicit opinion on the relative importance of the six main influences affecting modal choice, and to ascertain the extent to which attitudes varied with age, method of travel, purpose of journey and distance travelled.

3.2.1. Method of Analysis

The completed questionnaires were analysed in two ways: firstly, responses to questions were added solely on a 'one man, one vote' basis; secondly, responses were multiplied by the number of trips made by each respondent for each purpose prior to the additions, in order to provide a basis for the design of an optimised system of movement that takes account of journey frequency. To determine weightings for the degrees of importance listed on the questionnaire, the responses in each 'importance' column were added and calculated as a percentage of the total for the four columns. The percentage figure for 'unimportant' was then omitted, and the three remaining percentages multiplied by numerical values assigned to the terms 'not very important', 'important' and 'very important'. Six alternative weightings of importance were tested, but no significant variation between the rankings of the influences occurred; the simplest system of weightings - 0, 1, 2, 3, to represent degrees of importance - was adopted.

The number of responses recorded in each column was, therefore, multiplied by the weighting for that column, the totals divided by the number of respondents who stated their preferences, and finally this total was multiplied by 3.3 in order to give a range of values from 0 - 10, representing the relative importance of the influences.

3.2.2. Analysis of Attitudes

The values measured according to respondents' opinion and respondents' journeys were very similar. There was a consistency not only between the respondents but also within each age group, with a difference between the two methods of measurement never exceeding one point.

Safety was consistently the most important consideration of all age groups; comfort was the next consideration; time and cost were generally rated third and fourth in importance, in both cases the value rising with adulthood; the effort involved in travelling and the interest of the journey were not considered by most respondents to be very important.

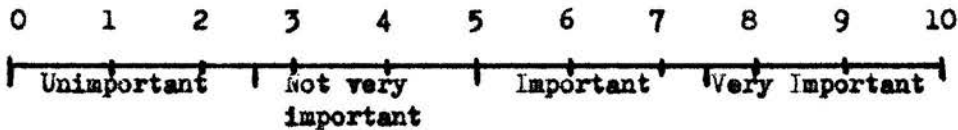
An examination of responses in each age group revealed that age has a fairly distinct influence on attitudes: the visual interest of journeys of pre-school children was considered by parents to be more important than time and cost; cost and effort involved in travel were of little consequence to primary school children who considered safety and comfort to be important; adolescents considered time as important as comfort, whilst cost, effort and visual interest of journeys were of little concern to them. Adults of working age generally held very similar views concerning the relative importance of all influences: safety was most important, and time, cost and comfort important; elderly persons recorded safety, comfort and effort as the most important influences on their journeys, and cost fairly important.

(see Table 3.34).

**Table 3.34. Importance of Influences Affecting Modal Choice
According to Respondent Opinion (RO) and
Respondent Journeys (RJ)**

Age		0-4	5-11	12-17	18-24	25-44	45-64	65+	All Ages
Persons in Sample		45	92	62	54	200	104	21	578
Total Journeys		372	1067	764	713	2388	1213	112	6627
time	(RO)	4	5	6	6	6	6	4	6
	(RJ)	4	4	5	6	6	5	4	5
cost	(RO)	3	3	4	6	6	7	6	5
	(RJ)	3	3	4	6	6	7	6	5
safety	(RO)	8	8	8	7	8	9	7	8
	(RJ)	8	8	8	8	8	8	8	8
comfort	(RO)	7	6	6	7	6	7	7	6
	(RJ)	7	6	6	7	7	7	7	7
effort	(RO)	4	3	4	5	5	5	6	5
	(RJ)	3	3	4	5	5	5	7	5
interest	(RO)	6	4	3	4	3	3	5	3
	(RJ)	5	4	3	4	4	4	5	4

Scale:



An analysis of attitudes according to method of travel revealed that safety, comfort and cost were the most important considerations of respondents travelling by car and bus, and time and effort the least important; however, more pronounced opinions were expressed by respondents travelling by the latter mode.

Time, cost, comfort and effort on bicycle journeys were not considered to be very important by the predominantly young respondents; comfort was rated the second most important factor on pedestrian journeys.

(see Table 3.35).

Table 3.35. Importance of Influences Affecting Modal Choice According to Method of Travel

	car	m/cycle	train	bus	cycle	walk
Total Sample	718	20	31	257	119	474
time	5	7	7	6	5	5
cost	6	6	6	7	4	4
safety	8	7	7	8	8	8
comfort	6	5	6	7	5	6
effort	5	4	4	6	4	4
interest	4	3	5	4	3	4

An analysis according to the purpose of the journey revealed that time and comfort on work journeys was important, but effort of little importance; comfort, cost and effort on shopping journeys were almost equally important; time and comfort on school journeys were important, but cost and effort of little importance; comfort was an important consideration on leisure journeys, but time and effort of little importance.

(see Table 3.3.6).

Table 3.36. Importance of Influences affecting Modal Choice According to Purpose of Journey

	work	shop	school	social	recreation
Total Sample	316	438	170	436	446
time	7	5	6	4	4
cost	6	6	3	5	6
safety	8	8	8	8	8
comfort	7	7	6	7	7
effort	4	6	4	4	4
interest	3	3	3	4	5

An analysis was carried out to determine the extent to which the importance attached to time, comfort and effort differed according to method of travel, over increasing distances: the importance of time rose for all methods except for walking; this exception may be due to the far greater predictability of time on these trips. The importance of comfort did not vary for car or bus journeys, though it rose slightly for cycle and walking journeys, reflecting perhaps the influence of weather on this 'exposed' form of movement; the importance of effort only rose with walking journeys, well reflecting the 'frictional' effect of distance.

(see Table 3.37).

Table 3.37. Influence on Modal Choice of Time, Comfort and Effort over Varying Distances

		0- $\frac{1}{2}$	$\frac{1}{2}$ -1	1-2	2-4
time	car	*	*	6	6
	bus	*	7	6	7
	cycle	4	6	6	7
	walk	5	5	5	*
comfort	car	*	7	7	7
	bus	*	8	7	7
	cycle	5	6	6	6
	walk	6	7	7	*
effort	car	*	6	6	6
	bus	*	7	6	6
	cycle	4	4	4	4
	walk	4	5	6	*

3.3. DISCUSSION OF SURVEY

The survey provided evidence on issues relating to the travel activities of different age groups, which were raised in the earlier chapters of this thesis; the most relevant of these issues form the subject of this discussion. However, even though there was a broad consistency of data, the author's comments must be viewed with some caution in view of the size of the sample.

3.3.1. Frequency of Journeys

In the conclusion to Chapter 1, reference was made to the changing levels of mobility at each stage in the life-cycle. In view of this, it was suggested that particular consideration could be given either to children because of the critical stages in the development of their intelligence and social adjustment, or to elderly persons in view of their declining faculties. Alternatively, it was pointed out that adult requirements deserve special attention, because of their present importance to the economic and social life of the country. The author concluded that each group merits equal consideration for satisfying its travel needs.

The similarity of activity of each age group in the author's survey would appear to support this view. The frequency of recorded journeys was fairly constant throughout the life-cycle; only the travel activity of elderly persons declined substantially and this may be due to decreased capabilities, diminished interests outside the home, or to an unsympathetic environment providing few incentives to go out. The variation between the number of weekly journeys for the essential purposes of travel to work, shops or school, and the optional travel for leisure purposes, was surprisingly small in each age group.

3.3.2. Independence of Movement

In discussing the constraints on the mobility of each age group (vide 1.7), the functions of independence of action and freedom of movement were stressed as important motivations for undertaking optional journeys. It was suggested that each person tends to travel on his own on the majority of journeys and as a member of a household for only a minority.

The survey of the three pre-adult age groups, provided overwhelming evidence of the increasing desire and ability of children and adolescents to travel independently of their parents. This is in agreement with studies cited (vide 1.2.5 and 1.3.5), that they generally prefer to spend their leisure time with others of the same age rather than with their own families. The ownership of a car within the child's household had relatively little influence on his method of travel, which is a further symptom of the urge to independence. The survey recorded a steady increase with age in children's travel by public transport and bicycle. Indeed, adolescents travelled more by public transport than by car, even in car-owning households.

The main stages of adult life have been classified as the years before marriage and the first years of marriage when there are relatively few family commitments, the middle years which are largely associated with bringing up children, the late middle years when children are likely to have left home, and the years in retirement when household size is generally small. These stages appear to be reflected in the proportion of accompanied trips made for each type of journey. The lack of precision of transportation studies based on data on 'household trips', in assessing individual travel needs is apparent from the fact that only about one third of all journeys, and less than one half of leisure journeys, were made accompanied by another

member of the respondent's household. The implication that leisure journeys are not necessarily a family event appears to be borne out by the National Travel Survey which recorded an average car occupancy of only 2.1 persons for these trips (Ministry of Transport, 1967, Table 8). In the author's survey, it appears that the mobility of individual members of a household was governed more by age than by the ownership of a car within that household.

3.3.3. Method of Travel and Influence of Car Ownership

The travel activity of each age group revealed some unexpected results: more weekly journeys were made by children in non-car-owning households than in car-owning households, but more weekly journeys were made by adults in car-owning households than in non car-owning households. This apparent anomaly may be due to the small sample size, though this is unlikely since the variation occurred in both child age groups and in two adult age groups. A possible explanation may be that children in households with cars may have less inclination to walk or cycle on their leisure journeys since they are far more likely to have grown accustomed to the convenience of travelling by car. The adolescent preference for independence could account for the change in pattern that occurred in this age group, for a marked similarity in the number and purpose of their weekly journeys in households with and without cars was recorded.

There was also little difference in the method of travel of children and adolescents in car and non car-owning households. The majority of journeys were undertaken on foot, and, increasingly with age, by bicycle. This is probably due to the available pedestrian and cycle ways for school journeys, and the convenient location of schools in relation to the town wards. However, leisure journeys, representing about one third

of the total number of their trips, were made increasingly by vehicle: nearly half were made by bus or car. The effect of one or even two cars in the household, did not appear to influence their method of travel significantly.

The considerable increase in vehicular journeys of young adults may be due to two causes: journeys to work are usually much longer than those to school, and preferred leisure activities such as clubs and dance halls, often necessitate travelling greater distances. Travel activity of young adults in car-owning households was greater than in households without cars: the increase could be attributed to a rise in the number of work journeys, probably resulting from the greater mobility of adults in these households, which enabled many of them to return home for lunch (Bunker, 1967, p.230), and made it more convenient for women to go to work; there was also a doubling of their leisure journeys, which suggests that the improved mobility of those old enough to hold a driving licence, considerably influences their activities.

The method of travel of adults between the ages of 25 and 44 years differed substantially in car-owning and in non car-owning households: in the former case, nearly two thirds of journeys were by car, whilst in the latter case, over half were by bicycle or on foot. This again emphasises the strong influence of household car ownership on method of travel. As with adolescents, there was a close similarity between the frequency and purpose of journeys made in car-owning and in non car-owning households. This may be accounted for by the inconvenience of travelling with young children, and the resultant decline in leisure pursuits at this stage of life; this conjecture appears to be substantiated by the increase in the number of accompanied journeys made on foot, and the decline in the proportion of journeys by public transport.

These explanations are supported by the subsequent increase in vehicular journeys by people between 45 and 64 years of age, whose pattern of activities is similar to that of the 18-24 age group, suggesting that once adults are relieved of the responsibilities of looking after children, they are more able to suit their own preferences when travelling. The large increase in the number of weekly journeys made in car-owning as opposed to non car-owning households is almost entirely accounted for by leisure journeys. This probably reflects the previously noted improved mobility and incentive to travel by car-owning adults. In households without cars, longer journeys have to be made by public transport or by bicycle.

Reduced economic circumstances could explain the low car ownership rate of elderly persons, and the relatively high proportion of journeys by bicycle and on foot. However, this finding could be distorted by the small size of the sample in this age group. Relatively few journeys were made by motor vehicle, probably reflecting the inconveniences of public transport (vide 2.8), which may deter people at this age (vide 1.5.5).

The small number of bus journeys made by all age groups for social and recreational purposes clearly reflects the disadvantages of public transport during off-peak hours: services in Stevenage run at twenty or thirty minute intervals, and sometimes terminate at 10.30 p.m. (London Transport, 1969).

Perhaps the most significant finding in these analyses is that in households without cars, nearly all journeys were made by other means, whereas in one car households over half, and in two car households one quarter were made by other means. The figures are similar to those recorded in the Tyneside survey - one of the few travel studies recording data on this aspect (Burns, 1966). Both this survey and the author's highlight

not only the effect of increasing car ownership on method of travel, but also the fact that, even in two car households a significant proportion of trips are made by other means.

3.3.4. Distance and Travel Time

The primary use of the car, accounting for over nine tenths of trips by this method, was for journeys over one mile; over two fifths were to destinations outside Stevenage, and less than one twentieth to destinations within a radius of half a mile. This suggests that the car is not preferred for short journeys, although the exclusion of multi-purpose trips may have affected these proportions (vide 3.0.9). The rare use of the car for short distance trips appear to confirm the previous analysis of the advantages of walking to close destinations (vide 2.1.6).

Few bus journeys were made to destinations within one mile, presumably because they could be accomplished in a shorter time on foot; over two thirds of bus journeys were to destinations between one and four miles. This also appears to substantiate earlier findings (vide 2.1.7).

The marked decline in the number of cycle and pedestrian journeys over increasing distances illustrates the influence of time and effort on the choice of these methods of travel (vide 2.4.5. and 2.4.6): over three fifths of pedestrian journeys were made within a half mile radius, and six sevenths within a radius of one mile. These figures clearly reflect the limitations of this method of travel and confirm the evidence cited with regard to the 'frictional' effect of distance.

This frictional effect has less influence on work journeys than on the other 'essential' journeys of shopping and school. This is probably due to the high rate of car use for work journeys, and the

importance of jobs overriding inconveniences associated with longer journeys. The isolation of the industrial area on one side of town probably accounts also for the relatively long work journeys and therefore the need for motorised forms of movement.

About half the shopping journeys were made within a one mile radius of home, almost certainly to the neighbourhood centres and two fifths were over distances of one to four miles, probably to the Town Centre. It should be noted that the wards of Broadwater, Shephall and Chells are up to two miles from the Town Centre. Fewer shopping trips were made when a car was available, probably because large quantities of goods could be easily transported on one trip (vide 2.6.2).

Over three quarters of school journeys were made within a one mile radius, demonstrating the well-considered siting of both primary and secondary schools in relation to the residential neighbourhoods; the greater distance travelled to secondary schools is probably due to their location between neighbourhoods, and the fact that they serve larger areas of population.

Half the leisure journeys were to destinations beyond a two mile radius. The relationship of car ownership and increased distance travelled, is particularly noticeable: leisure journeys to destinations outside Stevenage were cited more than twice as frequently by persons in car-owning households as in non car-owning households. This is similar to the findings of the Government's Social Survey that car owners spent four times the number of leisure periods in out-of-town excursions than those who relied on public transport (Sillitoe, 1969, p.18).

Only one quarter of the total number of journeys in the survey were made within a half mile radius; this confirms the conclusions of

Kuper (1953) and Willmott (1967), who were unable to find much evidence that neighbourhoods define the area of community activity.

Calculations of average time taken by each age group on journeys within Stevenage, support Bouladon's conjecture that there is an acceptable time for different types of journey (vide 2.1). The calculations also confirm the findings of the Government Social Survey of leisure activities which recorded a close correspondence in journey times of those able to travel by car and those without a car (Sillitoe, op.cit., p.28). Car ownership, therefore, appears to enable adults to travel greater distances within an acceptable time period: they can return home for lunch, enjoy increased participation in leisure pursuits and widen their choice of all activities within an effectively much enlarged catchment area.

3.3.5. Attitudes to Influences Affecting Modal Choice

Analyses of respondents' attitudes to the six influences affecting choice of travel mode produced unexpected results. Although time and cost are the two recurrent isolated parameters in transportation studies (vide 2.0), this survey suggests that they may not necessarily be the primary considerations. Consistently high ratings were attached to safety possibly indicating current public concern and publicity on this subject.

The importance attached to comfort is evident throughout the various patterns of travel activity, both in the surveys cited earlier in this thesis, and in the author's survey; bus passengers evinced most concern. This may be due to the discomfort often associated with walking to the stop and waiting for the bus in inclement weather. In this respect, the advantage of cars over all other forms of movement which was observed earlier (vide 2.4), was borne out in this survey.

Time and cost of travel were rated third and fourth in importance, with all respondents; this agrees with the findings of a major survey which recorded time and cost as relatively insignificant factors in modal choice (Greater London Council, 1969a, p.91). However, the ratings rose steadily with adulthood, probably because of the need for punctuality at school and employment, and a growing awareness of cost. Time and cost were of more concern to bus passengers than to those travelling by the other major methods of travel; this corroborates the view that the majority of car travellers assess costs on immediate running expenses, and value time spent travelling (vide 2.1 and 2.2). Bus passengers are also likely to be poorer than those who travel by car. Understandably, pedestrians were least concerned with time and cost; it is possible that the greater predictability of travel time on these journeys also accounts for the low rating, and for the consistency of rating noted over varying distances.

Suggestions that time is far more important than comfort (Burns, 1967, p.44), and that cheap public transport may be the key to the problem of urban movement (Buchanan et alia, op.cit., para. 457) are not substantiated by the findings of this survey.

The importance attached to effort involved in travel rose with age, weighing most heavily on the attitudes of elderly persons. The high rating attached to the effort involved in shopping journeys is self-evident.

The influence of the visual interest of the journey hardly differed between age groups, although parents considered it more important for very young children, and elderly persons thought it a more important influence than time. This may be because these journeys are less likely

to be hurried, so that more opportunities exist to take an interest in the environment: this would also appear to be substantiated by the greater importance attached by all respondents to visual interest on leisure journeys.

3.4. CONCLUSIONS

The most significant issue to emerge from the survey was the similarity in the pattern of travel of the seven age groups, in spite of the widely differing methods of travel. This aspect tends to be ignored in transportation studies which are based on household rather than on individual trips: in the former, the beneficial effects of household car ownership are seen to result in an increase in household trips. The author's survey suggests that ownership of a car within a household does not result in a similar improvement of mobility of all the individuals within the household. The pronounced increase in mobility resulting from car ownership appeared to benefit mainly the adult who had a car at his disposal for the majority of his journeys. It was less beneficial to the adult who only occasionally used it: the far greater use of cars for work journeys by male than by female adults illustrates the influence of sex, and confirms cited evidence (vide 2.7). Household car ownership is clearly least beneficial to those unable to drive.

This survey also reveals the high proportion of cycling and walking journeys when proper provision is made for them. They accounted for over half of the journeys made within the New Town; these methods of travel are usually omitted in transportation studies. Although the survey demonstrated that work journeys by car represented only one seventh of all journeys made, the structure of New Towns is increasingly being determined by this mode of travel (vide 5.6).

The fairly consistent use of public transport by all age groups, and for all types of journey, demonstrates its essential function for the whole community; a reduction in service frequency or in service hours during the evenings and weekends clearly reduces the effective

mobility of those without the exclusive use of a car. The increasing transfer from bus to car travel must affect the economy of public transport services (vide 4.2.3); the size and extent of the road network to accommodate the increased movement by car can cause further inconvenience to those travelling by bicycle or on foot (vide 4.1.7).

The relationship between the mobility of people in the seven age groups, and the satisfaction of their travel needs, was most evident in the analysis of their effective average speeds. When these are applied to determine the effective catchment area that is within their acceptable time for travelling for different purposes, the disparity between the age groups and between those in car-owning households is most apparent (vide 5.5).

There are considerable differences of opinion with regard to the perceived importance of time, cost, comfort, effort and interest on journeys, reflecting changing emphases at each stage of life, the difference being most marked during progression to adulthood. The fact that comfort was generally considered a more important influence than either time or cost, is strong evidence that the car will almost invariably be used if a choice exists between it and public transport. It has already been noted that the importance of road safety appears to be a factor largely ignored by those who travel by car. In these circumstances, the relative advantage of the car over the bus in respect of all the other influences examined in Chapter 2, further demonstrates the problems of reconciling individual preferences and community needs. The survey provides evidence emphasizing the need to establish systems of movement based on the activities and attitudes of all age groups, since opportunity to engage in urban life varies so substantially with mobility.

4.	<u>METHODS OF TRAVEL: FACTORS AFFECTING THE COMMUNITY</u>	
4.0.	INTRODUCTION	201
4.1.	AREA REQUIREMENTS	202
4.1.1.	Area Requirements: Movement by Car	202
4.1.2.	Area Requirements: Movement by Motor-Cycle	205
4.1.3.	Area Requirements: Movement by Bus	205
4.1.4.	Area Requirements: Movement by Taxi	206
4.1.5.	Area Requirements: Movement by Bicycle	206
4.1.6.	Area Requirements: Movement on Foot	207
4.1.7.	Comparative Analysis of Area Requirements of Six Methods of Movement	207
4.2.	PUBLIC EXPENDITURE	210
4.2.1.	Public Expenditure: Movement by Car	210
4.2.2.	Public Expenditure: Movement by Motor-Cycle	214
4.2.3.	Public Expenditure: Movement by Bus	215
4.2.4.	Public Expenditure: Movement by Taxi	217
4.2.5.	Public Expenditure: Movement by Bicycle	218
4.2.6.	Public Expenditure: Movement on Foot	218
4.2.7.	Comparative Analysis of the Public Expenditure Incurred for Six Methods of Movement	218
4.3.	ASPECTS OF COMMUNITY HEALTH	222
4.3.1.	Health Aspects: Movement by Car	229
4.3.2.	Health Aspects: Movement by Motor-Cycle	232
4.3.3.	Health Aspects: Movement by Bus	233
4.3.4.	Health Aspects: Movement by Taxi	234
4.3.5.	Health Aspects: Movement by Bicycle	234
4.3.6.	Health Aspects: Movement on Foot	235
4.3.7.	Comparative Analysis of the Health Aspects of Six Methods of Movement	238
4.4.	SOCIAL IMPLICATIONS	239
4.4.1.	Social Implications: Movement by Car	239
4.4.2.	Social Implications: Movement by Motor-Cycle	241
4.4.3.	Social Implications: Movement by Bus	241
4.4.4.	Social Implications: Movement by Taxi	243
4.4.5.	Social Implications: Movement by Bicycle	243
4.4.6.	Social Implications: Movement on Foot	243
4.4.7.	Comparative Analysis of the Social Implications of Six Methods of Movement	244
4.5.	SUMMARY AND CONCLUSIONS	246

4.0. INTRODUCTION

The motivating influences affecting the individual's choice of method of movement were examined in Chapters 2 and 3. It was seen that this choice is primarily based on the calculated benefits accruing to the individual rather than on any perceived costs to the community of his decision. This chapter examines the broad effects of these personal decisions, in the fields of land use, economics, health and social welfare. The relative advantages and disadvantages of alternative methods of movement are, therefore, compared under the following four headings:

4.1. Area requirements; 4.2. Public expenditure; 4.3. Community health; 4.4. Social implications.

The six methods of movement analysed on a comparative basis in Chapter 2 are examined: car, motor-cycle, bus, taxi, bicycle and walking.

4.1. AREA REQUIREMENTS

The total area required to accommodate traffic generated in towns is dependent upon the proportion of journeys made by different methods of travel; conversely, the layout of towns can affect this proportion. Area requirements of methods of travel, therefore, have an important influence on urban form. They may be evaluated as follows: the area occupied when stationary, the occupancy rate where applicable, and the area needed in motion.

4.1.1. Area Requirements: Movement by Car

Although the average car occupies only seventy square feet, considerably more space is needed for turning the vehicle, for permitting garage doors to be opened, and to accommodate the largest and least manoeuvrable cars (Ministry of Transport, 1967c, p.13A), with turning circles of forty one feet (Traffic Research Centre, 1968). One hundred and fifty square feet are usually provided for the garaging or parking of private cars, with a further one hundred square feet for access, giving a minimum requirement of two hundred and fifty square feet. Theoretically, this area should be provided at every home and at each of the car's potential destinations.

In Great Britain, the area required for parking a car in a residential area is some fifty square feet greater than the average area of residential accommodation recommended for one person: less than two hundred square feet in a typical four person dwelling (Ministry of Housing and Local Government, 1961), and two hundred square feet more than the minimum area of forty square feet recommended for each office worker (Shops, Offices and Railway Premises Act, 1963).

The total effect of these requirements on land use is pronounced since spacious car parks are increasingly required near factories, shops and places of recreation, as well as in the centres of towns. The area recommended for cars on industrial estates is four hundred and fifty square feet per worker, which represents nearly two fifths of total site requirements (Needham, 1967). Extreme solutions of the parking problem may be seen in the huge perimeter areas for suburban shopping centres in the United States where between two and four times the retail shopping floor area is required for parking (Lynch, 1962); these areas must be large enough to accommodate peak demands of Friday evening or Saturday morning shopping, although they are only partially occupied at all other times. Parking areas must also be provided for educational establishments: for example, recent plans for a comprehensive school have included places for one hundred cars (Skelmersdale Development Corporation, 1968). It has been forecast that the present parking areas provided in the centres of small towns will have to be doubled to provide for the needs of 1986 (Lamb, 1966, p.52), and that multi-storey car parks in these towns will occupy more space than carriage-ways (Smeed, 1963, p.285).

The greater the number of persons travelling in a vehicle, the smaller is the road area required per person: occupancy rate must, therefore, be an important consideration in respect of area requirements for alternative forms of movement. The National Travel Survey in 1964 (Ministry of Transport, 1967b, Table 4A), and a Government Social Survey (Gray, 1969, p.7, Table 5.1) recorded average car occupancy rates of 1.3 and 1.4 persons for work journeys, and 2.2 and 2.4 persons for leisure journeys: the London Traffic Survey (Freeman, Fox and Partners, 1964, p.59 para. 9.45) recorded rates of 1.2 persons during working hours, and 1.43

persons for the whole week; in two provincial towns, occupancy rates were 1.4 persons per car for the journey to work, 1.7 for weekday leisure, and 2.2 persons per car for weekend leisure (Lamb, op.cit., p.66; Taylor, 1968, p.122).

Roads have a profound influence on urban form, since moving vehicles require prodigious areas of road: depending on the number of road intersections, a two-lane carriageway is required for the equivalent vehicular capacities of between six hundred and fifteen hundred cars per hour in both directions, and a six-lane carriageway when the flow reaches sixteen hundred to forty five hundred cars per hour in each direction (Ministry of Transport, 1966, p.7, Tables 1-4).

Area requirements are also strongly dictated by the speed of vehicles. Although the proportion of carriageway occupied by vehicles in towns is larger with slower traffic, the effective area is much greater: seven times the number of vehicles travelling at 20 m.p.h. instead of 10 m.p.h. can be accommodated on a given stretch of carriageway (Smeed, 1968a, p.44). The Ministry of Transport (1967c, p.16) has recommended design speeds of 40 m.p.h. on new urban roads, and this has the further advantage of vehicular efficiency in time and cost.

Road networks designed for large volumes of traffic travelling at high speeds require several lanes and large areas for curves and complex intersections to achieve minimum reduction in speed when there are changes of direction, and considerable lengths of carriageway for changes in elevation. Minimum desirable radii of two thousand one hundred feet are required for design speeds of 60 m.p.h., nine hundred feet for speeds of 40 m.p.h., and five hundred feet for speeds of 30 m.p.h. (Duff, 1962); even for local distributor and service roads, radii of one hundred and twenty, and fifty

feet respectively, are considered necessary (Jamieson and Mackay, 1965, Table 1, p.113). Furthermore, braking distances increase with greater vehicular speed: for example, at 20 m.p.h. forty feet at 40 m.p.h. one hundred and twenty feet, and at 60 m.p.h. two hundred and forty feet are required (Ministry of Transport 1968f, para.35). Critical lengths of eleven hundred feet are necessary for the 4% gradients of primary distributor roads (Goldstein, 1966, p.32, Table 2; Ministry of Transport, 1966a, p.15).

4.1.2. Area Requirements: Movement by Motor-Cycle

Ten motor-cycles can park in the area normally occupied by one car (British Cycle and Motor-Cycle Industries Association, 1967). Motor-cyclists carry passengers on more than one fifth of pleasure trips on weekdays, and on nearly one third at weekends (Peters, 1966).

The motor-cycle occupies a smaller width of carriageway than do other vehicles, and probably requires less 'braking space' since the rider can exercise greater precision due to his all-round vision. Nevertheless, the area it requires for movement on urban roads is considered to be three quarters of that needed by a car (Ministry of Transport, 1968c, p.1, para. 15).

4.1.3. Area Requirements: Movement by Bus

Standard buses are seven and a half feet wide, have a length of twenty six feet, and turn in a radius of thirty eight feet; a layby to prevent the blocking of vehicular flow in one lane when the vehicle is at rest, requires one thousand five hundred square feet (Traffic Research Centre, 1968). The average occupancy rate of buses in Great Britain in

1968 was sixteen persons (Ministry of Transport, 1969a, Tables 1, 36).

Taking into account the fact that a bus has to stop frequently for passengers, it has been estimated that it requires an area equivalent to about three medium-sized cars (Ministry of Transport, 1968c, p.1, para. A5).

4.1.4. Area Requirements: Movement by Taxi

The area requirements of taxis are very similar to those of cars, with the important exception that taxis usually spend a greater amount of time in motion: for instance, London taxis make a daily average of twenty three trips and are driven eighty miles; their average occupancy is 1.6 passengers (Metropolitan Police, 1969). In theory, parking requirements may, therefore, be reduced by the number of parking places which would otherwise be needed for the equivalent number of car travellers that taxis carry as passengers (Meyer, Kain and Wohl, op.cit., p.316).

4.1.5. Area Requirements: Movement by Bicycle

The space occupied by a bicycle is very small: twenty can be parked in the area normally occupied by one car (Claxton, 1968, p.117). In use, a bicycle is thought to occupy the equivalent of one fifth or one third of the area of a car (ibid.; Ministry of Transport, 1968c, p.1, para.A5).

The minimum width of cycleways is five feet although nine feet are recommended (Keeble, 1964, p.159). The efficiency in land use of bicycles is clearly shown by the fact that twelve feet wide cycleways can accommodate more than five thousand persons per hour, which is very much more than the passenger carrying capacity of a twenty four feet wide carriageway used only by cars (Claxton, 1968).

4.1.6. Area Requirements: Movement on Foot

The minimum area for a stationary pedestrian can be calculated from the number of passengers that can fit into a lift: for instance, eight persons are contained in a cage of sixteen square feet.

The area required for walking has been estimated to be two and a half square feet per person in a subway, and eight and fifteen square feet for walking and running respectively (Gruen, 1965). The capacity of ten feet wide pavements in pedestrian shopping malls is six thousand pedestrians per hour (Capital and Counties Property Co. Ltd., op.cit., p.19). Paradoxically, pedestrian spaces tend to be over-dimensioned; a maximum area of about twenty square feet per person in public squares has been suggested (Institut for Center Planlaegning, 1965).

4.1.7. Comparative Analysis of the Area Requirements of Six Methods of Movement

Various calculations have been made of the relative area requirements of wheeled vehicles. The Ministry of Transport (1966a, p.6, Table 1-3) consider that on urban roads, buses require the equivalent of three times the area of cars or taxis, motor cycles need three quarters of the area, and bicycles need one third of the area. More detailed estimates of the relative requirements of cars and buses have been based on passenger occupancy rates and road conditions: the higher the occupancy of the bus, the more favourably it compares with the car, whilst greater traffic congestion makes the comparison less favourable (Foster, 1963). Estimates of the equivalent road area required for people travelling by car as compared with the bus, vary according to these factors. A number of calculations of this ratio have been made: twenty times the area (Constantine, 1968),

fifteen times (Smigielski, 1968), seven times (Road Research Laboratory op.cit., p.253), six times (Foster, op.cit.), and four times the area (Sharp, op.cit., p.104). If proposals for reserved lanes in central areas are implemented (Constantine and Young, 1969), the advantage of buses will be somewhat diminished.

Diagram 4.1. sets out the relative area requirements of the six methods of movement at rest and at varying speeds. It can be seen that cars and taxis make relatively high demands on the use of land because of their size and parking needs at origin and at all potential destinations; when in motion, and increasingly as speeds rise they require considerable areas of carriageway, complex traffic intersections and separation from pedestrians. If the area of land adjacent to motor roads, which cannot be economically developed owing to the unacceptable noise levels, is taken into consideration, the comparison with other methods of travel is dramatic.

Motor-cycles are not particularly economical users of road space although they occupy small areas when parked. Of all wheeled traffic, bicycles require the smallest area both when parked and in use. Pedestrian movement has, however, the lowest requirements.

Diagram 4.1. Area Requirements of Six Methods of Travel
According to Speed

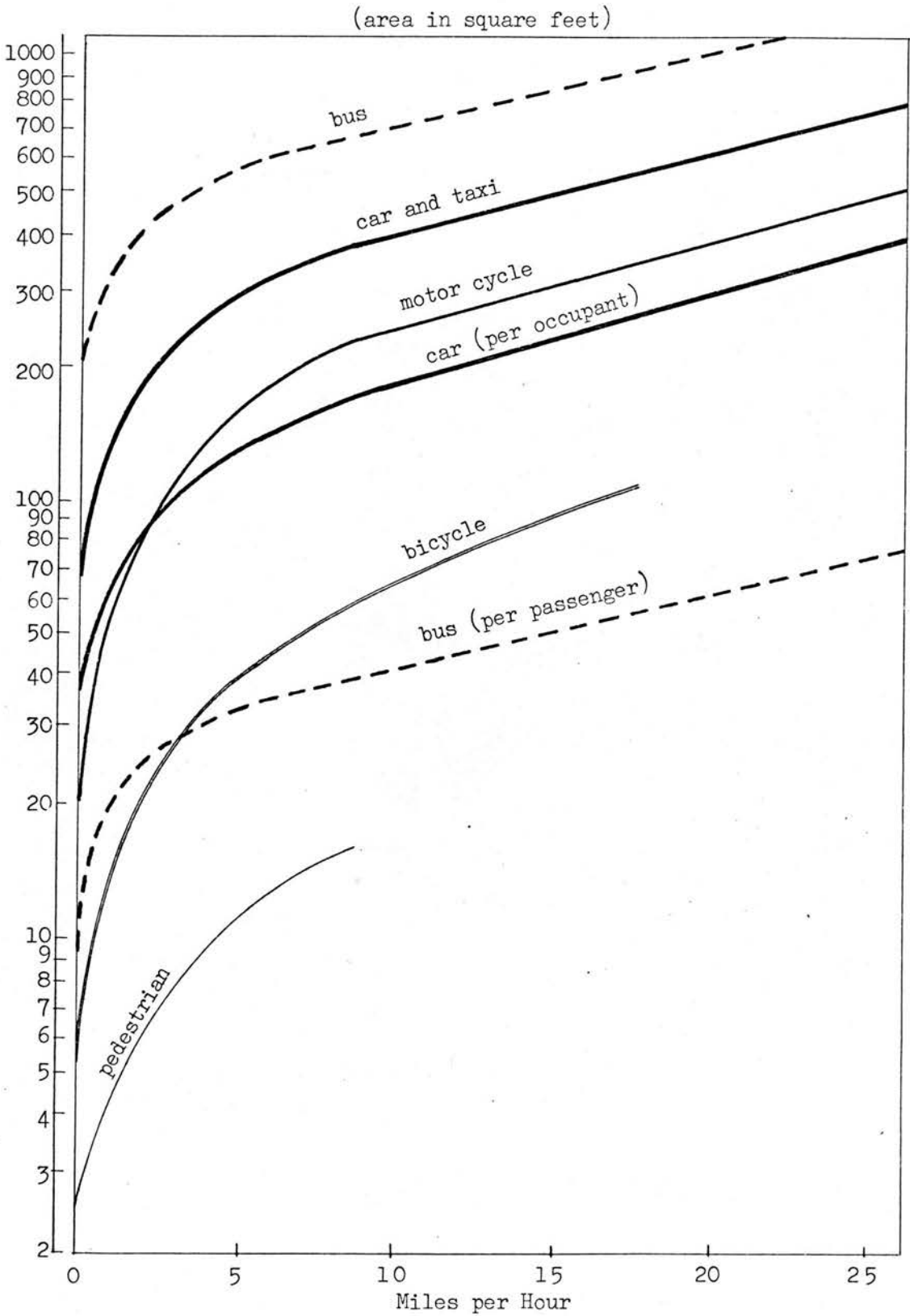


Diagram constructed from evidence cited by author (vide 4.1.)

N.B: Logarithmic scale

4.2. PUBLIC EXPENDITURE

Costs to the individual of different methods of travel were compared earlier (vide 2.2): cycling and walking are cheapest, while the relatively high cost of motorised movement depends on such factors as vehicle occupancy and whether the cost per mile is calculated on total annual costs or just running expenses. However, in all circumstances public expenditure is involved in the construction and maintenance of roads and these costs rise steeply as more people choose to travel longer distances more quickly and conveniently by car; costs are also inflated by the need to minimise risk of accidents and to provide road networks accommodating peak-hour traffic.

4.2.1. Public Expenditure: Movement by Car

The main burden of road expenditure is imposed by the increasing need to accommodate car movement. Estimated car mileage in Great Britain represents a rising proportion of the total vehicle mileage travelled on the roads: in 1958 it was 60%; in 1963 it was 67%; in 1968 it was 76% (Ministry of Transport, 1969b, p.44, Table 33).

A report by the Ministry of Transport (1968c) subdivided the expenditure involved into public and community costs and defined public costs as those mainly paid out of public funds, and community costs as those borne directly by society.

Public Costs. These include expenditure on new roads, improvements, maintenance, lighting, policing, administration, and accidents not borne out of insurance payments. It is difficult to assess these costs reliably, because they are financed by different agencies and vary considerably between and amongst existing and New Towns. It is well known, however, that proper

provision for car use is both very expensive and uneconomical, as roads must be designed for peak hour conditions and therefore remain underused for most of the time.

The total capital cost for accommodating the unrestricted use of cars in all existing British towns of over ten thousand persons, has been variously estimated at £10,000,000,000 and £20,000,000,000 at 1963 prices (Reynolds, *op.cit.*, p.72). The cost of roads to accommodate projected peak hour travel by car in New Towns is indicated by the following: highway requirements for towns designed in the last twelve years vary between £142 per capita in Cumbernauld and £236 in Washington (Ministry of Housing and Local Government, 1969); radial and primary distributor roads alone in Cumbernauld, with a planned population of seventy thousand persons, were estimated to cost £100 per capita (Jamieson and Mackay, 1965, p.118).

The predicted peak-hour traffic cannot, however, be absorbed in existing towns and cities, either physically or at tolerable costs, so that there will still have to be some measure of restraint (Reynolds, *op.cit.*, p.82); furthermore, a delay of about twenty years would occur before motorways needed to carry the traffic could be completed, whereas the main projected increase in the number of vehicles will have taken place well before then (*ibid.*, p.75).

In addition to the capital costs of new roads and major improvements great expenditure is incurred for non-constructional purposes: costs of maintenance, lighting, administration, traffic management, and control by the police, represented over 50% of total public road expenditure in the years 1965-1966 (Ministry of Transport, 1968c, p.10, Table 3.1); £52,000,000 were spent in that period solely on these latter police duties (*ibid.*). In provincial cities, police spend one quarter of their time on traffic

control, 40% of which is primarily of a supervisory nature (Martin and Wilson, 1969); fifty five thousand breath tests were carried out in the first twelve months of enabling legislation (Times, 1968b). Parking meter zones are being extended rapidly in an attempt to control the number of cars parked by commuters in central areas; 70% of the revenue from them has to be devoted to the administrative and operational costs, which include the wages of one traffic warden for every thirty meters (Royal Automobile Club, 1969b).

There is almost no limit to public expenditure that can be devoted to reducing the risk of road accidents: separating of different types of traffic; raising levels of lighting; providing road surfaces that are safe in wet weather; using more frequent police patrols (Smeed, 1968b, pp.268-275), and electrically heating steep gradients to prevent the formation of ice.

Community Costs. These are costs created by road users but paid by everyone, irrespective of how they personally travel. These include financial loss due to delays in traffic, loss of amenity due to noise, vibration and fumes, and the effects of accidents, including loss of output and the subjective costs of grief and pain (Ministry of Transport, 1968c, p.4, para.13); £1,000,000 were spent last year on road safety publicity (Ministry of Transport, 1969f, p.XIII).

Congestion on urban roads alone costs householders an average of over £30 annually (Dawson, 1967b). In 1963 it was estimated that a car parked in central areas of cities occupied an area for which it would be reasonable to charge between £2 and £3 per day, if valued at the same rental as adjacent land (Day, op.cit., p.78). Some indication of the costs that the average motor vehicle imposes on other vehicles at varying speeds during off-peak hours can be gained from Table 4.1. Payment to the community

through motor taxation, however, averages only about 3d. per vehicular mile (Gregory, 1968; Ministry of Transport, 1969a).

Table 4.1. Mileage Costs Imposed by Motor Vehicles on Other Vehicles at Varying Speeds in Central London in 1964

Speed	Cost	Speed	Cost
8 m.p.h.	6s. Od.	15 m.p.h.	1s.1d.
10 m.p.h.	3s. 6d.	20 m.p.h.	Os.4½d.

Source: Ministry of Transport, 1964, p.3.

The faster vehicles travel, the lower the costs of roads to accommodate them, and the lower the vehicular running costs (Road Research Laboratory, op.cit., pp.476-477, Table 15.1): if speeds are increased from 15 m.p.h. to 40 m.p.h., vehicular running costs decline by 37% (Woolsgrove, op.cit., pp.4-6 and Table 2). Using only the criteria of time-saving and the predicted reduction in traffic accidents, it is possible to justify the cost of motorway construction (Jamieson and Mackay, op.cit., p.110). Costs imposed indirectly upon the community are not, however, included in the calculations.

Air pollution caused by motor vehicles has been estimated to cost annually £80-90,000,000 with noise contributing a further £30-40,000,000 (Ministry of Transport, 1968c, p.16, paras. 51,52). Other factors concerned with environmental quality and health hazards associated with driving cars (vide 4.3), are no less important, despite the obvious difficulty of quantifying them.

Costs of accidents have been calculated in detail: costs for the whole country, including damage to property, medical treatment, administrative costs and loss of output, total £630,000 daily (Ministry of Transport, 1968d).

The average measurable costs of single incidents in urban areas in 1966 were £2620 for fatal accidents, £450 for serious accidents, and £140 for slight accidents, with an average of £240 for personal injury accidents, and £60 for accidents involving only material damage (Dawson, 1967b, p.67). When indirect costs such as those associated with pain, shock, and loss of expectation of life were added, the total average costs per accident were £8920 for fatal accidents, £710 for serious accidents, £150 for slight accidents, and £500 for an average personal injury accident (Dawson, 1967a, p.41, Table 29). A growing awareness of these factors may explain the increase in court awards for personal injury resulting from dangerous driving.

In theory, the costs of accommodating cars on roads should be paid for by those persons imposing them. In practice, few of these costs are covered by vehicle taxation and duties: the British Road Federation estimated that each motorist pays less than £100 per annum (Gregory, op.cit.). Although revenues from this source have over the last twenty five years exceeded gross expenditure on the road system by a factor of three (Mackay, 1967, p.108), the preceding analysis of all direct and indirect public and community costs may indicate that taxes paid by motorists are unrealistically low.

4.2.2. Public Expenditure: Movement by Motor-Cycle

The estimated mileage of motor-cycles in Great Britain in 1968 represented only 2% of the total vehicle mileage travelled on roads, and is proportionately declining rapidly (calculations from Ministry of Transport, 1969b, p.44, Table 33). In view of the area that motor cycles occupy and their small numbers, they incur low public expenditure to accommodate their use on roads.

4.2.3. Public Expenditure: Movement by Bus

Public expenditure is involved in the construction of works specifically for buses and their passengers, such as bus shelters and laybys, in the share of road space that they require, and in the subsidy of many services. However, it was seen in the previous section that bus passengers effectively occupy a much smaller area than car travellers. It should also be noted that the estimated mileage of buses and coaches in Great Britain represented only 2% of the total vehicle mileage travelled on roads in 1968 (ibid.).

The declining financial viability of public transport is reflected in evidence available from many sources: in 1960, personal expenditure on public transport was 36.5% of total travel expenditure, and was predicted to decline to 18% by 1975 (Beckermann et alia, op.cit., Tables 1.12 and 6.6); in the ten years up to 1967, passenger journeys by public transport vehicles declined by nearly 30%, and fares almost doubled (calculated from British Road Federation, 1969, p.21); passenger occupancy of buses in peak hours is nearly two and a half times of that in off-peak hours (Lyons, 1969), and the average is only 29% of seating capacity (calculated from Ministry of Transport, 1969c, Tables 1 and 36; British Road Federation, 1968b). It is not surprising that half the country's bus services are now running at a loss (Hutchings, 1967), and that many unprofitable services will either have to be subsidised by grants towards operating costs and the purchase of new vehicles (Ministry of Transport, 1967d, pp.15-20; Beesley and Politi, 1969), or discontinued.

The rapid increase in car ownership is the most important contributory factor to the reduction in the economic viability of public transport and has caused the sharp decline in bus passenger journeys particularly during

off-peak hours, which in London has occurred at double the rate of peak travel times (Thomas, 1968, pp.343, 346). Separated routes to speed buses are uneconomical (Bennett, op.cit., pp.42-43), as are the smaller buses which could take the lower number of passengers during off-peak periods: it has been estimated that operating costs of twenty-seater vehicles are two thirds higher than those of seventy-seater vehicles (Webster, op.cit., p.25, Table 15). The problem is aggravated by the need to subsidize attractive bus services (Lichfield and Associates, op.cit., p.41), and routes which tend to run at a loss (Sharp, op.cit., p.56). The shortage of labour at economical wages for a job entailing seven-day working and evening shifts (Patey, 1964) is of importance to a service in which wages alone account for 60% to 70% of operating costs (Jackson and Palmer, op.cit.; Thomas, 1968, p.373).

It seems paradoxical that whilst the cost of journeys to work does not appear to strongly influence commuters' choice of travel mode (Meyer, Kain and Wohl, op.cit., pp.107, 361), it is primarily at these times, with high occupancy rates, that public transport can make a profit (Wilbur Smith and Associates, op.cit., p.IX).

The uneven demand for public transport results in vehicles standing idle for a large part of the day and much of the weekend. Peak demand occurs in the morning when journeys to work and school coincide: in provincial towns, between two and three times the number of buses and crews are required in the rush hour than for the rest of the day (Storm, 1965, p.22, Fig.19; Birmingham Junior Chamber of Commerce, 1968; Bennett, op.cit.). To encourage the use of public transport in Runcorn New Town, five times the number of buses will be required for the rush hour than at other times of the day (Ling, 1967b). Nevertheless recurrent complaints of new town residents refer to the inadequacy of bus services (Osborn and Whittick, 1969).

Although public transport is uneconomical to operate in towns with populations of less than one million persons (Vorhees, 1968, p.333), various methods have been proposed to make existing services financially viable: improvements to attract more passengers such as smoother vehicle acceleration and air-conditioning installations have been recommended; service frequencies have been extended to economise on running costs, (Jackson and Palmer, 1968); buses are routed along priority lanes and the number of stops reduced so that they can travel at greater speeds (Woolsgrove, 1966; Dawson, 1967, p.2, Table 1); seats have been removed to accommodate more standing passengers at peak periods (Baily, 1968). Other economy measures now being implemented include the introduction of 'one-man' buses, which were expected to lower costs by 15% to 20% (National Board for Prices and Incomes, 1966), and reductions in the number of route miles over which buses operate.

The most common method employed to improve the financial viability of public transport services is by fare increases, but all the indications are that passengers faced with steeply rising fares or inconvenient services, find public transport a quite unrealistic choice if they can alternatively travel by car. It is not surprising, therefore, that predictions for the future of public transport, both in this country and in the United States, are consistently discouraging (Sharp, op.cit., p.92; Bennett, op.cit.; Meyer Kain and Wohl, op.cit., p.107). Even reductions in fares and improvements in service are unlikely to alter this situation, unless current pricing methods for road use are drastically revised (vide 4.2.7).

4.2.4. Public Expenditure: Movement by Taxi

Public expenditure on taxis is essentially different from that on buses in that the service is always run on a profit-making basis, and attracts

no public subsidy. Costs involved in accommodating taxis are identical to those of the car: they occupy similar road areas and cause similar scales of road congestion. However, in spite of their greater average road mileage, the effect on public expenditure is marginal since there are so few of them.

4.2.5. Public Expenditure: Movement by Bicycle

Similar observations regarding public expenditure involved in accommodating motor-cycles on the roads are applicable to bicycles, with the exception that the latter require less than half the road area of the former (vide 4.1.7), and on separated cycleways, a much reduced specification for construction, lighting and maintenance (Ferraton, op.cit., p.155).

4.2.6. Public Expenditure: Movement on Foot

Public expenditure involved in providing for pedestrian movement is minimal compared with that for vehicular traffic: the area required for pedestrian movement is less than that for cyclists, and the construction and maintenance of pavements and footpaths are relatively very inexpensive.

4.2.7. Comparative Analysis of the Public Expenditure Incurred for Six Methods of Movement

Conflicts inevitably arise in the allocation of resources to achieve acceptable environmental standards for pedestrians, an efficient public transport system, and unrestricted use of cars. For example, traffic engineers have the choice between designing an expensive but compact three or four level interchange or one occupying a much larger area on two levels

(Goldstein, op.cit., p.32). At road crossing points, they have the option of providing footbridges which are less convenient for pedestrians, or underpasses which may be ten times as expensive (Ministry of Transport, 1965, p.400). Alternatively, to permit pedestrian circulation at ground level, they have the option of providing elevated roads at two to eight times the cost of roads at ground level, or roads in cuttings or tunnels, which cause little environmental disturbance, at fifteen to fifty four times the cost (Kerensky, 1968, Table 3):

The diseconomies of providing an adequate public transport system have been noted. With the rise in car ownership and the increased value attached to time spent travelling, this aspect is proving to be increasingly significant. Fare increases to compensate for loss of revenue encourages bus passengers to purchase cars as does a reduction in the frequency of services (Humpidge, 1963). Thus, more public expenditure is required to accommodate more cars and to subsidise public transport services for people without cars. In the United States, it has been shown that the annual deficit on public transport would probably cover the taxi fares for trips of non car-owners, or pay for providing them with second-hand cars (Keefer, 1966, p.21)! The imbalance between the two types of expenditure can be seen in the calculation of public cost for each group of vehicles: public expenditure for private cars is more than ten times that for public service vehicles (Ministry of Transport, 1968c, p.30, para. 97), yet the estimated passenger mileage by car is only five times that by bus (Ministry of Transport, 1968d).

The community is adversely affected in other ways by car users: for instance, the effect of a London commuter choosing to travel by car instead of by bus can be seen in Table 4.2: an additional cost of 4s.7d. per mile

is borne by the community. If it were possible to add social costs (vide 4.4.1), it is possible to show that the community is paying substantial costs towards accommodating car commuters (Mishan, 1969, pp.237-240).

Table 4.2. Community Costs Involved when Commuter Travels to Central London by Car Instead of Bus

	Community Savings Per Mile	Community Costs Per Mile
Subsidy to Public Transport	2s. 5d.	
Road Congestion Imposed by Bus	5d.	
Road Congestion Imposed by Car		7s. 6d.
Additional Cost Per Mile		4s. 7d.

Source: National Board for Incomes and Prices, 1969, p.36.

Introducing measures to encourage motorists to travel by public transport would clearly result in considerable savings, and proposals have been made to achieve this: motorists should park outside town and travel free (Reynolds, op.cit., p.83); the number of car commuters in central areas of towns could be controlled by parking meters but the very high parking charge required to effectively insure the transfer to public transport would probably be so high as to be politically unacceptable (Quarmby, 1964).

Proposals have been made for subsidising public transport to encourage its use: Blumenfeld (1967) considered that if fares were abolished altogether, the lost revenue would in theory be recovered from savings in new road networks resulting from a reduction in car traffic. A free public transport service could be provided by putting a charge on household rates: as a result of the saving of 30% of running costs devoted to fares collection, it has been estimated that in London, this would increase rates by the

equivalent of four shillings per head per week, and in a provincial town, three shillings and sixpence per household (Architects' Journal). The implications of treating public transport as a social service are more fully examined later (vide 4.4).

Various methods have been proposed for taxing road users so that motorists would pay all the costs resulting from their movement; the most promising method appears to be through the use of a charging mechanism such as 'road pricing'. Charges would have to apply to private vehicles only to avoid the further undesirable transfer of passengers to cars. Road pricing may, however, encourage dispersal of facilities from central areas to avoid these charges, resulting in those travelling by public transport being involved in longer journeys. In the absence of such remedial planning policies, a continuing decline in public transport services can be forecast and a concomitant increase in the vast costs of accommodating cars.

The most direct method of reducing public expenditure in this field is, of course, by reducing the need for movement. This may be possible in redevelopment areas or in New Towns where land uses can be allocated to achieve this aim. Systems can also be developed to encourage walking and cycling as the constructional and maintenance costs for these forms of movement are comparatively low; furthermore, the area requirements would be reduced (vide 4.1). Finally, employers could decrease peak demands on roads and public transport services by staggering working hours.

4.3. ASPECTS OF COMMUNITY HEALTH

The health of an individual may be affected beneficially or injuriously by his method of travel. This aspect is usually ignored at the level of personal choice, yet it has a cumulative influence which has considerable impact on community health and welfare services. Even in 1940, it was noted that travelling, whether by car or by public transport, could have adverse effects on health (Royal Commission on the Distribution of the Industrial Population, 1940, para.187). The main hazards associated with vehicular movement are due to air pollution, noise and road accidents.

Air Pollution from Traffic. The toxic effect of vehicle exhaust gases is recognized as a potential hazard to health; this is aggravated by the increasing number of vehicles in use and by the fact that the pollutants are emitted into the air at low level. Carbon monoxide resulting from incomplete combustion is the most dangerous element in vehicle exhaust; other harmful constituents are lead, unburnt hydrocarbons, and nitrogen dioxide. In Great Britain, petrol engines are the main cause of air pollution from motor vehicles (Ministry of Transport, 1967c, p.77). In the United States, they produce more pollution than all other sources combined (Haar, 1968, p.14); in one year, ten thousand inhabitants of Los Angeles were advised by their doctors to leave the city because of its danger to their health (Breach, 1969).

The effects of carbon monoxide on human beings depend on the length of time which they are exposed to it: levels of 120 parts per million for one hour, which are considered dangerous, have often been recorded (Cohen and Preston, op.cit., p.141); during temperature inversions, concentrations reach twenty to thirty times mean annual levels (Ministry of Transport,

1967c, p.73); on busy streets, levels several hundred times greater than the accepted standard in aviation engineering have been recorded (Mackay, 1967, p.67).

Although Godber (1967) was unable to report any harmful effects from vehicle exhausts under British climatic conditions, much evidence is accumulating which suggests that comparatively low concentrations can impair efficiency and affect a person's ability to perform skilled tasks such as driving (Ministry of Transport, 1967c, p.103; Mackay, 1967, p.67; Lewis et alia, 1970, p.96). Similar effects were reported in studies in the United States, which showed that carbon monoxide also affected vision and caused lethargy (McFarland and Moore, op.cit., p.891), and that traffic fumes were dangerously near the level where they could harm mental processes (Larsen, 1962). Early symptoms of an excessive concentration of exhaust fumes are headaches, nausea and giddiness; irritation of eyes, nose and air passages has also been noted (Technical Committee of the National Society for Clean Air, 1967, p.13). Recent research suggests that carbon monoxide from vehicle exhausts is a contributory factor to heart disease (Silcock, 1970).

Whilst most health authorities agree that there is insufficient knowledge of the effects on health of continued exposure to the tetraethyl lead which car exhausts produce at the rate of one kilo annually (Lederberg, 1969), it is believed to cause irritability and to decrease brain function (Times, 1968a). Other pollutants include hydrocarbon waste which causes eye irritation, and nitrogen dioxide which aggravates chronic respiratory disease (Weiner, 1967, pp.11-12).

Studies are now being conducted to investigate whether some pollutants interact in the body with alcohol or drugs, to produce synergetic effects

(Technical Committee of the National Society for Clean Air, op.cit., p.14). Smokers, pregnant women, people taking many drugs, and those consuming alcohol, are particularly sensitive to high carbon monoxide levels since their oxygen uptake is already abnormally high (Zander, 1969). Old and very young people are particularly vulnerable to polluted air, the former in view of their relatively undeveloped lungs, and the latter because of the slow rate at which they can exhale fumes (Cohen and Preston, op.cit., p.145).

Noise from Vehicular Traffic. A survey noted that the sound of traffic was the major source of annoyance in 84% of the urban situations examined: the four main sources of traffic noise were from propulsion, horns, brakes and door slamming (Committee on the Problem of Noise, op.cit.). Composition of noise is of greater importance than its volume, since intermittent traffic can cause more nuisance than a continuous stream of vehicles (Langdon, 1969, p.91). Whilst commercial vehicles produce the greatest reverberation, motor-cycles and cars are increasingly responsible because of their numbers and ubiquity.

Although little research has been carried out into the effects of noise and vibration on human beings, they obviously interfere with communication and are generally believed to aggravate nervous states and to cause psychological fatigue (Burns, 1968, pp.113-134). Two studies have shown that noise undermines concentration, thereby reducing efficiency (Mackay, 1967, p.67); in experiments with Post Office workers in Moscow, significant improvements in productivity were recorded when noise levels were lowered (Aitken, 1968). Studies on patients with ulcers and on rats in laboratory conditions, have demonstrated the effects of this type of stress on physical condition (Mental Health Research Fund, 1967). Ears cannot shut out noise in the same way that eyelids can shut out light,

with the result that many people show fatigue from the effort of remaining asleep in spite of noise (Lukas, 1969). Furthermore, because of the unconscious fear of accidents, vehicular noise has to be constantly monitored, even when it is heard indoors.

Various preventive measures to reduce the harmful effects of air pollution and noise of vehicles have been proposed in recent years. Legislation for dealing with these problems at source is inadequate; statutory regulations governing permitted levels of exhaust pollution simply state that there should be no 'avoidable smoke or visible vapour' (Ministry of Transport, 1966b), but set no standards. It is clear, however, that toxic fumes would be dissipated more quickly and safely if exhaust pipes on vehicles were fixed higher; although petrol can be processed to be free of any lead content, at no more than twopence per gallon (Callow, 1970), no steps are planned to make this mandatory. Vehicles are permitted to emit noise levels up to eighty seven decibels, although this is louder than a pneumatic drill ten yards away (Connell, 1968); furthermore, the increase in the number of vehicles has largely invalidated controls since noise levels represent the cumulative effect of all traffic at any point in time (Ministry of Transport, 1967c, p.70; Burns, op.cit., p.266). Improved sound insulation of buildings is ineffective for a large part of the year, unless combined with expensive air-conditioning systems, as windows need to be opened for ventilation.

There is a likelihood that greater leisure use of the car, and improved traffic management will result in high noise levels over a greater portion of the day and night: the Greater London Council (1969) has reported an increase in overall traffic noise at night and weekends in the last few years, in spite of a reduction in the level of noise emission from individual vehicles.

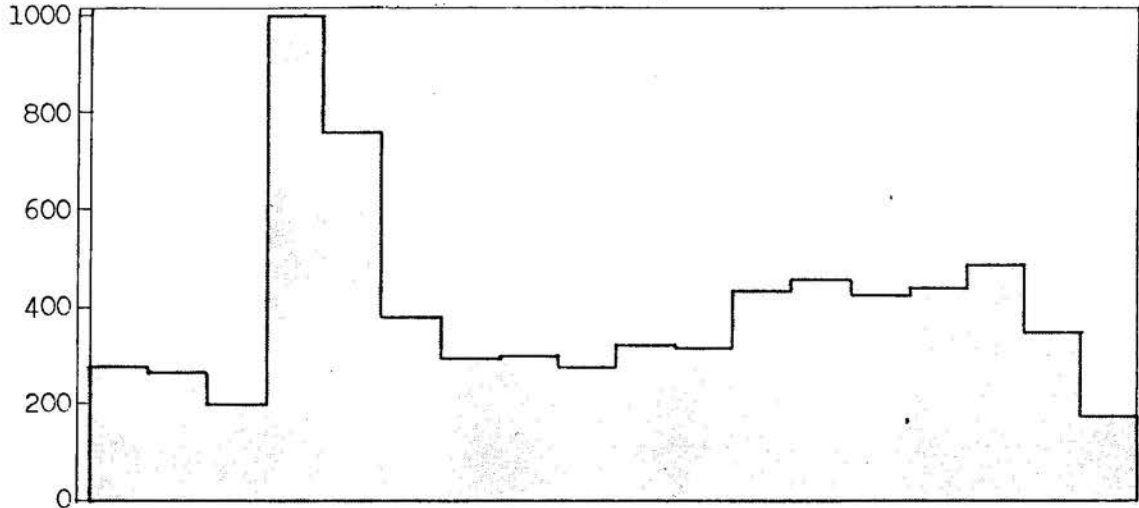
Much research has been carried out to develop cars powered by batteries, which would result in a considerable reduction in noise and air pollution. Unless they are cheaper than petrol driven cars, or the latter are banned from towns, they are unlikely to prove a practicable substitute: the present estimate for adding a battery power system to a family car is in the region of £400 (Times, 1968c). Other effective, though expensive ways, are by erecting impermeable screens to shield buildings (Holden, 1969), or siting traffic routes well away from areas in which people live or work (Langdon, op.cit., pp.90-91).

Road Accidents. These almost certainly have the most distressing influence on community health, of all factors associated with travel. In 1968, there were 6,800 fatalities, 88,600 serious injuries, and 253,800 light injuries on roads in Great Britain (Royal Society for the Prevention of Accidents, 1969, Table 1). If accidents continue at this rate, and there are few indications to the contrary, there is a 1 in 100 risk of death on the roads, a 1 in 7 risk of serious injury, and a 1 in 2 risk of light injury during any lifetime; over the last twenty five years alone, 150,000 persons have died and 6,600,000 persons have been injured on the roads (calculated from figures, ibid.). During this period, there has been an average of eight million vehicles on the roads; the forecast level for 1980 is twenty seven million, and for the year 2000, forty million (Tanner, 1967).

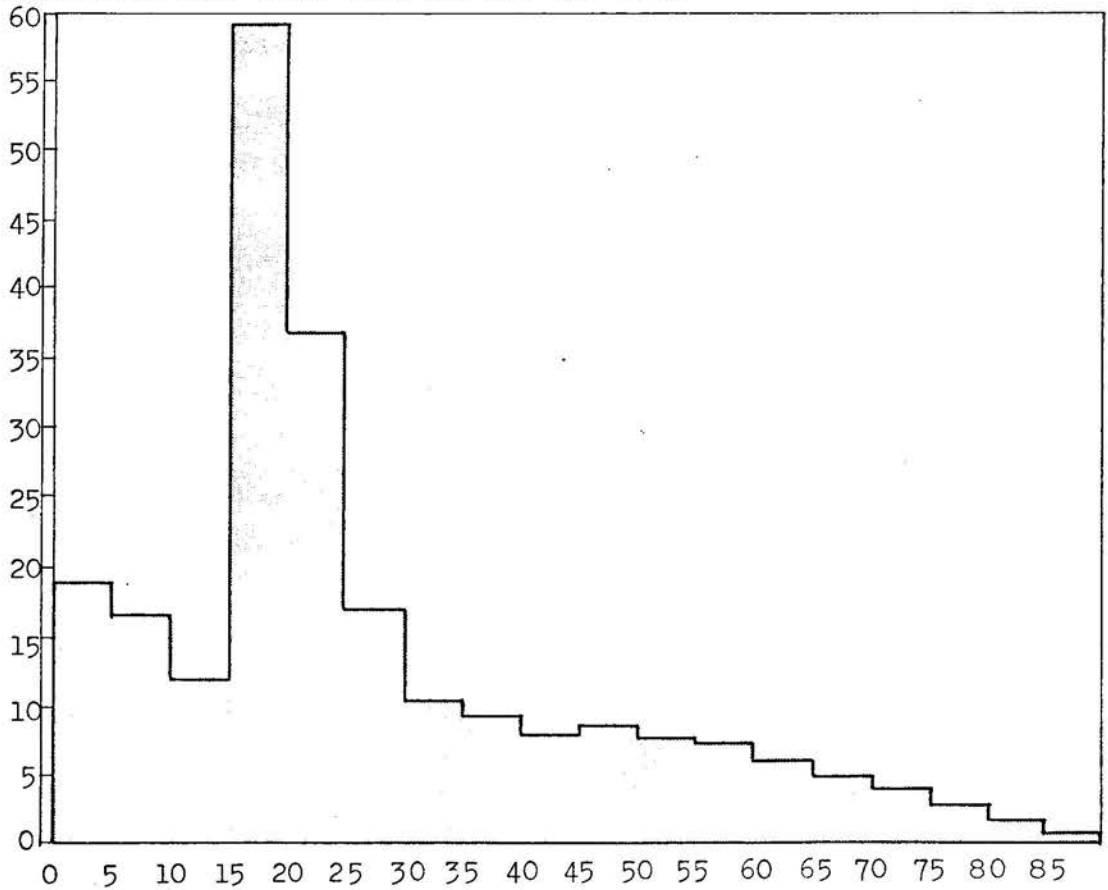
A further indication of the effect of accidents can be gauged from the fact that they are one of the primary causes of premature death. Diagram 4.2, which has been prepared by the author from available figures of road fatalities and life expectancy in 1967, illustrates dramatically the loss of life years from which can be inferred substantial suffering

Diagram 4.2. Road Fatalities and Life Years Lost According to Age (1968)

Number of Road Fatalities in Each Age Group



Thousands of Life Years Lost in Each Age Group



Constructed from Central Statistical Office (1969, Table 35)
and Royal Society for the Prevention of Accidents (1969)

and loss to the country of potentially productive human resources.

Although it is known that old people feel grief for the loss of children and other relatives for a considerable time (Office of Health Economics, 1968, p.175; Welford, 1969), and that children often suffer psychiatric disturbance when a parent dies (Wolff, 1969), research has not been carried out to ascertain the degree of suffering and hardship through bereavement.

The full extent of stress is not apparent from statistics of road casualties. Even if one only considers an average household of 3.5 persons, all of whose members will have experienced at least acute anxiety when a road accident occurred in 1968, there are now 17,000 bereaved persons as a result of road fatalities in that year, 220,000 persons in a state of stress as a result of serious injury, and 635,000 persons will have experienced anxiety because of a light injury to a close member of their family; in total, over 1,200,000 persons were emotionally affected to varying degrees by road accidents in the one year. Even if one excludes friends of people involved in accidents, and considers the grief caused only to relatives, defined in the Mental Health Act (1959) as additionally consisting of brothers and sisters, aunts and uncles, nephews and nieces, and grandparents, these figures would be multiplied many times, as a typical kinship structure consists of twenty members (Shanas, Townsend et alia, op.cit., p.169, Table VI).

The possibility of traffic accidents may itself produce stress:

Gavron (1966) found that children's play was a constant source of worry to more than three quarters of mothers for this reason; Levin and Bruce (1968) also detected consistent parental anxiety for the safety of children travelling to school; a survey into the use of playgrounds in Stevenage referred to the same concern regarding return journeys in the evenings (Stevenage Development Corporation, op.cit., p.25).

4.3.1. Health Aspects: Movement by Car

The comfort and convenience of car travel may relieve some of the tensions and frustrations associated with movement by public transport, such as having to rely on service schedules. There is also no risk of picking up contagious infections in cars as there is on buses. The car driver's privacy on his journey has been referred to as one of the few potentially relaxing periods of the day (Gans, op.cit., p.222). Cars are also the only practical means of travel for a small section of the population whose health or handicap does not permit them to walk or travel by public transport. On the other hand, car travel creates situations which are in many ways prejudicial to the health of the driver and the community.

Driving. Stress in driving arises from the need to be careful at all times, and to constantly assimilate information from traffic signs and from other drivers, irrespective of physical or mental well-being. The driver needs to exhibit a high level of skill, involving anticipation and concentration, which entails a sustained quality of performance which, judging by the number of accidents, taxes many well beyond the limits of their competence. It has been calculated that near collisions take place one hundred and twenty two times more frequently than the number of actual accidents (Platt, 1958). These near-accidents may encourage aggressive behaviour, frustration and anxiety, which are conditions deleterious to health because they cannot be dissipated easily within a motor vehicle.

Studies have shown behavioural changes in drivers, and emotional and psychological changes causing increased heart rate, higher blood pressure and sweating (Weiner, op.cit., pp.7-10): in a study carried out jointly by the Metropolitan Police and the Medical Research Council, in competitive situations

they showed a pronounced increase in heart rate, followed by marked fluctuations (Observer, 1968). Other studies have shown conclusively that driving causes an appreciable reduction in coronary artery circulation: pulse rates, even on country roads, were found to be 10% above normal in three quarters of drivers tested in city traffic; the rate of 80.6% rose by more than 20%; in critical situations it increased up to 30% in 28.3% of drivers, and by up to 40% in 11.2%; similarly blood pressure rose by 30% in 11.2% of drivers on lonely rural roads, in 28.5% of cases in urban traffic and in 30.3% of cases in critical traffic conditions (Hoffman, op.cit., p.5).

Delays due to road works may result in stress and anxiety. In addition, there are the possibilities of electrical faults, which are the most frequent cause of breakdown, running out of petrol, punctures, or mechanical failures; a quarter of motorists interviewed in a survey had been stranded in the previous twelve months (Automobile Association, 1967a), and in 1969 there were two million calls from the four million members of the Automobile Association, for their breakdown service (Automobile Association, 1970). Parking cars has been described as a "major anxiety attendant upon every journey by motor vehicle" (Buchanan et alia, 1963, para.11). Even the absence of the car for repair or maintenance may be a source of concern, particularly for people dependent for their livelihood on its use.

Car Accidents. The most serious causes of stress result from road accidents. Nearly one quarter of a million cars were involved in accidents in 1968 (Royal Society for the Prevention of Accidents, 1969, Table 16). The victims include not only drivers and passengers, but also pedestrians, who together represent by far the largest category of road casualties caused by vehicles. The gross effects of grief and stress have been indicated earlier.

Motoring Offences. Traffic and motoring offences accounted for two thirds of all indictable crimes in 1968 (Home Office, 1969, p.XI): over one million drivers were found guilty of traffic offences, and a further one and a half million were found guilty of motoring offences. 880,000 drivers were convicted for offences counting towards disqualification, and over 100,000 were disqualified (Offences Related to Motor Vehicles, op.cit.); traffic wardens issued over a million summonses for parking offences, and police departments a further four million (Charles, 1969a); nearly two million claims were made in 1967 on motor insurance policies (British Insurance Association, 1969). It is very likely that some element of stress was induced as a result of each of these incidents.

The possession of a car is dependent on numerous regulations covering driving licences, vehicle licences, insurance certificates, test certificates, condition of the vehicle, noise and exhaust emission, headlamps, tyre treads, etc. These regulations may also cause anxiety, due to their need to be adhered to, and the consequences should they be broken.

Noise and Pollution. The harmful effects of noise and air pollution from vehicles has been referred to (vide 4.3). Cars are the cause of an increasing proportion of these pollutants, resulting in lower efficiency at work and sometimes disturbed sleep, particularly in residential areas where cars are the predominant vehicles.

Physical Exercise. Regular travel by car usually results in failure to take daily physical exercise and the danger to health resulting from this is detailed later (vide 4.3.6).

Many of these aspects of car travel can directly or indirectly cause physical or mental disturbances. Stress is difficult to measure though it

is now fully accepted in the aetiology of psychosomatic illness; there are, however, few studies on this subject. Selye (1957) reviewed the physical and chemical changes in the body when living organisms are subjected to stress, and concluded that the same changes occurred whether stimuli are physiological or psychological; he also stated that there were long term consequences of excessive activity of adrenal glands, due to the limit of the adaptability of the body (pp.130, 274). Dubos (1967) similarly affirmed that whilst human beings can adapt to extreme situations, they pay later in one way or another for adjustment to undesirable conditions.

Physical disorders resulting from chronic stress include ulcers, coronary thromboses, strokes, increased vulnerability to infection and emotional disturbance (Stafford Clark, 1968). It has been surmised that stress reduces energy available for creative purposes (Paterson, 1969), and this would seem to be borne out by the ennui felt after travelling in congested traffic conditions at rush hours. The increase of 36% in the last two years in the number of prescriptions for tranquillisers, which rose to an annual total of 14.7 million in 1967 (Ministry of Health, 1968), may be indicative of this problem.

4.3.2. Health Aspects: Movement by Motor-Cycle

The main advantage of travel by motor-cycle is its convenience, free of the frustrations of service schedules. However, similar conclusions regarding the deleterious health aspects of driving cars can be drawn about riding motor-cycles. Moreover, the risk of accident is far greater (vide 2.3): in 1968, nearly 900 riders and passengers were killed, and 60,000 injured (Royal Society for the Prevention of Accidents, 1969, pp.4-5, Tables 4-6). Furthermore, motor-cycles at present cause excessive noise;

they subject riders and their passengers to strain due to the comparative instability and lack of protection of two-wheeled vehicles, and expose them to air polluted by exhaust fumes from other traffic.

4.3.3. Health Aspects: Movement by Bus

There are a number of health advantages associated with bus travel: the walk to and from the bus stop ensures some regular exercise, the benefits of which are described later (vide 4.3.6); bus passengers are free of the responsibilities of driving and parking, and in contrast to motorists, they can relax, read, or even doze; the risk of accident is small.

The main cause of stress and frustration associated with travel by public transport are due to the inconveniences of the various stages of the journey: waiting and queuing, sometimes in inclement weather and for inadequate services; there may be nervous tension associated with the desire for speed and punctuality (Wolffe, 1966). Indeed, convenient public transport to communal amenities has been cited as an essential element in the field of preventive medicine (Myasnikov, 1966)!

In this context, even recent proposals for the 'Dial-a-Bus' system (Haar, 1969) are unsatisfactory: the passenger, having boarded the vehicle to reach his destination as soon as possible, will constantly be in doubt as to the number of stops and re-routings that may occur on the way; this would certainly prove frustrating.

Bus passengers are exposed to cross-infections which can be a significant consideration from the point of view of community health, particularly during influenza epidemics. The health hazards of air pollution and noise from vehicle exhaust are particularly relevant to the diesel engines of buses, though the net effect per passenger journey is far less than that

caused by the number of cars which might otherwise convey the same passengers. Although buses produce sixteen times the noise equivalent of cars (Vulkan, 1969), they are also less likely to cause disturbance owing to their infrequency, particularly in residential areas, and their restriction to main roads.

4.3.4. Health Aspects: Movement by Taxi

Travel by taxi is advantageous in most respects of health. Passengers are relieved of the strain of driving and the problems of parking; furthermore, risk of accidents is considerably reduced with their professional drivers. Depending very much on economic circumstances, the traveller can be disturbed by the taxi meter!

4.3.5. Health Aspects: Movement by Bicycle

Cycling is one of the most silent forms of transport, and also has the advantage of not producing noxious fumes. It is a complete form of exercise, the benefits of which are discussed in the next sub-section, and is entirely conducive to good health (Woodward, 1965). Moreover, there is no medical reason why persons of any age, including pregnant women, should not cycle; indeed, it has been cited as an effective preventive measure for many rheumatic and arthritic conditions (ibid.). However, in the absence of separated cycleways, cyclists are exposed to noise and exhaust fumes from motor vehicles, and run a high risk of accident, the severity of which is generally great owing to their lack of protection.

4.3.6. Health Aspects: Movement on Foot

In common with cyclists, pedestrians are exposed to the noise and fumes of motor vehicles, and run a high risk of accident where no traffic-free routes exist. However, most health aspects of walking are entirely positive: it is a simple form of exercise which encourages natural use of limbs and lungs, and permits a wide range of exertion by varying speed; no adverse effects amongst healthy persons have been noted to result even from an excess of it (Abrahams, 1962, pp.103-105). It is only in existing traffic situations that pedestrians are exposed to vehicular noise and fumes, experience frustrations and delays in negotiating busy roads, and anxiety about their safety. Punctuality is relatively easy to achieve since the time taken on the journey is very predictable.

The decline in pedestrian movement is thought to be a significant contributory factor to ill-health; mechanisation and the development of modern means of transportation have reduced physical effort to such an extent that there has been a notable reduction in the use of muscles (Davies, 1968). A relationship between coronary heart disease and environmental factors such as lack of physical exercise has been demonstrated: for example, drivers of London's double-decker buses are more likely to die from coronary thrombosis than the conductors (Morris, 1951), and Government clerks suffer more than postmen from rapidly fatal heart attacks (Carter, op.cit., p.59). This causal relationship between heart disease and physical inactivity has been confirmed by numerous other authorities (British Medical Journal, 1965b; Office of Health Economics, 1966a, p.37; Office of Health Economics, 1966b, p.6; Teraslinna et alia., 1968; Fudkin, 1969).

A further contributory factor to heart disease is obesity (Baird, 1969), which carries an even greater health risk than smoking twenty five cigarettes

a day (Office of Health Economics, 1969a, p.3); one in five of the population of this country is technically obese (Lynn, 1969). According to some authorities, one of the main causes of obesity is lack of exercise (Craddock, 1969; Lloyd, 1969), for physical exertion has been shown to be very effective in keeping down the level of cholesterol (Susser, 1962). Moreover, obesity is believed to arise more from insufficient exercise than from too much eating (Davies, op.cit): a survey recorded that obese subjects walked only two miles a day, compared with controls' five miles (Office of Health Economics, 1969a, p.13). Leg exercise is a great variable in the expenditure of energy since 100-550 calories are used up per hour walking, and up to 600 when cycling (Mayer, 1968, pp.69-71).

Walking has been cited by many authorities as an effective method of taking regular exercise, and especially for those suffering from most heart conditions. In a study in Canada, an increase of 10% to 20% in the working capacity of young adults resulted from half an hour's exercise five days a week, and exercise for only ten minutes a day considerably improved working performance (Roskamm, 1967). Many authorities at an International Symposium on the cause and prevention of heart disease (Raab, 1966) recommended walking as a daily exercise throughout life because of its prophylactic value in this respect. It has also been cited as an effective means of treating obesity (Mayer, op.cit., pp.163, 201) and of combatting strokes which are the third commonest cause of death in England and Wales (Carter, op.cit., pp.12, 72).

Rheumatoid arthritis is also a degenerative condition of elderly persons; it is one of the two diseases with the highest consultation rates (World Health Organisation, 1965). Severe arthritis is aggravated by physical inactivity (Luthie, 1969); preventive measures recommended for this condition

are to be as active as possible (Thomson, 1962), provided that nothing heavy is carried (Goldsmith, 1967).

In a study of old age, one of the three main recommendations made for the prevention of disability was that physical mobility should be maintained for as long as possible; it was stated that the quality of life would thus be raised, and economic benefits would be brought to the community by the reduction of direct health and welfare expenditure (Office of Health Economics, 1968, pp.28-31). Indeed, exercise has been cited as an ideal measure to reduce both physical and mental illness in later life, resulting from decreasing mobility; to be effective, however, it must be taken regularly and throughout life (Hobson, 1956; Abrahams, op.cit., pp.103-105).

Participation in sporting activities such as golf, tennis, other intermittent sports and health clubs is considered a totally inadequate alternative to daily exercise, in preventive medicine (Cureton, 1966).

Walking is clearly beneficial to the physical health of children; it can also contribute indirectly to their psychological well-being. A study of the relationship between the journey to school, and social and emotional adjustment has shown that there is less absenteeism, higher academic results, and less mental anxiety amongst children who walk to school than amongst those who travel by bus or car (Lee, 1957); it was thought that this was partly due to the fact that the child knows that in a crisis he can reach home on foot whereas he would be crossing a 'no-man's land' if travelling by bus, and would feel entirely cut off from home if he had to wait to be collected by car.

4.3.7. Comparative Analysis of the Health Aspects of Six Methods of Movement

The harmful effects of traffic on the health of the community are very evident. It has been seen that they are primarily caused by decreasing incentives to walk, by road accidents and by air pollution. The stress and anxiety associated with vehicular noise and driving also have adverse consequences. Various preventive health measures have been noted, including proposals to ameliorate the ill-effects of traffic noise and exhaust pollution, more effective legislation to contain them at origin, and development of alternatives to the petrol engine as the source of vehicular power.

Although travel by car has been shown to be beneficial in limited ways, it is suspected of having a causal link with much ill-health; increasing affluence and rising standards of comfort reduce the need for physical activity in movement. Frustration associated with infrequent or unreliable bus services are to some extent compensated for, from the health point of view, by the beneficial effect of walking to and from bus stops. Community health is also affected by an increasing dependence on motorised transport; children, in particular, are victims of restraints imposed by exigencies for their safety, which effectively reduce their mobility and relative freedom of action.

4.4. SOCIAL IMPLICATIONS

Social implications were implicit in the analyses of the area requirements, public expenditure and effects on health of alternative methods of movement. Many of the aspects examined, which influence the individual's choice of method, were seen to be at variance with the interests of the community and indicate that choice is dictated almost entirely by considerations of personal advantage. There are also more direct social consequences: since movement in a town can be a social activity, the chosen method may influence social behaviour. Even twenty five years ago, reference was made to the "depersonalising effects of movement by mechanical means" (Carr-Saunders, 1944).

4.4.1. Social Implications: Movement by Car

Whilst cars enable journeys to be made frequently, quickly, in comfort and with little effort, and provide opportunities for their owners to occasionally provide a service for their less mobile friends or relatives, the broader social implications of car journeys should be weighed against these benefits. Social costs involved in the unrestricted use of cars in towns are difficult to assess; however, conflicting spatial needs of private and public transport (vide 4.1) highlight the fact that, with more people travelling by car, the relative immobility of people without the use of a car is accentuated (Bracey, 1966; Gans, op.cit., p.226; Pahl, op.cit.; Haar, op.cit., p.17).

It has been argued that accessibility rather than propinquity is the more important condition for maintaining social contacts (Webber, 1964), but this does not hold true for people without the use of cars. In their case,

accessibility and propinquity are synonymous, and social interaction and other leisure activities are very much influenced by distance; as a result, the convenience of those without cars is reduced in areas planned to accommodate unrestricted vehicular movement (vide 5.5).

Travel by car also has a direct influence on the speed of all other road users: Smeed and Wardrop (op.cit., p.301) have calculated that in Central London, if all journeys to work were undertaken by bus, vehicle speeds would rise by 24%, but would fall by 20% if the percentage travelling by car increased by only 10% - they considered these calculations to be generally applicable to other large towns. Webster (op.cit., p.1) has established that if all commuters travelled by public transport, the aggregate time for journeys of the total number of travellers would be reduced by one third. Yet the individual cannot be expected to be governed by this consideration when contemplating his own journey.

Similarly, although road accidents are an undesirable consequence of travel by car, it is unrealistic to expect a car driver to travel by bus because he feels it immoral to risk the lives of pedestrians, or because he wishes to make his small contribution to ensuring the viability of public transport!

In the analysis of the causes of road accidents (vide 2.3), reference was made to the personality transformation which the car driver often undergoes; this can be attributed to the anonymity of the motorist, who can withdraw from an embarrassing situation simply by driving faster. His physical detachment and the insulation from the noise of other vehicles, can engender a lack of sensitivity to other drivers and pedestrians (Lorenz, 1963; Morris, 1969, p.75), and a loss of appreciation of the environment. The driver's inability to communicate verbally prevents him from expressing gratitude, annoyance, caution

or courtesy. This decreases his social concern, encourages latent anti-social habits and selfish behaviour, and provides outlets for natural aggression, all of which are preferably dissipated in situations less disadvantageous to society.

Other social consequences of car travel include such immeasurable factors as the unsightliness of vehicles, road signs, signals, markings, parking meters and other associated 'street furniture' (Buchanan et alia, op.cit., p.21, paras.32-35), and the visual fragmentation of towns with public and commercial facilities surrounded by parking lots. Comparatively little research has been carried out in this field, although it is generally acknowledged to be 'a major social problem' (ibid., p.36).

4.4.2. Social Implications: Movement by Motor-Cycle

The main social disadvantages of travel by motor-cycle are the noise disturbance caused along its route and the costs to the community resulting from the high accident rate. It is however fairly economical in terms of the road area that it occupies and associated public expenditure.

4.4.3. Social Implications: Movement by Bus

The increasing transfer from travel by bus to car, which has contributed to the comparatively steep rise in bus fares, appears to encourage undesirable social stratification since those who travel by bus are usually poorer than those who travel by car. The declining financial viability of public transport (vide 4.2) is, therefore, of great concern to those who feel that this form of movement should not necessarily have to pay for itself, but should be a social service provided from public taxation. Even in an affluent society, various social, economic and age groups are still very dependent on

public transport; the fact that a substantial decline in its use has been forecast, in no way reduces their need for a frequent, reliable and economic service.

It has been estimated that the majority of the population are likely to be without the exclusive use of a car, even by the end of the century (vide 2.7): this includes not only all members of households without cars, but also people who do not wish to, or are unable to use 'the household car'. School children require transport throughout the day during the fifteen weeks a year that they are on holiday and to a reduced extent during term time; teenagers, until they are old enough and can afford to run a car, may require transport at all times of the day, often when the demand for a service is low; all adults without the exclusive use of a car are dependent on transport at varying times of the day. In these circumstances, buses are very clearly required as a public service.

A further example of conflict of interest can be seen in the introduction of 'one-man' buses: mothers with push-chairs and shopping, and old and disabled people who move with difficulty, obviously appreciate the assistance that a conductor can give them, and these are the people who are most dependent on public transport. The inconveniences of bus services are the subject of consistent complaints in established and new towns. Although substantial grants are being given by the Government (vide 4.2.2), and buses are recommended to be given priority on roads (Ministry of Transport, 1969b), current policy is that public transport should pay for itself, and local authorities are not prepared to run it as a social service. Society must choose whether it wants public transport to be run to maximise profits for the operators, or whether it wants a comprehensive though uneconomic service to be provided all day in the public interest (Foster, op.cit.); those who have no alternative to using buses clearly would prefer the latter option.

Travel by bus provides some opportunities for social behaviour. The immediacy of the situation, with the reward of social approval, is obviously more conducive to conversation or rendering of assistance to people in difficulty. Moreover, bus travel can be viewed as a typical communal activity since passengers share a public facility to satisfy their private needs.

4.4.4. Social Implications: Movement by Taxi

Travel by taxi has similar social consequences to travel by car, since both vehicles make demands on road space and effectively reduce the speed of other vehicles. However, the taxi has an advantage similar to the bus, in daily transferring a large number of people who may otherwise travel individually by car.

4.4.5. Social Implications: Movement by Bicycle

Travel by bicycle is beneficial from a social point of view as it does not cause noise or pollute the air. Along traffic-separated routes, only very rare and minor accidents are likely to occur; in these situations also, cyclists are able to communicate fairly easily with each other and with pedestrians.

4.4.6. Social Implications: Movement on Foot

Mutual recognition is considered the most important condition of communication, and is fundamental to social integration (Wynne-Edwards, 1962). People are more likely to evoke sympathy and reaction as a result of identification with others, for a greater sense of responsibility is shown

in places where people are recognised (Hall, 1966; Seebohm Report, 1968); it is also thought that there are more feelings of identity and friendliness in surroundings with which they are familiar (de Lauwe, 1963; Parr, 1965; Sommer, 1966; Ardrey, 1967; Gutman, 1967; Russell and Russell, 1968, p.175).

Pedestrian movement makes this possible and encourages social intercourse between people of different ages and in different walks of life and circumstances, thus promoting integration. Occasions arise naturally when help, such as carrying shopping for old people, can be given. The street generates interaction due to the likelihood of recurrent informal meetings (Festinger, Shachter and Back, 1950; Hole, 1959; Haynes and Raven, 1963; Ritter, 1964, pp.31, 225; Lee, 1967a). The social value of these occasions was stressed earlier (vide 1.7): in particular it was noted that children benefit from the observation of adults' activities and from contact with people outside their normal home and school environment; the street also acts as a convenient meeting ground for adolescents who increasingly prefer activities away from home, and for housewives who enjoy opportunities for meeting others in informal surroundings; it was also suggested that even the superficial level of social interaction may contribute to elderly persons' feelings of psychological well-being, and as a result, could be a factor in the prevention of their loneliness.

4.4.7. Comparative Analysis of the Social Implications of Six Methods of Movement

The chosen method of movement of one individual may conflict with the convenience of movement of others: pedestrians crossing roads may reduce the effective speeds of vehicles substantially, yet measures to prevent this delay usually result in pedestrians walking farther, with more effort and discomfort; travel by bicycle is inhibited by the danger, noise and pollution from vehicles.

Travel by car has social consequences which are mainly detrimental, whilst travel by bus, cycling and walking make much smaller demands on public space and expenditure, and encourage some social interaction. It would appear to be beneficial to the community, therefore, if more people could be encouraged to travel by means other than by car. There are many indications that public expenditure devoted to this end, such as treating public transport as a social service and providing covered ways and direct routes for pedestrians, could be of considerable social benefit. These considerations should be weighed against the personal preferences of the politically articulate adult car owner (Buchanan et alia, op.cit., p.31).

Parr (1967) has referred to the virtues of the pedestrian era of previous times in which the orbits of all members of the family coincided, resulting in many shared experiences; he considers that communication is not encouraged by the social separation so evident in existing residential neighbourhoods; this observation would appear to be equally applicable to the unwitting though effective separation, by age, income or ability, of people able to travel by car, and those obliged to travel by bus or on foot.

4.5. SUMMARY AND CONCLUSIONS

The effects on the community of travel by the six methods of movement are summarised in Table 4.3.

Cars, Taxis and Motor-Cycles are uneconomic from the community viewpoint: they have high areal requirements per person both when stationary and in movement. Considerable direct and indirect public expenditure is involved as a result of their use, particularly if it is unrestricted. The reduction in environmental quality due to noise and air pollution, the detriment to health and other social costs to the community, greatly exceed those of other methods.

Buses use little road area when vehicular occupancy is taken into consideration and public expenditure on roads per passenger mile is, therefore, much lower than for cars. They are more advantageous than cars from health and social viewpoints.

Cycling and Walking are extremely economical in terms of areal requirements and public expenditure. They are very beneficial to health, and have considerable social advantages relative to the other methods.

The author strongly calls into question any solution to the problems of movement in towns, which primarily benefits only one section of society to the detriment of others. He believes that the convenience, health, and social welfare of the community as a whole, are more valid criteria than the cost or time-saving of the minority who have sole use of cars, in assessing the relative advantages of different methods of movement.

The planning of towns requires conscious decisions about the allocation of public resources - both areal and financial - to meet the optimal needs of persons travelling by car, public transport or on foot.

Since it has been concluded that cars, motor-cycles and to a limited extent, taxis are mainly disadvantageous to the community, particularly in reducing the efficiency of the other methods of movement upon which the majority of the population depend, it would appear that a reappraisal of the movement systems for towns is merited. Consideration could be given to methods of reversing the current trend of increased travel by car. The only realistic solution, applicable primarily in new urban areas, would appear to be to plan deliberately to reduce the need for vehicular movement and to promote travel by other methods. If this could be achieved, both the individual and the community would benefit substantially.

Table 4.3. Summary of Major Aspects of Six Methods of Movement Affecting the Community

Factor Affecting Community	CAR	MOTOR-CYCLE	BUS	TAXI	BICYCLE	WALK	notes
AREA REQUIREMENTS							Number of asterisks indicates relative economy, quality or benefit of each method assessed as a conclusion from the author's consideration of evidence in this chapter.
measured by economy of road space:							
when stationary	*	***		*	***	****	
when in motion	*	**		*	***	****	
with typical occupancy		*	**		-	-	
PUBLIC EXPENDITURE							** represents the mean - represents inapplicable
measured by saving of costs on roads per person mile:							
construction		*	**		****	****	
maintenance		*	**		****	****	
traffic control		*	**		****	****	
costs of accidents			**	*	****	****	
and by saving of concealed:							
social costs		**	***	***	****	****	
health costs		**	***	***	****	****	
COMMUNITY HEALTH							
quality measured by lack of:							
air pollution	*	*		**	****	****	
noise and vibration	*		**	*	****	****	
personal stress			**	***	****	****	
stress to others	*		***	*	****	****	
spread of disease	****	****	*	****	****	****	
SOCIAL CONSIDERATIONS							
advantage measured by							
sharing of experience		*	**		***	****	
ease of movement of others		*	***	*	***	****	
and encouragement of:							
social intercourse		*	***		**	****	
social behaviour		*	***		***	****	

5. URBAN STRUCTURE AND MOVEMENT SYSTEMS

5.0.	INTRODUCTION	250
5.1.	ACTIVITIES	251
5.1.1.	Social Facilities	252
5.1.2.	Social Activity	255
5.2.	LOCATION	260
5.2.1.	Problems of Optimal Location	261
5.2.2.	Benefits of Optimal Location	262
5.3.	ACCESSIBILITY	266
5.3.1.	Accessibility and Proximity	266
5.3.2.	Distance and Methods of Movement	269
5.3.3.	Factors Influencing Acceptable Distance	270
5.4.	COMMUNITY SIZE	277
5.4.1.	Population	277
5.4.2.	Physical Size	278
5.4.3.	Population Density	284
5.5.	ACTIVITY OPTIONS	291
5.5.1.	Method of Travel and Available Time	291
5.5.2.	Age and Mobility	291
5.5.3.	Density and Opportunity	293
5.6.	MOVEMENT SYSTEMS FOR NEW TOWNS	298
5.6.1.	The Private Car: Public Transport: Pedestrian System	299
5.6.2.	The Private Car: Pedestrian; Public Transport System	307
5.6.3.	The Public Transport: Private Car: Pedestrian System	313
5.6.4.	The Public Transport: Pedestrian: Private Car System	319
5.7.	SUMMARY AND CONCLUSIONS	323

5.0. INTRODUCTION

The main advantage of living in towns is the opportunity for interaction with people and activities, and the stimulation that it can bring (Morris, 1959); urbanity can be measured by the amount and variety of this interaction (Webber, 1964b, p.88). Whilst the physical environment may be relatively unimportant in determining behaviour (Broadly, 1968), where individuals work, or which schools or hospitals they attend, it can affect individual motivation by reducing the 'costs' and effort of travel and by increasing the available options.

A number of conclusions were drawn in the previous chapters, from identification of the mobility and patterns of activity of each age group, and the characteristics of alternative methods of movement; these factors are generally the main determinants of urban structure. The basic criteria for an optimal structure designed to balance the travel needs of people of all ages in the community are examined in this chapter. They must be based on the activities, abilities and preferences of individuals, with minimum prejudice to the interests of the community. Conflict of interests inevitably arise: in nature, this is resolved by the subordination of individual activity when the welfare of the community is threatened (Carr Saunders, 1922, p.216; Wynne-Edwards, 1962); the planner's function would seem to be to attempt to make individual and community interest coincident.

The following interrelated aspects of urban structure are considered:

- 5.1. Activities; 5.2. Location; 5.3. Accessibility; 5.4. Community Size;
- 5.5. Activity Options; 5.6. Movement Systems.

5.1. ACTIVITIES

Peoples' activities can be divided between the essential ones of work, shopping and school, the primary purposes of which are economic, domestic and educational, and the optional ones of friendship, entertainment and recreation, which are mainly for social, cultural and physical cultural purposes. It has been suggested that an essential characteristic of urban life is the wide range of opportunities it provides: this has always been dependent on 'catchment areas', usually of population (Bauer, 1952). In many surveys, families that have moved from London to New Towns have complained that they missed most the facilities and amenities of the big city (Thomas, 1969, p.390). The range of opportunities is being affected by two clearly identifiable trends: greater expectation of choice (Mann, 1965, p.104), as a result of higher wages, rising standards of comfort, increased leisure time and improved mobility, and a concomitant increasing specialisation of facilities.

An examination of these activities shows that their size and location are usually determined by economic considerations which dictate larger rather than smaller units. This is socially justifiable, for example in the case of health centres that may provide a better clinical service, or commercially, in the case of supermarkets which can offer a wider choice of goods. Social interaction is also dependent upon population catchments, and this is particularly relevant to the formation and maintenance of friendships of children, mothers of young children and elderly persons.

5.1.1. Social Facilities

Many facilities such as churches, parks, sports centres, clubs, cinemas, and restaurants, are frequented by people of most ages (Waldorf, 1966). Swimming and dancing are the most popular activities outside the home (Rodgers, 1967, Section 1.7; Sillitoe, 1969, p.34); sports centres that include gymnasias and club facilities catering for school children during the week, and for the recreation of the whole family in the evenings and at weekends, are increasingly popular (Allen, 1969). A library service, secondary school, and community college complex can be organised most effectively for populations of thirty thousand (Department of Employment and Productivity, 1968).

The Ministry of Health recommends large health centres with six doctors, to serve about ten thousand people; these centres can contain maternity and welfare clinics, and offer dental services, preventive screening facilities, and a twenty four hour emergency service (Cohen, 1966; Ministry of Health and Social Security, 1967a; 1967b). District General Hospitals normally serving populations of one hundred to one hundred and fifty thousand persons, and providing treatment and diagnostic facilities, and short stay psychiatric and geriatric units, are also recommended (Ministry of Health, 1962). The Seeborn Report (1968, paras.108-109) refers to the benefits of decentralisation of social services so that they can be more accessible to the public; it also refers to the advantages of all departments being under one roof in area establishments serving between fifty and one hundred thousand people (ibid., pp.583, 590). Such numbers of people are necessary to support mental health centres (Caplan, 1964; Department of Health and Social Security, 1969).

In addition to the above, social facilities are required for specific age groups:

Pre-school Children. The need for nurseries, preferably planned near primary schools, was stressed in the Plowden Report (Plowden et alia, 1967, para.302). Small children also need outdoor play spaces, preferably supervised by trained adults, or within sight of their mothers (Hole and Miller, 1966; Antony Beckingham et alia., 1968; Stevenage Development Corporation, 1969, p.34).

Primary School Children. The Plowden Report recommended two- or three-form, rather than one-form entry primary schools (Plowden et alia, op.cit., para.467); a choice of schools is also preferable (ibid., para. 130; Levin and Bruce, 1968, p.63). Children require a range of playground facilities and equipment to meet their changing needs, and a choice of locale for their outdoor activities (Hole, 1966, p.34; Planning and Research Department, 1966, p.10; Shankland, Cox and Associates, 1969, p.13), preferably with toilets, indoor accommodation for bad weather, and flood-lighting in winter months, to extend their period of use (Stevenage Development Corporation, op.cit., pp.29,34).

Adolescents. The benefits of combining two large comprehensive schools with a total student population of eighteen hundred pupils, in order to make it economic to provide specialised facilities, has been cited (Sports Council, 1968, p.71); in the United States, 'educational' parks for over four thousand pupils are proposed for similar reasons (Abel, 1970). Population catchments for the leisure activities that adolescents enjoy, increase as they grow older: they develop interests in the diversity of central urban activities such as dance halls, clubs and sports centres, rather than the security and limited range of local ones.

Adults. The range of opportunities for employment increases with the size of population. This can strongly affect women's motivations to work, especially in part-time employment; the complementary functions of nurseries, upon which working mothers often rely, are likewise dependent upon adequate population catchments. The ease with which they can return home for lunch or attend to young children is a further influence. Housewives prefer shopping centres with more than one supermarket, to give them a wider range of goods and competitive prices (Byron, 1967, p.103; Consumers Association, 1969). Here again the trend is towards serving large populations: the forecast growth of supermarkets in the decade from 1967-1977 is 250%, by which time it is estimated that they will be responsible for three quarters of the retail trade (Lintas, 1968). Supervised play areas and public lavatories in shopping centres were given high priority in a shopping survey enquiring into the existing provision of facilities (Consumers Association, op.cit.); coffee houses and social clubs are also desirable. Maternity child welfare clinics and social service centres within walking distance of home, for mothers with perambulators, have been recommended (Cullingworth et alia, 1967, pp.31-33).

At present, half the men and one third of the women in the United Kingdom are members of clubs, and nearly one in four men prefer organised group activities (Sillitoe, op.cit., pp.18, 30). A preference for large dance halls, rather than local community centres has also been noted (Alderson, 1962). Adults seek a choice of sports facilities (Willis, 1968; Sillitoe, op.cit., p.32): in the last ten years, there has been a considerable growth in sports activities such as golf, judo, badminton, squash racquets and archery, especially amongst adults over the age of thirty (Sports Council, 1969). It has been suggested that the expanding range of

leisure activities in which adults participate, are related to class and intelligence, and should be provided in an analogous manner to which the B.B.C. provides four channels on radio, and two on television (Brooke-Taylor, 1963).

Elderly Persons. Old age pensioners are even more dependent than younger adults on large populations for job opportunities, since the scope of their work is likely to be more limited. They visit surgeries, clinics and hospitals more frequently than the general population, and these too require large populations to support them. The same criterion is true of luncheon clubs, day centres and welfare centres, which often cater for the social needs of old people; many prefer clubs and organisations which are not exclusive to their own age group (Shanas, Townsend et alia, 1968), and which tend to serve urban rather than local areas (Willis, 1969). Old people also spend much of their time walking and visiting parks (Sillitoe, op.cit., p.18), and enjoy places where they can sit in comfort and watch other people (Greater London Council, 1968, p.6).

The population catchments of social facilities, and a suggested frequency of visits by age, are shown in Table 5.1. However, it cannot be assumed that specific populations will necessarily be able to use facilities which they can support in theory (Brown, 1966a); in practice, some of these facilities may not be provided until substantially larger populations exist.

5.1.2. Social Activity

Participation in many urban functions, such as shopping or sports, may have social significance. However, satisfaction of social needs is

**Table 5.1. Potential Frequency of Visits to Social Facilities
According to Age of User**

(key: * monthly ** weekly *** daily)

	0-4	5-11	12-17	18-24	25-44	45-64	65+
LOCAL FACILITIES (Four thousand persons)							
5 Nursery Playgroups	***			(***)	(***)		
1 Corner Shop	(***)	***	***	***	***	***	***
Playground	***	***	***	(***)	(***)		
MINOR DISTRICT FACILITIES (Eight thousand persons)							
2 Primary Schools		***					
2 Public Houses				**	**	**	**
1 Post Office			*	*	*	*	**
1 Church	**	**	**	**	**	**	**
1 Public Park	***	**	**	***	***	**	***
DISTRICT FACILITIES (Sixteen thousand persons)							
Local Employment				***	***	***	***
2 Secondary Schools			***				
Range of Shops	(***)	**	**	***	***	***	***
1 Community Centre		***	***	***	***	***	***
1 Public Library		*	*	*	*	*	**
1 Health Centre	?	?	?	?	?	?	?
1 Restaurant/Cafe			**	**	**	**	**
1 Bank				**	**	**	**
1 Catholic Church	**	**	**	**	**	**	**
Public Playing Fields		***	***	**	**		
CENTRAL FACILITIES (Sixty four thousand persons)							
Range of Employment				***	***	***	***
1 Community College			***	***	***	***	***
Department Stores	(**)		*	**	**	**	**
Specialised Shops	(**)		*	**	**	**	*
1 Civic Centre			*	*	*	*	*
4 Banks				*	*	*	*
1 Main Library			*	*	*	*	*
1 Social Service Centre	?	?	?	?	?	?	?
1 General Hospital	?	?	?	?	?	?	?
1 Cinema		**	**	**	**	**	**
1 Dance Hall			**	**	**	*	*
3 Restaurants				**	**	**	**
1 Sports Centre			***	***	**	*	
1 Swimming Pool		**	**	**	**	**	
1 Bowling Alley			**	**	**	**	
1 Central Sports Ground		**	**	**	**	**	*
1 Town Park	**	**	**	**	**	**	**
1 Golf Course				**	**	**	**

Asterisks in brackets refer to visits accompanying user. Question marks are used where frequency is dependent on personal circumstances

Sources: Population Catchments - Consultants' Reports for New Towns

Frequency of Use - mainly from evidence cited in Chapters 1 and 5

far more dependent upon direct social interaction with friends and family, the importance of which is recognised in the field of preventive medicine. The Seebohm Report (op.cit., para.451) recommended the promotion of conditions which "common sense indicates lessen overall risk of social distress"; it is thought that this distress, which may cause illness, could be reduced by encouraging neighbourly co-operation (Pearse and Crocker, 1943; Taylor and Chave, 1964). A rider to this recommendation could be added regarding the need to lessen the risk of 'distress' due to a reduction in physical mobility, for it is clearly desirable that there are the minimum of constraints on the ability of the individual to satisfy his daily needs independently. The influence of the urban environment in this context was examined earlier (vide 1.1.5 - 1.7.5): it was seen that individuals have diversified needs, which alter rapidly throughout life as a result of physical and mental development, changing roles in society, and relationships within the family unit. Morris (1967, pp.162-163) believes that individuals need a similar number of intimate relationships to the original tribal group; the satisfaction of this basic need appears to be influenced by mobility. The author's survey found a consistency in the frequency with which each age group makes social visits; it also established a correlation between independence of movement and age (vide 3.1.1 and 3.1.2).

Each age group has specific social needs:

Pre-school Children. There is a strong discrimination in friendship on the basis of similar age and sex. Social interaction with persons outside the family is a fundamental element in the development of an awareness of a world beyond the security provided by parents (vide 1.1).

Primary School Children. Friends of similar age are preferred and are changed fairly frequently, so that opportunities for establishing a

wide range of social contacts are particularly limited by their mobility. The external environment is the locale for much of their play and social interaction (vide 1.2).

Adolescents. Preference is shown for the company of other adolescents, and a strong desire develops to lead lives independent of parents; this independence relates not only to the type of activity engaged in, but also to the methods of movement permitting a high degree of spontaneity of action and personal initiative. The street often provides a satisfactory informal environment for social activities (vide 1.3).

Adults. The need for social contact varies according to the relationship with colleagues at work; housewives and particularly mothers of young children, may be tied to the home and become socially isolated. In view of the decline of the reciprocal helping role traditionally afforded between members of the three generation family, adults have a greater need for closer and more informal relationships with friends and neighbours (vide 1.4).

Elderly and Disabled Persons. These groups benefit by active participation in community life, which contributes to their well-being and sense of belonging. They are particularly prone to isolation and loneliness because of their reduced mobility. The retention of independence may be the most important single objective concerned with their welfare (vide 1.5).

It may be concluded that the wide range of facilities which individuals of all ages are obliged, or increasingly wish to use, require large population catchments for their support. Furthermore the choice and frequency of friendships is related to the number of persons that can be easily contacted. In addition to their practical function, these

activities and social relationships can contribute significantly to physical and mental well-being, particularly if individuals can act on their own initiative: ability to do so is dependent upon their location and the ease with which they can be reached.

5.2. LOCATION

In traditional towns, the location of different urban functions was determined by such criteria as ease of access on foot, site characteristics, climate, and occasionally, prestige or defence. The close relationship of people and varying land uses had many advantages, but insufficient social and health legislation to control urban development since the Industrial Revolution, caused the appalling conditions from which many people still suffer.

This problem was apparently easily solved by the separation of land uses, particularly as increasing specialisation and 'land hungry' industry required larger sites which could only be found in peripheral urban areas; the population could disperse to residential suburbs, travel to and from which was facilitated by the development of public transport, and subsequently by the rise in car ownership. Urban activities could be located so that the environment of residential areas was not marred by the close proximity of untidy sites, noisy or noxious industries, or heavy volumes of commercial traffic; land could be designated for particular uses, to maintain environmental standards and to simplify planning control.

The results of adopting these measures have been positive in respect of these limited aims: in suburbs, families are able to live in spacious surroundings and to breathe clean air, whilst the disturbance of commerce and industry is confined to appropriate areas. However, this solution accentuates problems of movement. Although, in theory, essential journeys to work, school and often shopping, can be organised efficiently, most journeys are lengthened; uneven levels of traffic are generated, requiring specially designed road networks which remain underutilised for the greater part of the day. Furthermore, many of the reasons for which land use

restrictions were imposed no longer apply: for instance, much industry today is quiet, the energy source is clean and the traffic generated by it interferes only minimally with the local environment. As a result, the planning proposals of the last decade often exclude the more rigid zoning of land uses of the previous decade.

5.2.1. Problems of Optimal Location

The arrangement of land uses and the siting of urban facilities are the most direct ways in which the planner can affect the pattern of movement in towns. Facilities can be sited so that all 'costs' of travel are reduced, and the movement systems serving them optimised. Nevertheless, consideration must be given to overriding factors such as objectionable effluents from certain industrial processes.

Decisions about the location of facilities must be based on considerations of both the convenience of the 'supplier' and the 'users': for instance, in the case of a cinema, the patrons' needs are clearly paramount as negligible traffic is generated in servicing it, whereas the delivery and dispatch of goods to factories could be a more critical consideration than the convenience of the employees. This aspect is further complicated in the case of the location of a hospital: it is sometimes preferable to site it for the convenience of visitors rather than patients, since it may be more important to mitigate the stressful experience of hospital stay by enabling frequent visiting than to have the more specialised but less accessible facilities of a larger hospital (Forster, 1970).

In the author's opinion, the optimal location of urban facilities can best be determined by analysing the available methods of movement of people wishing to visit the facilities and their likely use of them:

factories, public houses, or golf courses - used invariably by adults - can be easily sited if one assumes that nearly all users of these facilities will eventually be able to travel by car; the siting of schools and playgrounds can be determined by the fact that nearly all school children have little alternative to walk or cycle to them. However, the location of most facilities is more complex: although they very often serve people of all ages, they cater for such large populations that they can rarely be reached on foot. The increasing proportion of vehicular journeys to reach facilities means that access by many sections of the population is inhibited; in the author's survey, a high proportion of journeys were made unaccompanied (vide 3.1.2), suggesting a dependency on public transport, which has been shown to be very inferior to the car.

5.2.2. Benefits of Optimal Location

Many advantages would accrue if convenience of access were the primary criterion for location of facilities. Abolition of zoning would be beneficial in this respect, and restrictions would have to apply only to noisy or noxious industries, to those requiring large areas of land, or to any function generating abnormal levels of traffic. It should be noted that the main expansion in employment has occurred in the service sectors of industry, and in white collar jobs relative to heavy industry (vide 1.4.4); light industries such as toy, confectionery or bakery, printing or bookbinding, could be sited in residential areas, and their working hours would not conflict with the need for quiet and absence of traffic during evenings and weekends. A move away from rigid zoning can be seen in the plans of recent New Towns, in which a few light industrial

factories have been located in residential districts.

Increased flexibility would result from the optimal location of land uses, since many urban facilities required for comparatively short periods, could serve several functions: schools and playing fields are usually vacant in the evenings, at weekends, and during holidays, and could thus be used by adults at these times; 'all-purpose' halls could serve as youth clubs for most of the week, and for adults organisations at agreed times (Department of Education and Science, 1970). The function of buildings, the uses or needs of which had declined, could be interchanged, thereby permitting expansion or contraction of floor space: it should be noted that the area requirements for residential accommodation, professional offices, or small shops hardly differ (Ministry of Housing and Local Government, 1961; Langdon, 1967). A computer analysis of locations of urban activities showed that there was a greater stimulus to social activity where land uses were intermixed to the maximum (Roberts, 1969); in this way, therefore, it could be assumed that participation in urban activities would be encouraged. The integration of land uses would contribute to a visually more stimulating environment and to a feeling of urbanity, which is more often felt in towns where differing functions are in close proximity (Gruen, 1965, p.28; Lynch, 1962).

Finally, the integration of land uses, particularly for employment, could reduce traffic considerably, and decrease land requirements since compensatory flows could be created (Brown, 1966): a theoretical analysis of alternative urban locations for industry showed that person mileage and lane requirements were minimum when employment was evenly distributed (Blewelyn-Davies, Weeks, Forestier-Walker and Bor, 1968, p.146). Although this analysis related solely to car journeys to work, it would

be equally applicable to the location of numerous facilities that do not have to be central. Land requirements could also be reduced since many facilities could share parking areas, and multi-purpose journeys could be more easily made due to the greater ease with which a variety of activities could be engaged in. For instance, recreation or entertainment could be enjoyed during lunch hours; adult attendance at colleges of further education or cultural centres after working hours would be facilitated, and visits to playgrounds or libraries could be made on the way home from school. The convenience of locating local social services near schools, libraries, playgrounds, nurseries or even coffee houses, has been stressed (Seebohm, op.cit., para.584).

The advantages of distributing facilities within a town to improve accessibility refer to car travellers, since the 'frictional' effect of distance on them is largely outweighed by the speed at which they travel. On the other hand, it has been noted that a large proportion of the population are dependent upon public transport which operates more efficiently on a radial rather than a grid road network since transfers are not necessary. In order to encourage the use of facilities which often have to be reached by public transport, therefore, central locations would be necessary.

An even greater degree of accessibility could be achieved by having a high proportion of facilities within walking distance; in this way all age groups could benefit. More women and old age pensioners would be able to take up employment, particularly part-time, if, for instance, there were light industrial factories and offices within residential areas. An increase in the proportion of journeys undertaken on foot would result from reducing the distance that pedestrians have to walk for essential

purposes, and by siting facilities which occupy large areas of land, such as playing fields, on the periphery of towns.

It may be concluded that the dispersal of facilities improves the accessibility of persons able to travel to them by car, whereas their centralisation is far more likely to be convenient to bus travellers. Location should, therefore, be determined by consideration of the method of access of those who wish to use the facilities, and the likely frequency of their visits.

5.3. ACCESSIBILITY

Participation in activities depends on the ease with which they can be reached. Many studies, including the author's survey, have noted that travel time is the main limitation on journeys. In view of this, planning often concentrates on reducing vehicular time, since it is generally believed that greater use of urban facilities can be assured by optimising the convenience of travel by car. The result has been that more 'flexible' urban structures with dispersed facilities are planned (Llewelyn-Davies, Weeks, Forestier-Walker and Bor, op.cit., p.15). However, the author has argued that car mobility is achieved largely at the expense of the efficiency and convenience of those other methods of travel upon which the majority of the population rely.

5.3.1. Accessibility and Proximity

The strong influence of distance on all types of urban activity has been frequently reported. The importance of factories being within reasonable walking or cycling distance of residential neighbourhoods was emphasised in the Final Report of the New Towns Committee (1946). Surveys have indicated that distance from work is significantly associated with the attractions of living on a new estate (Chesler, 1965, p.20), and that easy access to work and to friends is considered more important than social aspirations (Jennings, 1962). In a study of New Towns, it was noted that satisfaction with jobs was reduced by the square of the intervening distance to the place of employment (Ogilvy, 1968). People who have moved from London to new or expanded towns consider accessibility to social facilities to be one of the most valued features (Rock, 1969, p.395).

In the United States, numerous studies cited by Rosow (1961) and Gans (1968, pp.152-153) have confirmed the almost mechanical effect that proximity has in the formation of social relationships: its importance has been particularly noted in close-knit working class communities, although the social activity of middle class children, and to an extent non-working middle class mothers and elderly persons, is similarly affected (Webber, 1964a, pp.62, 66). In this country, corresponding findings have been recorded (Hole, 1959, p.167; Hole and Allen, 1962; Willmott, 1962, p.125; Mann, op.cit.; Gavron, 1967; Shankland, Cox and Associates, op.cit., p.69); an inverse relationship between distance and frequency of contact between parents and children has been established (Hubert, 1965). The importance of opportunities for reciprocation of visits between young families and grandparents, which is usually dependent on proximity, has been stressed (vide 1.7.2).

Close proximity of friends enables relationships to be maintained more easily and informally (Hole, 1959, p.165), and the quality of friendship thereby influenced. As job mobility extends to wider sections of the population, this aspect could be of increasing significance, since friendships take time to develop. Alexander (1965) has suggested that the trend in urban living formalises and, as a result, trivialises personal friendships. He argues that one needs several intimate contacts for mental well-being, and that these must be sustained by frequency of meeting and informality of situation; in his opinion, such conditions can only be made possible by living within close proximity of friends. The term 'close friendship' perhaps reflects this basic requisite.

Many surveys have established the significance of proximity in the maintenance of 'interaction' and participation in leisure pursuits:

increased distance to recreational activities reduced demand (Rodgers, op.cit., p.11); greatest use of playgrounds was made when they were located for visibility and could be easily reached on foot (Hole, 1966, pp.8-25); there were large increases in attendance at evening classes, sporting activities and in visits to open spaces when they could be easily reached (Byron, op.cit., pp.110-114). The distance between home and parks in London was found to be a major factor determining their use, for there were two and a half times the number of visits by those living within one quarter of a mile as those living between one quarter and one half a mile (Greater London Council, 1968, pp. 22, 78, and Table 13); recreational places to which people walked were generally visited two or three times as frequently as those visited by other methods of movement (Sillitoe, op.cit., p.20).

Nevertheless, it has been suggested that accessibility, rather than proximity, is becoming the key determinant of urban form (Ginsberg, 1967). This theory of communications is based on the assumption that interaction can be maintained without people living closely together (Webber, 1964b, pp.81, 109; Gans, 1968, p.226); indeed, geographical considerations are thought "the least influential of the variables affecting personal growth and economic growth" (Webber and Angel, 1970). The implication of this argument is that improved communications and the extension of physical mobility afforded by the car, negate the 'frictional' effect of distance: proposals for the new city of Milton Keynes refer to its future 'mobile and sophisticated population' for whom communications and not movement will be important (Cowan, 1969). These widely held views on accessibility, however, only take account of the requirements of adults with cars, and ignore the needs of large sections of the community which

have to be very dependent on local activities, and for whom accessibility and proximity are synonymous (vide 2.7).

5.3.2. Distance and Methods of Movement

The influence of distance on the attractions of alternative methods of movement is apparent from studies of the chosen methods for journeys to work in four provincial towns: journeys on foot declined sharply over half a mile; the proportion of cycling journeys declined for distances over one and a half miles; journeys by bus only reached significant proportions over distances of three quarters of a mile; journeys by car rose consistently as a proportion of total journeys, as the distance increased (Hobbs and Richardson, 1967). The London Traffic Survey recorded that people were prepared to walk one and a half miles on the work journey rather than travel by public transport (Greater London Council, 1969). The author's survey recorded that, in Stevenage, average car journeys were over two miles, whereas cycle journeys were less than one and a half miles, and walking journeys only half a mile (vide 3.1.6).

A survey of the use of open spaces in London recorded a sharp decline in pedestrian journeys up to one mile, whereas no rise in use occurred for other types of journeys until over three quarters of a mile (Greater London Council, 1968, p.21, Fig.7); the National Leisure Survey established that car owners made four times the number of trips for out-of-town journeys as those who relied on public transport or walking (Sillitoe, op.cit., p.18). In the United States, there were substantial declines in the rates of attraction of urban facilities as the distance by car increased (Wilbur Smith and Associates, 1961, p.109).

The influence of method of movement on the distance that can be covered within an acceptable period of time becomes more acute as distance increases, since the relative advantage of the faster methods is accentuated. Clearly pedestrian journeys are the most sensitive and car journeys the least sensitive to distance: only one hundred yards can be covered on foot in the time that a bus passenger can travel an additional quarter of a mile, or a car driver can travel half a mile.

5.3.3. Factors Influencing Acceptable Distance

Various distances or travel times to social facilities proposed in planning reports are described as 'reasonable' or 'the maximum acceptable', and some of these are set out in Table 5.2: many are based on the assumption that people can walk as directly 'as the crow flies', and do not materialise in accordance with planner's expectations (vide 5.6.2). The distance that a person is prepared to travel is, in fact, influenced by a wide range of considerations, many of which also determine his chosen method of movement (vide 2.1 - 2.8).

Distance and Available Time. Economy of time is perhaps the primary consideration of acceptable distance. It appears to be the critical determinant of leisure journeys, and to a lesser extent, of essential journeys (vide 3.1.7). The influence of time has been noted in relation to certain activities, such as those of women or old age pensioners who are considering taking up work: one of the two main factors which make a job pleasant for women is being within easy travel distance of work (Hunt, 1968), particularly if they have to take and bring home children from school (Byron, op.cit., p.109); it is also one

Table 5.2. Recommended Distances to Social Facilities in New Towns in Great Britain

Recommendation	Date	Facility	Miles
Ministry of Town Country Planning	1944	Local Centre	$\frac{1}{4} - \frac{1}{2}$
New Towns Committee	1946	Neighbourhood Centre and Primary School	$\frac{1}{2}$
Ministry of Town Country Planning	1952	Local Centre	$\frac{1}{2}$
<u>Mark 1 New Towns</u>			
Stevenage	1946	Primary School	$\frac{1}{2}$
Crawley	1947	Local Centre and Primary School	$\frac{1}{2}$
Harlow	1947	Town Centre Neighbourhood Centre	$1\frac{1}{4}$ $\frac{1}{2}$
<u>Mark 2 New Towns</u>			
Cumbernauld	1958	Town Centre	(70% pop.) $\frac{1}{2}$ (100% pop.) $\frac{1}{2}$
Hook	1961	Town Centre	(60% pop.) $\frac{1}{2}$
<u>Mark 3 New Towns</u>			
Skelmersdale	1964	Town Centre	(100% pop.) $\frac{1}{2}$ (70% pop.) $\frac{1}{2}$
Redditch	1964	Local Centre	$\frac{1}{2} - \frac{1}{2}$
Washington	1966	Local Centre and Bus Stop	$\frac{1}{2}$
Irvine	1966	District Centre and Bus Stop	$\frac{1}{2} - \frac{1}{2}$
Runcorn	1967	Local Centre and Bus Stop	$\frac{1}{2} - \frac{1}{2}$
<u>New Cities Sub-Region</u>			
Northants, Beds. and N. Bucks	1965	Local Centre and Bus Stop	$\frac{1}{2}$
Central Lancs.	1967	District Centre Neighbourhood Centre	$\frac{1}{2}$ $\frac{1}{2}$
Milton Keynes	1968	'Activity Centre' and Bus Stop	$\frac{1}{2}$
Warrington	1969	Bus Stop	$\frac{1}{2}$

Source: Reports of Consultants to New Town Corporations

factor determining whether a school child or working adult is able to return home for lunch. A preference for employment within, rather than outside New Towns has been noted, in view of the greater time that can be spent with the family (Thomas, op.cit., p.398). The influence of time can also be inferred from earlier references to the effect of proximity on social relationships (vide 5.1.2), and appears relevant to the frequency with which many recreational activities are engaged in: lack of time was by far the most important reason quoted for not using parks more frequently (Greater London Council, 1968, p.16, Table 4).

Distance and Economic Circumstances. Costs of car ownership are the main influence that economic circumstances have on the movement of adults, for the car relieves the owners of many of the 'frictional' effects of distance; the use of a taxi can achieve the same effect. Costs of travel may deter people with low incomes, including children, from making long or frequent journeys by public transport.

Distance and Physical Comfort and Effort. Comfort and effort on a journey play an important role in determining the distance that can reasonably be covered. Lack of protection from inclement weather can deter both pedestrians and bus travellers who have to walk at either end of their trip; changes of level may reduce the distance that can be covered, particularly if goods have to be carried. Gruen (op.cit., p.250) considers that lazy pedestrians are prepared to walk two minutes in an unprotected attractive environment, and sixteen minutes in a protected and highly attractive environment.

The effort involved in journeys also depends on the way that they are perceived and understood (de Lauwe, 1963): the 'mental map' or imagined distance to desired facilities, which is related to the clarity of the

movement network, is also an influential factor in a person's travel behaviour (Lee, 1964; Carr, 1967; Levin and Bruce, op.cit., p.58). In conditions of danger, distances are consistently overestimated (Langer et alia., 1965), and this may, therefore, affect attitudes to journeys involving crossing main roads.

Distance and the Interest of the Route. The distance that people are prepared to travel may be influenced by the degree of visual interest of the route. Parr (1965) has written eloquently on the pleasure of walking in traditional towns, where the diversity of activity and unexpected meetings make journeys much more exciting. It is well known that people prefer to walk along routes with more visual interest and human activity, and that good company can reduce the apparent distance covered; women are prepared to walk long distances in supermarkets, and commuters on the Underground in London walk relatively long distances through tunnels and up and down escalators when transferring from one line to another.

Distance and the Frequency and Purpose of Journeys. Motivation may affect the distance people are prepared to travel: the attractions of work opportunities in the United States are so great that employees are prepared to travel within a fifteen mile radius of their homes (Wilson and Womersley, 1965, p.43); the wider choice of goods in town centres is sufficient to attract housewives to travel long distances rather than to shop in local centres (Jones, 1969); children are prepared to walk much farther to an equipped playground (Council for Children's welfare, 1966), and attendance at 'serious' educational establishments is hardly influenced by distance (Lee, 1966). Although studies have shown a 'null relationship' between distance and the rate of use of specialist medical facilities, far greater attendances at preventive medical centres have been recorded when

they were close (Shannon, Bashur and Metzner, 1969); a study of the relationship between parental visiting and distance to a Hospital for Sick Children has established a substantial decline in frequency as distance increased (Forster, op.cit.). Other social contacts and leisure activities are encouraged by close location to the home, and are engaged in far more frequently when they can be easily reached (vide 5.1).

Distance and Availability of Choice of Method of Travel. A large proportion of the population without the use of a car does not have a real choice for distances beyond those which can reasonably be undertaken on foot, and are therefore greatly dependent upon the availability and frequency of public transport (vide 2.7). The significance of this aspect is illustrated by the satisfaction with living in residential areas, which is greatly influenced by the availability of public transport and door-to-door distances to destinations (Chesler, op.cit., Tables 34, 38, 42; Vorhees, 1968, p.335; Architectural Research Unit, 1968).

Distance and Habit. People become accustomed to particular ways of life, even if they are detrimental to their health. Long journeys to work by car or bus may be made regularly, the initial degree of discomfort hardly continuing to register; regular walking along the same route often decreases appreciation of the real distance covered: in the author's survey, it was suggested that the more frequent journeys of children living in households without cars could be because they act more often on their own initiative rather than wait for the opportunity of travelling in a comfortable car (vide 3.3.3).

Distance and Age and Mobility. Some of the factors outlined above are of more significance to certain age groups. This is primarily due to the rise and decline of mobility of the seven age groups of the life-cycle and the particular problems of disabled persons (vide 1.1.5 - 1.6.5);

for instance, the variation in walking speed at different ages was set out in Table 2.2 (vide 2.1.6).

As children grow older, their mobility is limited more by the freedom of movement that they can be given than by their physical capacity: Levin and Bruce (op.cit., p.60) found that primary schools within a radius of 0.4 miles were accessible on foot even for five year olds. In a comprehensive survey of playgrounds, 70% of children using them lived within a half mile radius, yet only an additional 15% lived within a one mile radius of them (Planning and Research Department, op.cit., p.5, Table 3, and p.8); in the London survey into the use of open spaces, short distance from home was found to be the most important consideration for young children, mothers with infants, and old people: as a result, recommendations were made for small parks within one eighth to one quarter of a mile from homes (Greater London Council, 1968, p.77). It has been noted that children's friendships are strongly influenced by proximity. In a survey in provincial towns, between 70% to 80% walked daily to destinations within half a mile, and this was reduced to 30% to 75% for destinations between half a mile and one mile (Atkins, 1964); similar findings were recorded in the author's survey (vide 3.1.6).

Easy access to places of employment is important to women early in marriage, and subsequently once their children are at school, particularly as they usually prefer to work part-time. Elderly people use accessible amenities far more frequently. In a survey, the vast majority were able to walk half a mile, and considered shops within this radius easy to reach; even when a bus was available, attendance at cinemas, churches etc. dropped dramatically when they lived farther away (Hole and Allen, op.cit., Table 5). No doubt for these reasons, it has been recommended that old persons dwellings

be sited within two to three hundred yards of centres catering for their daily needs (Brooke-Taylor, 1966).

Since attraction appears to decline with distance, the author suggests that a latent need for such social, cultural and recreational activities would be met if less effort and time had to be expended to reach them, for in these situations the 'friction of distance' operates in discouraging those who cannot conveniently travel from doing what they would otherwise have chosen to do.

It may be concluded that a minimisation of the 'costs' of travel will play a significant motivational role in encouraging participation in activities, particularly of those dependent on others for the majority of their movements outside the home.

5.4. COMMUNITY SIZE

The extent of choice of work and leisure opportunities is related to the size of population and the area in which the community lives, both of which are components of population density.

5.4.1. Population

Although it has been suggested that every community has an optimum number that enables the greatest income per head to be earned (Carr Saunders, op.cit., pp.200, 213), the wide variation of population size of towns and cities in Britain seems to indicate that there are no criteria on which to base formulations for New Towns. However, larger urban areas are generally growing faster than smaller ones, probably because they are better able to offer a diversity of employment, educational, cultural entertainment opportunities and groupings of complementary activities; costs per capita of services and infrastructure are also usually lower as a result of economies of scale (Nicholson, 1961). These factors are increasingly promoting the growth of towns. The analysis of urban activities and their population catchments (vide 5.1) suggests that large populations are necessary to support many activities and facilities for which demand is rising. From a social viewpoint, large communities are more tolerant and less conservative (Gist and Fava, 1967, pp.444-449).

On the other hand, in small communities, the need for vehicular movement and concomitantly environmental disturbance are reduced, unrestricted car use can be more easily accommodated, and the countryside is more accessible. People are thought to be happier in small communities which they feel they can influence (Storr, 1968); sociologists have found that

that social behaviour is encouraged, and that as a result of personal relationships tending to be less anonymous, criminal culture is less likely to develop (Mann, op.cit., pp.48-49, 63, 102; Gist and Fava, op.cit., p.452).

The New Towns Committee (1946) recommended populations of thirty to fifty thousand persons as the maximum size which would allow reasonable access to facilities, at acceptable densities: the majority of New Towns designated in the years immediately after the Second World War were of this size. It is interesting to note that approximately one third of the urban population of Great Britain live in towns with populations below one hundred thousand persons (calculated from General Register Office, 1962), and that one half of the population live in communities below fifty thousand persons (Mann, op.cit., p.170). More recently, the case for larger populations has been put forward; examples of these and the premises on which they are based, are set out in Table 5.3.

The result of this new climate of opinion has been that in the last decade, several New Towns, well advanced in construction, have been replanned with substantially increased populations, and more recent proposals have usually recommended far larger populations than were previously entertained. Furthermore, the importance of planning for continuous growth has been stressed in view of the experience gained from the first New Towns. The trend in increasing populations over the last twenty years can be seen in Table 5.4.

5.4.2. Physical Size

Traditionally the size of towns was limited by the distance that people could walk to work; thus the typical centre of old cities was about one square mile and contained no more than fifty thousand persons

Table 5.3. Recommendations for the Size of Urban Communities

Premise	Author	Date	Population (ths.)
Provision of locally based social services	Seebohm	1968	50-100
Present size of economically thriving country towns	Hall	1968	50-200
Unrestricted use of cars	Buchanan et alia	1963	(max.) 80
	Wilson and Womersley	1967	(max.) 90
Reasonably spacious home and garden with tolerable distances to work, social facilities and countryside	Whittle	1965	80
Full range of leisure and health facilities	Robertson	1964	(min.)100
Adequate services and accessible facilities	Vorhees	1968	100
Decreased travel time with smaller populations	Stegman	1969	100
Adequate range of facilities if not far from a metropolis	Ash	1969	100
Optimum expenditure per capita for facilities	Hirsch	1959	150
Reasonable access to full range of facilities	Martin	1967	100-200
Wide range of facilities and employment opportunities	Wilson and Womersley	1965	200
Loss of mobility	Wilson and Womersley	1965	(max.)200
Administrative purpose of Local Government	Redcliffe Maud	1969	(min.)250
The larger the population, the relatively cheaper are public facilities, owing to economies of scale	Nicholson	1961	

Table 5.4. Proposed Populations for New Towns in Great Britain

	Year of Designation	Persons in Thousands
Reith Committee	1946	30 - 50
Mark 1 New Towns		
Stevenage	1946	60
Crawley	1947	50
Harlow	1947	60
Hemel Hempstead	1947	60
East Kilbride	1947	45
Glenrothes	1948	30
Mark 2 New Towns		
Cumbernauld	1955	50
Hook	1961	100
Mark 3 New Towns		
Skelmersdale	1961	80
Livingston	1962	100
Redditch	1964	90
Runcorn	1964	90
Washington	1964	80
Irvine	1966	90
Marks 1 and 2 New Towns (revisions)		
East Kilbride	1960	90
Cumbernauld	1960	70
Hemel Hempstead	1963	80
Stevenage	1966	105
Crawley	1966	120
Glenrothes	1966	95
Harlow	1967	90
New Town and City Sub-Regions		
Peterborough	1966	175
Northampton, Beds. and Bucks.	1966	220
Ipswich	1966	170
Central Lancashire	1967	450-500
Warrington	1967	210
Milton Keynes	1967	225
Telford	1968	200-250

Sources: Osborn and Whittick (1969); Reports of Consultants to the Respective New Town Corporations.

(Doxiadis, 1969). Densities increased as the population grew, and environmental standards declined in the absence of public health provision. With the development of public transport, and subsequently of the motor car, the distance that could be travelled to work within a reasonable time extended greatly, industry was no longer tied to central locations, and the original deterrent to the physical growth of towns was removed. This coincided to a large extent with a general rise in the standard of living, improved environmental standards, more leisure, and a greater demand for space within and around the home.

The growth of suburbia which appeared to cater for the prerequisites of these developments, has however resulted in increased time, cost and effort of travel; this has often been insufficiently appreciated, possibly because traffic studies have been primarily concerned with solutions to problems posed by peak hour travel on the journey to and from work (vide 2.6.1). There is also a common misconception that the car enables most people to maintain social activity over greater distances, and that therefore the needs of car users should be the paramount determinant of the shape of future cities (Webber, 1964b). However difficulties of access may be aggravated for people of all ages who do not have sole use of a car (vide 2.7.4 and 3.1.3); their effective mobility in suburbia is often reduced since they are far removed from facilities which are concentrated in central areas in order to serve the whole town.

Many New Towns were planned in the belief that the main disadvantage of suburbia could be avoided by planning neighbourhoods containing facilities for the majority of family needs, other than places of employment. This is often expressed in the names that have been used for these areas - the 'superblocks' of Hook New Town (London County Council, 1961), the

'villages' of Washington New Town (Llewelyn-Davies, Weeks and Partners, 1967) and the 'residential districts' of Irvine New Town (Wilson and Womersley, 1967). Their sizes have usually been dictated by the maximum acceptable volumes of vehicular traffic which can be contained with a reasonable degree of pedestrian and vehicular separation, and without major road construction: indeed, 'environmental areas' have been described as "no more and no less than a method of arranging buildings for motor traffic" (Buchanan et alia., 1963). However, in view of the volume of traffic generated in these areas, they can ideally only have populations of between one and two and a half thousand persons (Burns, 1966): the number of people required to support social facilities demonstrates how ill-equipped such populations are to accommodate the majority of family needs (vide 5.1.1).

It appears that the neighbourhood can have little functional value, apart from the fact that its components are better perceived and that it encourages a sense of identity (Lee, 1963-1964). Only the needs of very young children are likely to be within its boundaries and few of the preferred activities of teenagers (Mann, op.cit., p.160). It does not contain the major activities of its population: in the author's survey, only 24% of all journeys were to destinations within a radius of half a mile, and only 40% within a radius of one mile of home (vide 3.1.6). In a survey of the hire of premises in New Towns, nearly three quarters of the organisations catchment areas were from the whole town or outside it, and only one quarter for local functions (Ministry of Housing and Local Government, 1966). Yet activity outside the neighbourhood is usually dependent upon travel by car or bus, which acts as a particular limitation on movement, particularly of children and elderly persons.

It is surprising to note that recommendations to include 'reasonable accessibility' to communal facilities (Ministry of Town and Country Planning, 1946), and the 'minimisation of the need for local transport' (New Towns Committee, op.cit., p.8), in the first New Towns, are not mentioned in recent planning proposals.

Since most journeys within a town are made by public transport or on foot (vide 2.7, 3.3), the area of a town is an important determinant of accessibility; in the United States, journeys were more frequent and shorter in smaller communities than in larger ones (Wilbur Smith and Associates, op.cit., p.65). Similar findings have been recorded in Britain, although length of journey is not directly proportional to the size of a town (Taylor, 1968). In the Border towns of Scotland, half the journeys to work were made on foot (Scottish Development Department, 1968). It appears that the smaller the town, the higher is the proportion of potential pedestrian journeys.

Aristotle stated that a town should be able to encompass all its functions without interfering with them. This social concept may be as valid today as it was when first proposed, although in those days citizens were equally mobile whereas today there is a widening gap between the mobility of car drivers and all other travellers. This aspect is neglected in plans which cater for unlimited growth of towns by 'flexibility', on the grounds of economic logic, unrestricted car use at predicted levels of ownership, and the apparent preference of 'people' for low density living.

5.4.3. Population Density

Population density is a function of the size of a town and its population, and has a close relationship with the activity, movement, and type of housing within it.

Population Density and Urban Activity. At low densities many of the annoyances resulting from the proximity of neighbours and their children are removed, although some of the pleasures of their company may be sacrificed. Low density housing is also more satisfactory for babies and very young children who prefer to play in private gardens, and who are in any case dependent on parents for their movement outside the home; working adults with exclusive use of a car are able to enjoy the quiet and privacy of a home in spacious surroundings, in contrast to their working environment. Social facilities, however, may be distant and the activities of children, mothers and old people, which must willy-nilly be local, are limited; furthermore, social activity tends to become formalised (Gist and Fava, op.cit., p.121).

On the other hand, a wider range of facilities and a greater choice of social contacts are available in areas planned at higher densities (Hole, 1959, p.171; Chermayeff and Alexander, 1963; Webber, 1964b, p.92; Pickard, 1965; Bracey, 1966; Lee, 1967; Doxiadis, 1968; Stoller, 1969). Isolation and loneliness are less likely to occur, and childrens' friendships, which are dependent on peer groups and are often of short lived durations, can develop more easily (vide 1.2, 1.3 and 5.1.2).

Population Density and Movement. The opportunity to engage in a wide range of activities is governed as much by accessibility as by availability. The increased mobility afforded by the car has indirectly

extended distances to social facilities, since proximity is no longer thought to be an important factor in the location of home in relation to them. As a result, housewives are increasingly obliged to act as chauffeurs to the family when only one car is available. This situation is worse in low density areas, where difficulty of access may be a strong deterrent to many journeys. Significantly higher proportions of journeys by vehicular means are recorded in both car and non car-owning households, as population density declines (Hall, 1969). There is a dramatic contrast between the size of a town predominantly planned for public as opposed to private transport (vide Table 5.9). The car competes with public transport because the latter's efficiency and financial viability depend on high population catchments (Dyckman, 1965; Burns, 1965; Meyer Kain and Wohl, 1965; Keefer, 1966); pedestrian journeys are also extended by an optimal layout designed for car movement.

Conversely, high density usually enables a greater proportion of journeys to be undertaken without the aid of bus or car, and in less time. However, if this density is achieved in multi-storey flats, movement is dependent on mechanical lifts the 'frictional' time effect of this is similar, though limited, to that of public transport (vide 2.1.3).

Population Density and Type of Housing. Density of population largely dictates the type of housing and the extent of available private outdoor space for each household. Whilst it may be desirable that the minimum of restraints be placed on residential development at low densities, the additional land required effectively extends travel distances. It has been argued that low residential densities only increase the size of towns by a narrow peripheral ring (Best, 1966). However, all journeys within and beyond that ring are thereby extended; moreover, as leisure

time increases, it may be anticipated that journeys to destinations outside towns will increase more than others. It has also been argued that, on current trends in the construction of low density housing, the urban area of the United Kingdom will only rise from 11% to 16% by the end of the century (Best, 1968), but this extra land will probably have to be located in overpopulated regions with already inadequate countryside for recreational purposes.

Animals in crowded conditions exhibit disturbances of psychological and social behaviour, and these have been compared with the effects of high densities on human populations (Calhoun, 1962). Fears have been expressed about their correlation with social distress and unhealthy conditions in existing slum areas (Spencer, 1964, p.282), yet the causes may be due to numerous interacting factors, such as poverty, noise, and lack of proper sanitation, privacy and sufficient open space, or 'withdrawal' from the stress of traffic congestion in existing urban areas. People have traditionally lived comfortably in socially cohesive communities with high densities of population: much high density housing built in the 18th and 19th centuries had high standards of amenity (vide Table 5.5). Furthermore, there is no evidence that mental disorders increase with high density (Stoller, op.cit.).

Table 5.5. Some Existing Residential Densities in London

Existing Development in London	Period of Construction	Net Density in Persons per Acre
Nash Terraces: Regents Park	18th c.	104
Speculative Housing: Regents Park	18th c.	130
Residential District of Mayfair	19th c.	200
Town Houses: Brompton Square	19th c.	100
Town Houses: Pembroke Square	19th c.	90

Sources: Denby (1956); Manthorpe (1956).

A preference for low residential densities has been noted in numerous social surveys carried out in post-war years; respondents have usually been asked to state whether they would choose to live in flats or houses, or in houses with large or small gardens and generally show a preference for detached houses with large gardens. Whilst this preference has occurred with the rise in living standards (Willmott, 1969) it could be due to the unfortunate associations previously referred to, or to the fact that both land and housing are cheaper on the outskirts of towns. It is also possible that high density and high flats are synonymous concepts in the public mind, because of the far greater problems of altering flats to meet a family's changing needs, the desire for home ownership and the greater opportunities for self-expression in houses (Ministry of Housing and Local Government, 1961, p.10; Jung, 1965; Morris, 1967, p.160; Gans, *op.cit.*, p.133). Furthermore, many of the health hazards of living in multi-storey flats (Fanning, 1967; Stevenson et alia., 1968; Times, 1968) are more commonly appreciated by the public.

Surveys show divergent uses of gardens such as relaxation in fine weather, hanging out washing, and storage (Willmott, 1963, p.90); only a minority are used for children's play, and there are relatively few active gardeners in the increasing numbers of households owning cars and in which wives go out to work (Cook, 1968, pp.219, 231-232; Sillitoe, *op.cit.*, p.51). As people devote more time to leisure interests, their preference for large gardens and gardening declines because of the constant care and effort involved (Ministry of Housing and Local Government 1961; Willmott, 1963, p.217). Other surveys have shown that people want gardens for cultivation rather than privacy, and that those without cars prefer high density housing with small private gardens (Sillitoe, *op.cit.*, p.190; Centre for Urban Studies, 1969).

Interest in gardens also varies with age: small private screened open spaces are considered an adequate alternative to gardens, except by families with very young children (Cook, op.cit., p.232; Shankland, Cox and Associates, op.cit., p.14); children over six years of age rarely like playing in their own gardens, but prefer public places (Architectural Research Unit, op.cit., p.59; Cook, op.cit., p.219); married people, both with and without cars, favour higher densities with smaller gardens, as they grow older (Sillitoe, op.cit., p.31).

Urban sociologists have argued that most people prefer low densities because of the greater privacy but, at the same time, that they want a wider choice of facilities and opportunities for social contact (Willmott, 1962, p.120). Elderly persons are more concerned with social interaction and access to facilities than about having a garden and prefer to live centrally for the convenience of facilities, and for the psychological security of being in animated surroundings (Sillitoe, op.cit., p.17; Simmie, 1969). It is germane to note that surveys on this subject are usually addressed to householders (Abrams, 1960; Cook, op.cit., pp.217, 227; Sykes, Livingstone and Green, 1968), and it could be rewarding to question other social groups.

It appears that the alleged preference of the majority for large gardens may well be exaggerated, and that, in part, it is due to a lack of appreciation of the relationship between density and accessibility (vide 5.5). As this preference for low density housing is one of the primary reasons for planning new towns in the last decade at the densities that can be seen in Table 5.6, and since its effect is to adversely influence accessibility other than by car, it would seem necessary to give greater consideration to this aspect of urban structure.

Table 5.6. Proposed Densities for New Towns in Great Britain

	Year of Designation		Proposed Net Density in Persons per Acre
Abercrombie (1945)		(max.)	50
New Towns Committee (1946)		(gross)	13 - 15
<hr/> Mark 1 New Towns <hr/>			
Stevenage	1946		35 - 60
Harlow	1947		30 - 50
Hemel Hempstead	1947		45
East Kilbride	1947		45 - 50
Glenrothes	1948		45 - 50
<hr/> Mark 2 New Towns <hr/>			
Cumbernauld	1955	(av. 81)	44 -120
Hook	1961		40 -100
<hr/> Mark 3 New Towns <hr/>			
Skelmersdale	1961		40 - 70
Livingston	1962	(av. 46)	30 -200
Redditch	1964		25 - 75
Runcorn	1964	(av. 70)	50 - 80
Washington	1964	(av. 43)	40 - 50
Irvine	1966		25 - 75
<hr/> New Town and City Sub-Regions <hr/>			
Northampton, Beds. and N. Bucks.	1966		60
Ipswich	1966		50 - 60
Central Lancashire	1967		30 - 60
Warrington	1967	(av. 45)	20 -120
Milton Keynes	1967		20 - 30

Sources: Reports of Consultants to their respective New Town Corporations; Osborn and Whittick (1969).

It may be concluded that there is a basic conflict between the desire of each individual to live in a 'Buckingham Palace' while at the same time having the facilities of the 'West End' on the doorstep; it must be resolved for the vast majority of the population by a compromise. The resolution of this conflict is rendered more difficult since the relative importance attached to these two aspects changes at each stage in the life-cycle. It is clearly desirable to afford a range of residential densities in varying locations, with acceptable standards of space and privacy, and to impose a minimum restriction on land use and growth. Although there is no ideal community size or density, larger populations and greater densities provide wider choices of accessible facilities and social contacts. However, it should be borne in mind that both pedestrian and public transport movement function better at higher densities, whereas private transport movement functions better at lower densities.

5.5. ACTIVITY OPTIONS

The desire for space around the home and a high level of accessibility has been considered mainly in relation to adult requirements, with the result that emphasis in planning has been directed towards the provision of low density housing in the belief that popular car ownership would ensure adequate accessibility. However, evidence cited earlier in this thesis, and particularly data from the author's survey, show that the relative mobility of individuals varies substantially according to age and household car ownership.

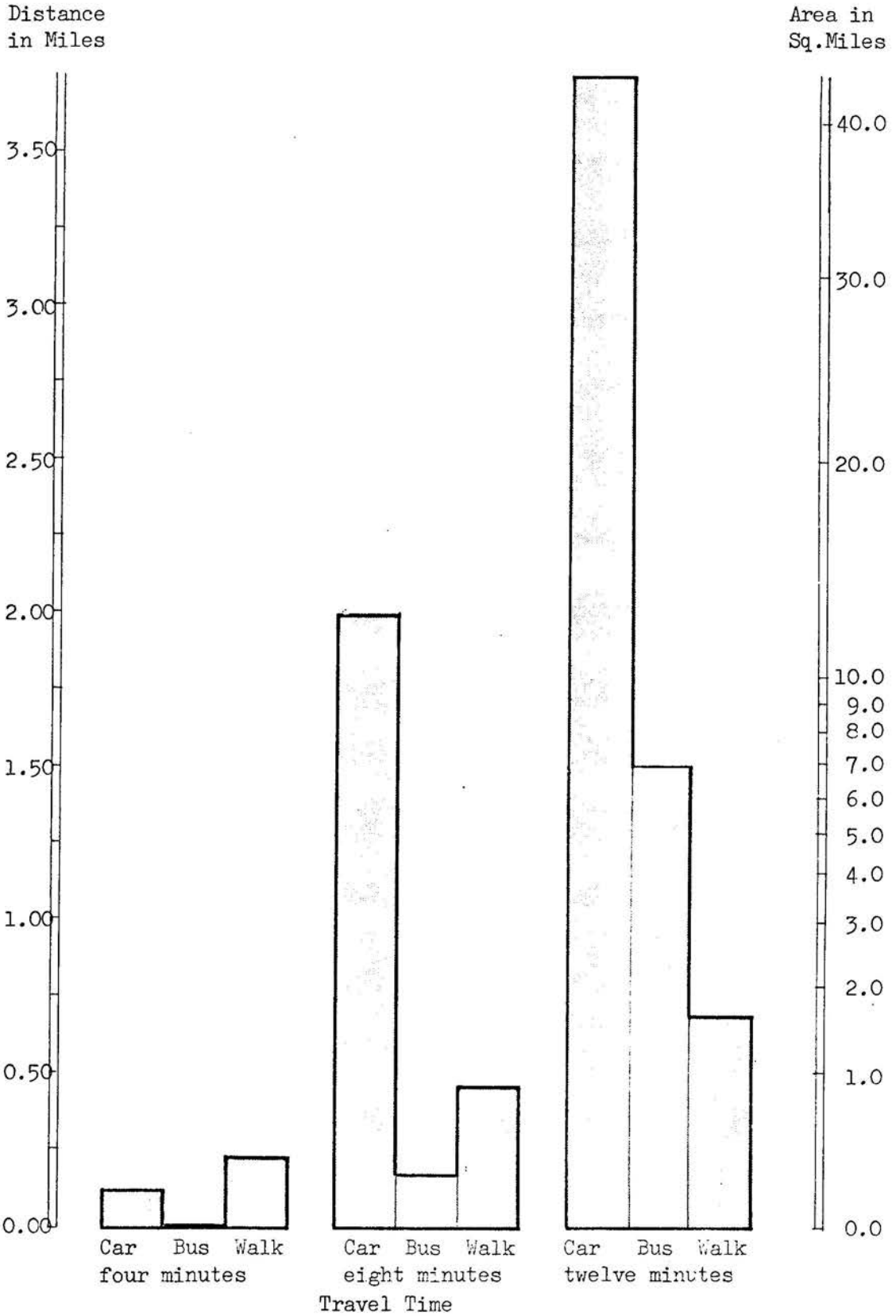
5.5.1. Method of Travel and Available Time

Speed of travel is an index of the social opportunities available to individuals, since the linear measurement of speed determines both how quickly point destinations can be reached, and the potential sphere of interest. Diagram 5.1. illustrates the distance that can be covered and the 'area of accessibility' in four, eight and twelve minutes, by the three main methods of travel. The great advantage of car travel is apparent from the comparison with both bus and walking; travel by bus is advantageous over walking only for journeys lasting over ten minutes, and is considerably slower than by car; it is quicker to walk up to about one third of a mile than to travel by car.

5.5.2. Age and Mobility

Mean speeds for each age group, which were calculated from the distances covered in Stevenage by each method of travel, in the author's survey (vide 3.1.6., Table 3.32) have been used to measure the 'area of

Diagram 5.1. Distance Travelled and Area of Accessibility According to Method of Travel and Time



accessibility' in a fixed travel time; these are shown in Diagram 5.2.

Although the calculations should be treated with some caution since they are based upon a small sample, they do give an indication of the considerable, if not unexpected, influence on mobility of both age and car ownership. Present car ownership is approximately 0.5 cars per household; by the end of the century, this is expected to rise to 1.5 cars per household.

5.5.3. Density and Opportunity

Mobility can be viewed as a measure of convenience since it largely determines "the space of free movement of individuals" (Lewin, 1952, p.245). An attempt can therefore be made to relate accessibility to urban form by this measurement: the population accessible within the area travelled in an acceptable time can be considered at different densities. An index of convenience can be determined, which is related both to the frequency of potential social contacts and the ease of access to different social facilities. In this way a relationship between accessibility and density can be established. Furthermore, the efficiency of alternative movement systems proposed for New Towns can be evaluated in terms both of the convenience of individuals at different ages, and of the total community.

On the assumption that the speed at which an individual travels determines his convenience, then the number of people with whom he may come into contact will be given by the equation:

$$\pi (ST)^2 \times D$$

where S = mean speed

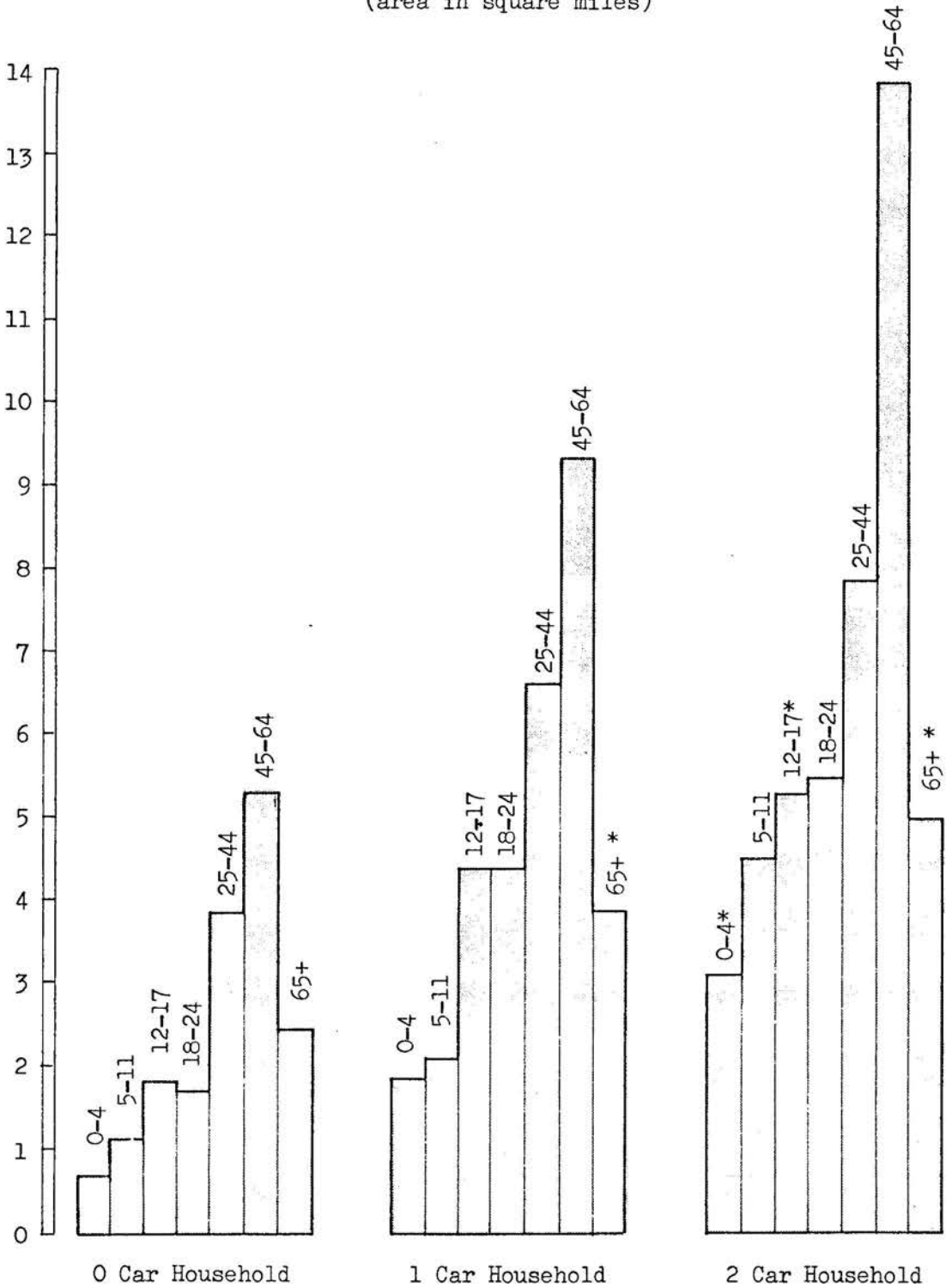
T = travel time

D = density of population

and the 'community convenience' will be:

Diagram 5.2. Area of Accessibility in Ten Minutes of Travel Time According to Age Group and Household Car Ownership

(area in square miles)



* Author's interpolation as no data available

$$\sum_i \pi (S_i \times T)^2 \times P_i \times D$$

where i = age groups (1-7)

P_i = the proportion of the population in age group i

S_i = the mean speed in miles per hour of the population in age group i

In attempting to establish the number of people that may be contacted, problems arise regarding calculations for individuals living close to the edge of towns since their 'area of accessibility' will partly encompass countryside. Such detailed calculations are not warranted in this limited study. However, the percentage of the population in any particular age group, that can theoretically reach a particular social facility will be:

$$\frac{\pi (ST)^2 \times 100}{\pi R^2}$$

where S = mean speed

T = travel time

R = radius of the population catchment of the facility.

Table 5.7 has been prepared to show these percentages according to population density, age group, and household car ownership. For the purpose of comparison, district and central facilities supported by populations of 16,000 and 64,000 persons have been taken (vide Table 5.1) with travel times of six minutes and twelve minutes respectively, to represent reasonable time periods to reach these facilities. For the calculation, distances have been increased by one fifth to compensate for measurements being straight line (Holroyd, 1969); different densities in three new towns examined in the next section of this chapter - Milton Keynes, Washington and Cumbernauld - have been chosen to demonstrate the influence of density on mobility; net residential densities are used for calculations of access to district facilities and gross town densities for calculations of access to central facilities.

Table 5.7. Population with Easy Access to Facilities, According to Density of Persons per Acre, Age Group and Household Car Ownership
(figures represent percentage of total population in each category)

	Six Minutes to District Facilities			Twelve Minutes to Central Facilities			
net residential density 27.5 p.p.a.				gross density 11 p.p.a.			
	%	%	%	%	%	%	
0-4	21	61	100*	8	24	41*	
5-11	37	70	100	15	28	60	
12-17	95	100	100*	37	58	70*	
18-24	91	100	100	36	58	72	
25-44	100	100	100	52	87	100	
45-64	100	100	100	70	100	100	
65+	81	100*	100*	32	52*	63*	
net residential density 43 p.p.a.				gross density 15 p.p.a.			
0-4	33	95	100*	12	33	56*	
5-11	58	100	100	20	37	81	
12-17	100	100	100*	50	79	98*	
18-24	100	100	100	49	79	100	
25-44	100	100	100	70	100	100	
45-64	100	100	100	97	100	100	
65+	100	100*	100*	45	70*	86*	
net residential density 81 p.p.a.				gross density 20 p.p.a.			
0-4	61	100	100*	15	44	76*	
5-11	100	100	100	27	50	100	
12-17	100	100	100*	68	100	100*	
18-24	100	100	100	66	100	100	
25-44	100	100	100	94	100	100	
45-64	100	100	100	100	100	100	
65+	100	100*	100*	59	94*	100*	
	0 car	1 car	2 car	0 car	1 car	2 car	

* Author's interpolation

It can be seen that adults in car-owning households have a high level of accessibility even at low densities, sufficient to enable most of them to reach all facilities within a reasonable travel time. However, the proportion of children and adolescents in car-owning households and of all persons in non car-owning households, who are able to reach these facilities is much lower, and declines sharply with lower densities.

The theoretical 'community convenience' could be calculated with the figures in Table 5.7, by relating them to the present age structure in car and non car-owning households, or to figures projected for future dates. Unfortunately no detailed data are available: the Sample Census in 1966 only recorded household car ownership according to size of households.

It may be concluded, however, that living at low density with easy access to social facilities can only be enjoyed consistently by car-owning adults, who are at present about one fifth of the population, and even at the end of the century are likely to be only two fifths (vide 2.7).

5.6. MOVEMENT SYSTEMS FOR NEW TOWNS

Movement systems are primary determinants of urban structure, patterns of land use, and levels of accessibility. Efficient systems reduce the 'costs' of movement which the planner has to consider if he wishes to reconcile the previously noted conflict between the interests of the individual and the wider community. (vide Chapters 2 and 4).

At present, most movement systems proposed for post-war New Towns give preference either to private or public transport; the desirability of separating vehicles and pedestrians has been recognised for at least a quarter of a century (Abercrombie, 1945), though with the notable exception of Stevenage, the principle has only been widely applied in the Mark II and III New Towns. Commercial traffic does not influence the design of new town systems since it represents a small proportion of total traffic, and its use of the road network generally occurs at random times (Jamieson and Mackay, 1965, p.110).

Three alternative systems to encourage travel by particular methods have been identified, with the following order of priorities:

5.6.1. Private car, public transport, pedestrian;

5.6.2. Private car, pedestrian, public transport;

5.6.3. Public transport, private car, pedestrian.

There appears to be an unaccountable lacuna with regard to a fourth alternative system:

5.6.4. Public transport, pedestrian, private car.

These four systems are assessed by examining current proposals based on them, to determine how they work or are likely to work in practice.

5.6.1. The Private Car, Public Transport, Pedestrian System

Proposals for the new town of Washington and the new city of Milton Keynes are based on movement systems orientated towards the maximum convenience of car users, and the provision of a viable public transport system and safe pedestrian routes (Llewelyn-Davies, Weeks and Partners, 1967; Llewelyn-Davies, Weeks, Forestier-Walker and Bor, 1968). Since cars afford "enormously increased mobility" and since this can be catered for without restriction, "the design of a new town needs to be such as to enable these advantages to be enjoyed" ... "by the provision of an adequate road network" (Llewelyn-Davies, Weeks and Partners, op.cit., pp.13, 57), and the accommodation of the highest likely levels of use during peak hours so as to reduce delays to a minimum (Llewelyn-Davies, Weeks, Forestier-Walker and Bor, op.cit., p.146, Table 1). In Washington, calculations for the road network were made solely from projected figures for car journeys in car-owning households, and ignored all other motorised, cycling and walking trips (Llewelyn-Davies, Weeks and Partners, op.cit., pp.119-120); in London, the proportion of trips made by bicycle or on foot was 55% of all journeys (Greater London Council, 1967) and, in the author's Stevenage survey it was 44% (vide 3.1.4). There are no comprehensive cycleway systems in either town, in spite of the convenience of bicycles particularly for children and adolescents (vide 3.1.3).

Alternative models simulate the projected pattern of car journeys in the future to establish an optimal system for their unrestricted movement; this is achieved basically by dispersing the traffic load on roads through assignment of land uses on a hierarchical road grid to 'even out' accessibility (Llewelyn-Davies, Weeks, Forestier-Walker and Bor, op.cit., pp.15, 145-146), and by developing the town at low densities of population. Only grid

patterns for primary road networks are examined in detail (ibid., p.15; Llewelyn-Davies, Weeks and Partners, op.cit., p.15).

Private Vehicular System. The structure of these towns has the advantage of accommodating the unrestricted use of cars and the preference for more living space within and around the home. It has the effect of increasing the opportunity of people who can travel by car, by the provision of an adequate road network for driving quickly, and facilities for parking anywhere. The area requirements are determined by the need to accommodate projected peak hour levels of traffic (Llewelyn-Davies, Weeks, Forestier-Walker and Bor, op.cit., pp.145-150), to permit high vehicular speeds, to reduce traffic noise and air pollution, and to provide a high level of road safety (vide 4.1). They are also closely related to the number of persons travelling by car: Liebrand estimated that, on a nine feet wide carriageway in a town centre during the rush hour, thirteen times the number of pedestrians, or four and a half times the number of bus passengers, can be accommodated than the equivalent number travelling by car (Ritter, op.cit., p.14, Table III). Sneed's (1963) theoretical analysis of the urban area for commuter traffic on forty feet wide carriageways demonstrated the great increase in space required for roads and parking for unrestricted car use, compared with predominant travel by bus (Table 5.8); he also showed that eleven times the number of commuters can travel to work by car if 40% rather than 20% of the ground area is devoted to roads and parking (Sneed, 1964).

The relationship between the proportion of the central area of some existing towns occupied by roads and footpaths, and their population, has been examined by Owens (1968); he has shown that the road area alone occupies 12% of the centre of towns of about ten thousand persons, but over 18% when the population exceeds three hundred thousand.

Table 5.8. Area Requirements According to Type of Commuter Traffic and Urban Population.

(percentage of total urban area)

Method of Travel	Nature of Parking	Road Area %	Parking Area %	Total Area Road & Pkg. %
10,000 population				
Bus	-	1	0	1
Car	multi-level	5	11	16
Car	ground level	4	54	58
50,000 population				
Bus	-	2	0	2
Car	multi-level	11	10	21
Car	ground level	8	53	61
100,000 population				
Bus	-	2	0	2
Car	multi-level	16	11	27
Car	ground level	11	51	62

Source: Sneed (1963).

The area occupied by cars travelling at preferred high speeds is so great (vide 4.1) that transportation planners can only accommodate them completely in two ways: by constructing multi-width carriageways and grade separated intersections on the primary road network (Llewelyn-Davies, Weeks and Partners, op.cit., p.20) both of which involve very high public expenditure, or by dispersing certain urban uses and developing land at low densities, which require relatively low capital costs of construction but far greater areas of land (Llewelyn-Davies, Weeks, Forestier-Walker & Bor, op.cit., pp.79, 82). Paradoxically, plans to economise on road space and costs by decentralisation of urban facilities (ibid., pp.147-148; Buchanan et alia, op.cit., paras. 55-56) must include for each facility, large parking areas which will be used for a fraction of the day, when in other circumstances they could be shared, for example, by workers during the daytime, and

visitors seeking entertainment in the evenings.

The need for road space is exaggerated in low density development, since all adults capable of driving are encouraged to own a car, in view of its inherent convenience for most journeys over a third of a mile (vide 2.1.7); in Washington, population densities will have to be lowered to provide more residential land for two-car families (Llewelyn-Davies, Weeks and Partners, op.cit., p.70). The total volume of rush hour traffic can only be accommodated without restriction in new towns planned at low densities of population (Llewelyn-Davies, Weeks, Forestier-Walker and Bor, op.cit., p.82).

The siting of buildings is directly affected by noise, vibration and air pollution from motor vehicles: the subjective response to traffic noise has been shown to decline appreciably with increased distance from the road (Griffiths and Langdon, 1968) - at a distance of one hundred feet, the noise levels from two thousand vehicles per hour was seventy five decibels, and at one thousand feet it was fifty decibels (Waters and Waters, 1969). Considerations of noise are thus highly relevant to the area requirements of vehicles for they effectively raise the apparent width of roads and motorways. A distance of three hundred feet to buildings in which people live or work, has been recommended, in order to reduce noise to an acceptable level (Committee on the Problem of Noise, 1963).

As a result the distances that have to be travelled by all methods of movement are considerably extended. The claim that a safe and environmentally attractive system can be achieved on such a network (Llewelyn-Davies, Weeks, Forestier-Walker and Bor, op.cit., p.25) is to an extent denied by the effects of increased motorised movements; furthermore, the risk of accidents may be exacerbated particularly by the incentive to

ignore amber traffic lights to get in phase with the next green ones.

Public Transport System. A bus system is considered essential for "a fairly small minority" ... "who cannot, or do not wish to own a car" (ibid., p.27). In fact when car 'saturation' level is reached towards the end of the century, well over half of the total population will still require regular public transport (vide 2.7); in both towns under examination, over one third of the population will be below driving age (Llewelyn-Davies, Weeks and Partners, op.cit., p.46; Llewelyn-Davies, Weeks, Forestier-Walker and Bor, op.cit., p.70).

Hierarchical grid networks which are optimal for cars, conflict with the needs of public transport systems which operate most efficiently on radial routes in existing towns, or along central spines in new towns (Wilbur Smith and Associates, op.cit., p.45; Jamieson, Mackay and Hatchford, 1967; Buchanan, 1968); a grid network increases the mean length of journeys up to 27%, compared with a radial road system (Holroyd, op.cit.). It is not surprising that no justification could be found for a fixed track public transport system on the grid layout of Milton Keynes (Llewelyn-Davies, Weeks, Forestier-Walker and Bor, op.cit., p.147).

The geographical spread of facilities and population also results in a less efficient public transport system. The number of stages of a journey may be greater because transfers become necessary more frequently, causing loss of time; yet the need to change buses is the most important factor, other than time, operating against their use (Burns, 1967). Furthermore, convenient access to public transport is more difficult to provide in low density residential areas, since services are less financially viable when operating over longer routes (Buchanan and Partners, 1968). Claims that "the road network and indeed the whole form of the town..." of Washington

has been planned "... to provide the best possible transport system" (Llewelyn-Davies, Weeks and Partners, op.cit., p.63) and that the "diffuse distribution of facilities together with a well distributed and efficient public transport system allows good accessibility" in Milton Keynes, "... for those least likely to own private cars" (Llewelyn-Davies, Weeks, Forestier-Walker and Bor, op.cit., p.81) thus appear to be erroneous. Moreover, the suggestion that a grid network has a flexibility "to allow for expansion and change" (ibid., p.25) would not appear to be applicable to an optimal public transport system.

Those without cars in Washington, are dependent on bus services which run around the secondary road network at off-peak frequencies of one quarter to one half an hour, with quarter mile walks at either end of their journeys (Ardill, 1969). After considering forty six equipment types of public transport for Milton Keynes, the most convenient and yet one of the most expensive systems is most favoured: it consists of fourteen passenger buses, which a person can call by dialling his destination when he reaches the bus stop; this "frequent and convenient service" (Llewelyn-Davies, Weeks Forestier-Walker and Bor, op.cit., p.25) enables people to travel to a typical destination two 'grids' from home in about eighteen minutes, at an average direct door-to-door speed of 4.5 m.p.h. (ibid., p.155, Table 2)! Moreover, it is clear that passengers en route to their destination will experience some frustration each time the bus is re-routed to pick up additional passengers.

Whilst the movement system is designed to include a "high quality public transport service" and to "attract a substantial number to use it in preference to their cars" (ibid., pp.25-27), it is accepted that travel by bus will never improve on equivalent journeys by car (ibid., p.150).

As has been suggested earlier (vide 2.8), there is no "freedom of choice between private and public methods of transport" (ibid., p.25) in a new city: if you have a car, you use it, and if you do not, you have no 'choice'. The form of the grid network and the dispersal of facilities to enable unrestricted car use will have the effect of encouraging car ownership, and increasing dependence of those without a car, because public transport operates optimally on radial or linear routes to centralised facilities.

Pedestrian System. Although "provision for free and safe movement as a pedestrian" is cited as a transport goal (ibid., p.25), it is clear that pedestrian distances are effectively extended in layouts which permit unrestricted and relatively safe movement of vehicles. Wide carriageways extend pedestrian journeys: on average, pedestrians have to wait ten times as long to cross a road twenty four feet wide as one twelve feet wide (Smeed, 1968). Diversions to pedestrian underpasses or footbridges are necessary to separate vehicles and pedestrians economically and safely; the number of intersections and pedestrian crossings must be kept to a minimum for they can halve the effective road space for vehicles (Road Research Laboratory, 1965, p.78), whilst vehicular segregation can treble it (Ministry of Transport, 1966).

Although pedestrians can in theory move around freely and safely over the whole town, in practice they are obliged to walk long and indirect distances on all trips other than the radial ones to the local centres with their limited facilities (Llewelyn-Davies, Weeks and Partners, op.cit., pp. 23, 71); only about 10% of the population of Washington will be within reasonable walking distance of the Town Centre (West, 1967).

A serious disadvantage of the grid form structure is that the 'villages' of Washington, and the environmental or 'cellular' areas of

Milton Keynes contain only a small proportion of the total trips generated by them (vide 3.1.6); a 'local activity centre' in Milton Keynes will contain on average only the facilities that can be supported by a population of one thousand two hundred persons, yet houses will be as much as one third of a mile from them (Healy, 1970). The consequence is the same as that outlined with regard to the proportion of traffic that can by-pass an urban centre (Buchanan et alia, op.cit., p.34): environmental areas are kept small to increase this proportion and to facilitate the separation of pedestrians and vehicles. As a result a high proportion of journeys are made beyond the area defined by the primary road network, which acts as a barrier to pedestrian movement, and whose form is inconsistent with an optimal public transport system.

It seems paradoxical that a car orientated system should require dispersal of 'traffic generators' for unrestricted car use of a minority of the population, although the road networks will remain uneconomically used at all other times. By giving priority to the convenience of car travellers, the efficiency of public transport is diminished and pedestrian movement is deterred physically and psychologically. This renders the access of the majority more difficult, as the less mobile are dependent on car drivers or on public transport, the viability of which is itself threatened by pressures for increased car ownership. Estimates of the likely proportion of trips that will be made by means other than by car when the near saturation level of 1.5 cars per household is reached, are found in both the Tyneside survey (Burns, 1966) and the author's Stevenage survey, in which two fifths of the total trips at this level of car ownership would still be made by other means (vide 3.1.3).

5.6.2. The Private Car: Pedestrian: Public Transport System

Plans of the new towns of Cumbernauld (Wilson, 1958, 1959 and 1962) and Skelmersdale (Wilson and Womersley, 1964) are based on hierarchial road patterns designed to accommodate future peak levels of car traffic for work journeys on the shortest and most convenient routes (Crow, 1961, p.112), and are structured on "desire line diagrams indicating ideal paths for traffic" moving about the town for various purposes (Bibbs, 1959). It is felt that the realities of accommodating unrestricted use of cars at the projected levels of ownership must be faced as they are expected to "continue to be the most economical form of transportation over the distances involved" in new towns (Wilson, 1959, p.5; Wilson and Womersley, 1964, p.1).

The communications pattern consists of a main road system clearly defining the local areas linking the various sections of the town, and giving access to the main regional routes; industrial areas are sited around the town to spread the peak hour traffic load. Footpath systems are included to provide safe and convenient routes for pedestrians; to achieve easy accessibility for all inhabitants to the town centre, a compact form is planned so that all housing is within easy walking distance of the major facilities concentrated there (Wilson, 1958, pp. 1, 9, 17 32; Wilson and Womersley, 1964, p.1). It is hoped by these means to provide for the maximum convenience of both motorist and pedestrian (ibid., p.30).

Bicycles were not expected to cause 'any major difficulties' in Cumbernauld, because of the hilly nature of the site and the local weather (Wilson, 1959, p.6); the decline in their use was anticipated to be so great that, in Skelmersdale, no special provision has been made for them other than cycleways to some of the industrial areas (Wilson and Womersley, 1964, pp.32, 70). Yet in the author's survey, one tenth of all journeys

including over one quarter of those of adolescents, were made by this means (vide 3.1.3).

No special consideration was given to the influence of public transport on the structure of the town since it only represents a very small percentage of total peak flows; buses are routed along the most convenient roads, the size and distribution of which have been determined to accommodate car traffic. Neither town is oriented towards pedestrian use: in Cumbernauld, it was originally anticipated that 20% of the working population would walk to work in 1983 (Crow, op.cit., p.113), but this was subsequently revised to 11.0% (Cumbernauld Development Corporation, 1966, p.6); in 1967 only 8% walked to work, and nearly half the residents travelled to the town centre by motor vehicle (Sykes, Livingstone and Green, op.cit., p.19). In Skelmersdale, only 5% are expected to walk to the central area, and 6% to work (Wilson and Womersley, 1964, p.70).

Private Vehicular Movement. Every attempt has been made to accommodate the unrestricted use of cars - indeed restrictions are referred to as 'despairing suggestions' (Wilson, 1959, p.4). This has necessitated the construction of multi-level intersections and a complete redesign of the road system to reduce traffic unnecessarily passing through the town centre (Crow, op.cit., p.114); surface junctions which are relatively economical in road space were 'unacceptable', primarily because they would delay traffic (Jamieson and Mackay, op.cit.). The road network will, however, remain underused until car saturation level is reached (Crow, op.cit., p.114).

It was originally forecast that 39% of people would travel to work by car in 1983 (ibid., p.113); in 1967, the percentage was 59.2% (Sykes, Livingstone and Green, op.cit., p.19). Detailed studies of the peak hour

journey to work now reveal that ultimately 84% are likely to travel to work by car in Cumbernauld (Cumbernauld Development Corporation, 1966, p.6); in Skelmersdale, the figure is expected to be 85% (Wilson and Womersley, 1964, p.70). The higher than anticipated levels of car usage suggest that the road networks of both towns adequately meet the needs of car travellers.

Pedestrian System. The independent footpath system in Cumbernauld was planned to radiate from the town centre to the residential areas (Wilson, 1958, p.2) "by the most direct routes possible" (Wilson, 1962, p.22). It was stated that 70% of houses would be within one third of a mile of the town centre and that all houses would be within three quarters of a mile (Wilson, 1958, p.30). In practice, in 1980, only 36% of the population will live within straight line distances of half a mile, and only 52% within three quarters of a mile of the town centre (Copcutt, 1963); it is a quarter of a mile closer by road than by footpath from many local areas, such as Kildrum and Abrohill (Waters, 1970). Furthermore, the pedestrian system is often circuitous, confusing and not comprehensively planned. It was proposed that the footpath system would enable walking "in comfort and safety between the various parts of the town" (Wilson, 1958, p.20). However, the provision of a footpath system separated from vehicular traffic has not totally insured the safety of pedestrians: since the routes are not the most direct and involve the extra effort of crossing by footbridges or underpasses, many pedestrians use the roads, with the result that, over the seven year period to 1968, the proportion of pedestrian casualties to total casualties differed little from the National average in built-up areas (Waters, op.cit.).

Although the sites of both towns are exposed to prevailing winds (Wilson, 1958, p.4; Wilson and Womersley, 1964, p.5), weather protection is

not provided along the footpaths. Moreover, in Cumbernauld, people have to climb as much as two hundred feet from some residential areas to reach the town centre which has been built on a hilltop (Brown, 1964) - identical to the climb from Holyrood Palace up to the Esplanade of Edinburgh Castle! Pedestrian movement between many of the local areas is not facilitated as the major roads "form barriers between one part of the town and another" (Wilson, 1959, p.5).

In the Cumbernauld Household Survey which was carried out in the autumn, one third of respondents thought the pedestrian system inadequate because it was too lengthy and inconvenient, not sufficiently direct, too uncomfortable in bad weather, or because it had a poor surface: over 44% visited the town centre by car or bus, and only 8% walked to work (Sykes, Livingstone and Green, op.cit., p.19) - already well below the 13% originally predicted for 1983 when the level of car ownership will be far higher (Gibbs, op.cit.). Although it is claimed that Skelmersdale is planning to give "primary consideration to pedestrians", 30% of primary school children, and 70% of sixth form and college students are expected to travel to school by motor vehicle (Wilson and Womersley, 1964, pp.70, 71).

It is apparent that the characteristics of the pedestrian system do not encourage residents to walk; it is not surprising, that therefore, assumptions regarding the proportion of residents who would walk to work and to the town centre (Cumbernauld Development Corporation, 1966) have proved to be totally unreliable.

Public Transport System. Although it is considered that public transport can only succeed if it provides a form of transport as convenient, quick, clean, comfortable and cheap as the private car (Crow, op.cit., p.115),

no attempt has been made in Cumbernauld or Skelmersdale to make buses competitive with cars for any journeys: regional bus services are simply re-routed for local use (Wilson and Womersley, 1964, p.32). The majority of the population are thus dependent upon services which ideally should run on routes radiating from the town centre, but in practice use roads designed to accommodate car traffic, and therefore, operate uneconomically (vide 5.6.1), and are infrequent particularly outside peak hours of travel.

Although 41% of workers were originally predicted to travel to work in Cumbernauld by bus in 1983 (Crow, op.cit., p.113), a decline to only 10.5% was subsequently forecast (Cumbernauld Development Corporation, 1966, p.6); in 1967, the figure was only 22.3% (Sykes, Livingstone & Green, op.cit., p.19). Inadequate public transport has not surprisingly been a common complaint of residents (ibid., p.33).

Revisions to forecasts of the method of travel to work and town centre suggest that a direct result of planning for unrestricted car use even in rush hours has been to diminish the efficiency and effectiveness of other methods of travel: grade separated junctions occupying large areas of land, and underpass or footbridge crossings of primary roads extend both the length and effort involved in pedestrian journeys. In view of the inadequacies of the pedestrian system in respect of directness and clarity of route, protection from weather, and the hilltop site, residents without cars are dependent upon unsatisfactory public transport for a high proportion of their journeys.

A detailed survey of the urban form system in Cumbernauld has established that the road system is the dominant organising feature of the town as a whole and the local areas; the pedestrian network is not structured on a 'systemic basis', with the result that the road system strongly influences the movements

of both car travellers and pedestrians (Waters, op.cit.). The intention that in a compact town the unrestricted use of cars would not prejudice the convenience of pedestrians, does not appear to have been fulfilled.

5.6.3. The Public Transport: Private Car: Pedestrian System

The new towns of Runcorn (Ling and Associates, op.cit.) and Irvine (Wilson and Womersley, 1967), have been planned to accommodate peak hour levels of traffic; however, both towns are orientated to give priority to public transport so that residents will enjoy a high level of accessibility irrespective of whether or not they own a car. It is felt that since a social need exists for public transport for a proportion of shopping, social and school journeys, and even of work journeys, public transport can operate more economically if some car owners can be induced to travel by it (Ling and Associates, op.cit., p.66). A Symposium on New Towns similarly concluded that emphasis should be given to public transport rather than cars for all regular journeys (United Nations, 1964).

The public transport system is designed to serve "at least 15% of the population who will be without the use of a car at a particular time" (Ling and Associates, op.cit., p.66). The planners were probably only considering adults, for it has been shown in the present study that when the car ownership level is saturated, three fifths of the total population, and two fifths of the adult population will be without the optional use of a car (vide 2.7) and that at this level of car ownership it is likely that two fifths of total trips will be made by other means (vide 3.1.3).

The structure of both towns is linear, since public transport operates most efficiently along a 'corridor'; stopping places as foci of 'neighbourhoods' or 'districts' are provided at intervals along its length. This should encourage a far higher passenger load per route mile than would operate on a grid layout. A reserved route for buses, with priority ensured by the use of phased traffic lights where it crosses distributor roads, and a design speed of 40 m.p.h., is planned either on an exclusive road as in Runcorn

(ibid., p.70), or on the central carriageway of the main traffic route as in Irvine (Wilson and Womersley, 1967, pp.6-7). Single deck buses, with low floors to facilitate mounting, will operate during peak hours at intervals of five minutes, and during opp-peak hours at intervals of fifteen minutes (Ling and Associates, op.cit., p.73).

All other motor traffic is accommodated on residential distributor roads and expressways at Runcorn (ibid., p.69) and on residential distributor roads and the outer carriageways of the central 'communications spine' at Irvine (Wilson and Womersley, 1967, p.13). Land uses which generate high levels of traffic are dispersed to achieve the maximum balance of peak flows at the predicted levels of car usage (ibid., p.6). Within the residential communities, pedestrian movement is segregated and given priority, and is encouraged by restricting walking distances. In Runcorn, pedestrian paths are split for use by cyclists on some routes; in Irvine, it is thought that the use of bicycles by adults (sic!) will decline to such an extent as to be "unworthy of particular consideration" (Wilson and Womersley, 1967, p.209).

Public Transport System. Economy in the use of vehicles can be seen in Table 5.9. Although buses travel over four times as much as cars on urban roads, they carry over ten times the number of travellers. Moreover, the emphasis on movement by public transport achieves benefits through lower road network sizes and less public expenditure than would otherwise be required if all car owners travelled to work by car.

Both towns, however, have twenty four feet wide carriageways exclusive to the bus service and it is thought that over 70% of work journeys in Irvine will be by car (Wilson and Womersley, 1967, p.209), and 85% of motorised leisure journeys in Runcorn (Ling and Associates, op.cit., p.128).

Table 5.9. Daily Vehicular Mileage and Vehicular Occupancy on Urban Roads According to Method of Travel

	Daily Mileage ¹	Average Occupancy ²
Private Car	11	1.5
Motor-Cycle	7	1.2
Bus	48 ₃	16.0
Taxi	82 ₃	1.6

¹ Calculated from Ministry of Transport (1969, Tables 35 and 38).

² See figures in Chapter 4.

³ National Board for Prices and Incomes (1969).

Nevertheless, a modal split of 50:50 between the use of private cars and public transport on work journeys has been taken as an objective at Runcorn, with a service planned to be cheap, fast and frequent, giving as near a door-to-door service as possible (ibid., p.67). Although the town is structured to focus on the public transport route, and the bus system is designed to attract a substantial number of workers who will own a car, in the comparison of work and shopping journeys by car and bus, the car is shown to be faster even when car speed is taken at half the speed for which roads are designed: typical journeys by bus outside the rush hour, will take double the time taken by car, and the average door-to-door speed will only be 5.6 m.p.h. (ibid., pp.132-133).

In assessing the relative costs of a typical journey it is shown that, by employing the questionable technique of including a fairly high parking charge of 2/- a day, the journey by public transport will be 7d. cheaper. This analysis clearly takes neither account of the value that the commuter attaches to the extra time, effort, and discomfort involved in travelling by public transport, nor of any parking concessions that employers may offer to their workers. Furthermore, analyses of the likely modal split are made

taking earnings at a future annual income of £1370, which is already the average wage.

The public transport system in Irvine is aimed at keeping door-to-door times 'comparable' with the car (Wilson and Womersley, 1967, p.8), but evidence cited (vide 2.1) suggests that this will not be achieved. A further disincentive is that passengers must walk to bus stops on a central island reservation through an underpass about one hundred and twenty feet long, then to climb to road level and there be subjected, from the adjacent carriageways to noise which is expected to exceed 80 decibels in the rush hour (ibid., pp.13, 93). It seems highly unlikely that those with the option of travelling by car will choose the bus, in view of its many disadvantages (vide 2.8).

Private Transport System. Private vehicular traffic is accommodated on expressways consisting of dual two-lane carriageways with grade separated junctions, designed for speeds of 50 m.p.h. (Ling and Associates, op.cit., p.69). The convenience of this network for car users is apparent from the references in the sub-section on the public transport system.

Pedestrian System. The majority of people in Runcorn will be within five minutes walking distance of a bus stop and a local centre for eight thousand people (ibid., pp.18-20); in Irvine, they will be within a seven to ten minute walk from a bus stop and district centre for about fifteen thousand people (Wilson and Womersley, 1967, p.7). In both towns the pedestrian ways are focussed on these centres. Yet in the author's survey only about one quarter of all journeys were made within a half mile radius of home, which suggests that only a minority of journeys will be able to be made conveniently and in safety on foot. No indication is given of how

pedestrians can travel conveniently between residential communities and town centres: to control pedestrians at Irvine, the central communications spine is to be a "continuous impenetrable physical barrier", with enclosed footbridges or underground arcades only at the public transport stops (ibid., p.93).

The traffic figures for Runcorn show that few pedestrian journeys are likely to be made to destinations outside the residential communities: only 7% of journeys to the central shopping area, and 55% of journeys to secondary schools will be made on foot (Ling and Associates, op.cit., pp.127-128); at Irvine, less than 10% will walk to work (Wilson and Womersley, 1967, p.209). These figures suggest that the form of both these towns will strongly favour motorised movement for the great majority of journeys.

The case for public expenditure by improving public transport rather than seeking to accommodate unrestricted car use has been proven, in a cost benefit study, from the point of view of community costs (Lichfield and Associates, 1969, p.38). However, in concluding that this expenditure is preferable, it is admitted that no attempt has been made to discover whether the public will prefer it - its high attraction had to be 'presumed' (ibid., p.8).

It may be argued on the basis of the evidence cited that the public transport service will attract few travellers who can otherwise travel by car, particularly as car ownership is not expected to be deterred to any degree by the attractions of buses (Ling and Associates, op.cit., p.127). As car ownership increases, the financial viability of bus services becomes uneconomic and results either in reductions in frequencies, particularly during off-peak periods, or in gradually rising fares: it is unlikely that

the eighty to ninety passenger buses to be used in Runcorn (ibid., p.73) can be operated economically with low occupancy rates. Alternative measures to encourage car owners to travel by bus would be to restrict parking or to increase parking charges considerably, neither of which measures would appear to be acceptable in a New Town; moreover, they would not be applicable to most off-peak journeys when higher occupancy rates on buses are necessary to improve the viability of services.

Although in theory the orientation on public transport systems is preferential from the viewpoint of the community, it would appear that in the two plans examined, the achievement of a 'balance' (ibid., pp.66, 114) between public and private transport is not possible without restricting car use.

5.6.4. The Public Transport: Pedestrian: Private Car System

The plan of a new town designed with this order of priorities would be structured to integrate the movement systems so that public transport and walking would be the predominant methods of travel; public transport would be employed to extend the pedestrian's range, and the car would fulfil its most useful role for long distances to otherwise inaccessible destinations, or for essential journeys in town. In this way, each element of the movement system would be functioning optimally.

In Britain, there are no plans for a New Town specifically designed with these objectives. Since it has been seen that the percentage of the population who are unable to walk reasonable distances and to travel by public transport is extremely small, it is clear that such a system would meet the vast majority of travel needs, and a high level of mobility would not be dependent upon age, ability or income - the three requisites of car ownership.

Public Transport System. The main disadvantages of buses compared with other methods of travel, are the slowness of door-to-door journeys and their unreliability (vide 2.8). Therefore, a movement system designed to truly compete with the car would have to make door-to-door journeys beyond reasonable walking distances more convenient by public transport. To achieve this, pedestrian movement would have to be channelled towards a highly efficient public transport system in order to optimise its use. Such a solution could only be viable in circumstances in which it operated on a very frequent cheap and totally reliable service.

Pedestrian Movement System. The relative advantages and disadvantages of walking compared with other methods of travel were examined and summarised

in Chapter 2. It was concluded that pedestrians have a time advantage over those who travel by car only for journeys up to about one quarter of a mile, and over those who travel by bus for journeys up to about three quarters of a mile. Costs of travel are negligible, and in traffic separated areas the risk of accident is almost nil. Pedestrians are also better able to appreciate the visual aspects of the environment. However, they have a limited range of movement, they are exposed to inclement weather and to physical effort when walking long distances, in negotiating changes of level, and occasionally in having to carry goods.

Many of the public considerations of urban movement conflict with those of the individual able to travel by car at will, quickly, and in comfort. From the examination of these aspects in Chapter 4, it was concluded that a reduction in vehicular movement would bring about a concomitant reduction in the size of road and parking facilities (vide 4.1); there would be considerable saving of public expenditure for their provision, maintenance and management (vide 4.2). The primary health benefit of the pedestrian movement system would be the promotion of walking, which has considerable prophylactic value in preventive medicine; the decrease in the number of motorised journeys would lessen stress, and subjection to noise, vibration and air pollution, thereby contributing to the physical and mental welfare of the community (vide 4.3).

As a result of the reduction in the need for vehicular movement, the maximum degree of independence would be enjoyed by all, thereby contributing to individual freedom of movement and initiative; a relationship between long journeys and mental anxiety in school children would also indicate the desirability of walking (vide 4.4). Furthermore, there would be a feeling of security through not having to pay attention to motorised traffic

(Buchanan et alia, op.cit., paras. 23, 96; Parr, 1969). The opportunity of walking to most destinations would reduce the isolation felt by certain sections of the population, particularly children and elderly persons; it would decrease the chauffeuring role that many adults are obliged to assume for those unable to travel independently. The formation of friendships would not be restricted to one side of the road (Whyte, 1956; Hole, 1959, p.167), social intercourse would be encouraged and the visual stimulation of such an environment would be of particular benefit to children and elderly persons (vide 4.4).

In order to achieve the aim of promoting pedestrian and public transport movement, facilities would have to be located at the convergence of their routes; major space utilising facilities like playing fields, parks, and certain types of industry would need to be sited on the town periphery, thereby reducing walking distances and enabling expansion outwards without interfering with the structure of the town. An integrated system of pedestrian ways would permit choice of open or covered routes on the rare occasions when it rains on a short walk (vide 2.4.6). There would be few changes of level and gradients, and delivery of shopping would be encouraged; in this context, it should be noted that surveys have shown that women increasingly rely on packaged goods, so that quality and viewing are becoming less necessary, and expansion of delivery services is anticipated (Times, 1969). Finally, walking would also be encouraged by the inclusion of features of interest to make routes visually stimulating.

Private Vehicular System. In view of the inherent disadvantages of the private car to the community as a whole (vide 4.1 - 4.4), the aim of this system would be to promote journeys by other methods, but not to

restrict travel by car. The road network would be available for those unable or unwilling to walk, such as some disabled people and housewives carrying weekly shopping, and for all essential vehicular traffic. In practice, a car or taxi could be hired for these journeys or for urgent journeys outside town, thereby rendering it unnecessary for a household to own even one car.

The car would be fulfilling the role for which it is ideally suited since it would be mainly used for diverse out-of-town activities, which are increasingly likely to be for leisure purposes (Rodgers, *op.cit.*, Tables 4, 9); moreover, it would be serving family travel needs far more frequently on these journeys.

This suggested movement system attempts to exploit the virtues of the main methods of movement examined in Chapters 2 and 4 so that each could function optimally without prejudice to the efficiency of the others. Considerable savings in personal and public expenditure would result from the reduction in vehicular journeys, and from the removal of the incentive for every adult to own a car because of the great advantages in towns designed for its use. Road accidents would be greatly reduced as fewer journeys would be made by car. Almost all the public considerations point to the outstanding benefits of such a system. If the limitations of walking could be greatly reduced by integrating a pedestrian network with a truly efficient public transport service, this system would go a long way towards reconciling individual and community interests.

If we measure the efficiency of a movement system by its satisfaction of the travel needs of the whole community, then this arrangement of priorities of the main methods of movement would appear to represent a feasible alternative to the three systems previously examined. Such a system would reduce dependency on motorised movement for most journeys, and grant equality of access to each individual irrespective of age, condition and income.

5.7. SUMMARY AND CONCLUSIONS

The main factors by which the planner may evaluate the efficiency of movement systems have been analysed in this chapter. In New Towns today, only one form of vehicular movement is given preference, although the aim is that the three main methods of movement should each function optimally. However, unrestricted car use, efficient public transport and a convenient pedestrian network are not attainable simultaneously since the optimal conditions for each are incompatible. Furthermore, different methods of movement are more convenient for particular types of journey and at each age of the traveller. There is no perfect solution because of the conflicting desires of maximum space around the home as well as a high level of accessibility.

At present the full potential for a pleasant environment may be unrealised since planners do not see a compact community as a functional necessity in view of the predicted increase in the number of cars. However, the low density necessary for their optimal use satisfies the need of only a minority, albeit an economically powerful one. Although there is no doubt that new towns can accommodate unrestricted car use, the total effect is socially undesirable and contrary to community interests: the dictum that feasibility is not a main indication for performance appears particularly apt in this context.

The cost benefit study of public transport in Stevenage, concluded that the car orientated movement system was less preferable than either of the public transport systems analysed, from both measured and unmeasured costs and a strong case was made for public intervention in the community interest against "individual consumer preference" (Lichfield, 1969, pp. 38-41). The studies in this chapter support the suggestion that a reappraisal of the

benefits of planning primarily for unrestricted car use is necessary, as alternative systems provide for the travel needs of all individuals more equitably. Current proposals have been criticised on the grounds that physical mobility is becoming increasingly dependent upon vehicular movement, which only satisfies the needs of adults with optional use of a car. It has been shown that this effectively reduces the accessibility and, therefore, the opportunities of the majority of the population.

In reviewing the relative advantages of alternative movement systems, it is suggested that the aim of an optimal solution must be to make individual and community interests coincident. It appears that the fourth movement system examined meets this criterion since people of all ages can enjoy equality of access with the minimum of undesirable social consequences. A movement system that neglects these considerations should be regarded as inadequate.

6. OUTLINE PROPCSALS FOR A NEW COMMUNITY

6.0.	INTRODUCTION	326
6.1.	URBAN STRUCTURE	330
6.1.1.	Linear Grid	330
6.1.2.	Compact Form	333
6.2.	LAND USE	336
6.2.1.	Housing	336
6.2.2.	Education	336
6.2.3.	Industry	337
6.2.4.	Central Facilities	338
6.2.5.	Open Space	338
6.3.	MOVEMENT SYSTEM	340
6.3.1.	Public Transport	340
6.3.2.	Pedestrians	342
6.3.3.	Private Transport System	343
6.3.4.	The Movement System in Use	344
6.4.	COMMUNITY SIZE AND REGIONAL CONTEXT	347
6.4.1.	Community Size	347
6.4.2.	Regional Context	348
6.5.	COSTS AND BENEFITS	350
6.5.1.	Public Costs	350
6.5.2.	Social Benefits	350
6.6.	CONCLUSIONS	353

G.O. INTRODUCTION

Chapter 5 concluded that an urban structure orientated towards public transport and pedestrian movement would be the most efficient in satisfying total travel needs. This chapter makes proposals for a new community based upon this conclusion.

Traditionally the size of towns was conditioned by the distance that people could reasonably walk, and the speed of wheeled traffic was rarely so great as to constitute a hazard. Weather protection was often provided: even in pre-historic times, there were covered streets in the Stone Age settlements of Skara Brae in the Orkney Islands (Childe, 1935); the arcading in the centres of mediaeval towns, such as Prague and Berne, and in the Rue de Rivoli in Paris, is a traditional solution to this problem; in the 19th century, a New Town named after Queen Victoria was proposed, in which the "comfort and convenience of all classes" was to be afforded by continuous shelter from the weather in the main parts of the town, under a twenty feet wide first floor promenade which could be used in fine weather (Buckingham, 1859).

Development of horse-drawn public transport, of motorised buses, and later of the private car, meant that the limits to urban growth were extended and determined increasingly by the amount of time adults were prepared to spend travelling to work. Less attention was given to pedestrians, and gradually the forms of existing towns were adapted, and those of new towns structured, on motorised traffic systems. This has resulted in greater numbers of journeys having to be made by motorised methods.

The principle of giving pedestrians priority of movement in New

Towns has been applied so far only at Toulouse-le-Mirail in France, at Neu-winsen in West Germany, and at Noord-Kennemerland in Holland (Ritter, 1964, pp.126, 138, 139). In this country, a "walking size town" was considered for Runcorn New Town but rejected because of the "extensive area covered by existing settlements" (Ling and Associates, op.cit., p.1). It is only in some town centres, new residential neighbourhoods, and in the plans of a few of the new British universities (Brawne, 1967) that a comprehensive attempt has been made to give pedestrian movement preference over motorised movement; this has been achieved by keeping walking distances within acceptable limits, by excluding vehicular traffic, by providing covered routes, and by focussing activity and interest on these routes.

The author has, however, been associated with designs for three urban communities based on this principle, from which the present proposals have evolved. These are described here in outline:

In 1956, proposals were made by Lehrman and the author, for a pedestrian orientated linear New Town (Hillman, 1957). The form of the town was an interpretation of some of Jose Sert's proposals for a city. It was designed to allow an "adequate communal life within walking distance" of residential areas, by disestablishing the neighbourhood centre in favour of a single linear centre, by limiting distances to this centre from the residential areas to half a mile, by planning to a net density of sixty five persons to the acre, and by siting all major open space outside the town; in fact, this was the first time in prototype new town plans, that green belts between residential areas were omitted (Tyrwhitt, 1963, p.95).

A linear central area was proposed as a continuous sequence of piazzas, walkways and small parks. Similarly, the residential strips were long super

blocks, entered from flanking roads but focussing on the footpath system which linked schools, local shops, recreation and light industry. The complete separation of pedestrians and motor traffic was achieved without imposing restrictions on the free use of the car: culs-de-sac were no more than one hundred and fifty feet from any dwelling.

(vide Appendix 6.A).

These ideas were further developed in later New Town proposals for Cumbernauld (Wilson, 1958), Noord-Kennermerland (Backema, 1959), Hook (London County Council, 1961), Laureat (U.A.A. Architects, 1961), Neuwinsen (Rosner, 1962) and Pulo Mas (1964) all of which had aims and forms similar to those of Lehrman and the author.

In 1967, the author carried out studies for the Planning Research Unit of the Department of Urban Design and Regional Planning, University of Edinburgh, for the sub-regional plan of the Central Borders; this was prepared for the Scottish Office. The research involved the construction of a model for a new town. The main aim was to plan for the convenience of all inhabitants by designing a compact pedestrian orientated town in which the need and desire for car use to take part in the majority of activities was unnecessary. The structure was rectilinear and provided a hierarchical framework within which the separate movement systems could function effectively yet flexible enough to accommodate natural features without disruption of the basic form. Open and covered pedestrian ways were proposed along the most direct routes, to the activities focussed on them. The built-up areas were arranged around arenas of open space, each of these being planned with a distinctive character by varying its dimensions, and by having a minimum of land use zoning. Stepped housing, rarely exceeding four storeys in height,

was proposed, since it provides private outdoor terraces for each dwelling, and meets the greater demand for lower floors of residential accommodation. (vide Appendix 6.B).

Within the terms and conditions of a competition, similar principles were applied in a design for a residential community of eight thousand persons in Runcorn (Hillman and Samuels, 1968): the pedestrian network was structured so that routes would be short, safe, and weather protected, and have a clear 'image'. This was achieved by radiating the routes towards the local centre and bus stop, by planning a 'spine and rib' system of sheltered ways, and by serving most housing off cula-de-sac. At the same time, a very high proportion of dwellings was planned at ground level, with immediately adjacent parking areas and open space. The structure of the neighbourhood was laid out on a flexible principle so as to retain existing landscape features. Housing types were specifically chosen so that there would be a minimum of disturbance from traffic distributor roads.

(vide Appendix 6.C).

The main disadvantage of these pedestrian orientated plans is the limitation on their size and growth. In attempting to overcome this, planners have sought to increase the range of pedestrian movement by focussing the structure of the town on a linear public transport system (vide 6.1.1). The present proposals evolve from this attitude, in consideration of the research and evidence discussed earlier. The structure of the proposed community is primarily determined by the integration and location of land uses and the movement system. A population of sixty thousand persons has been considered initially, so that comparisons can be made with data from Stevenage New Town. Nevertheless, it is suggested that the population and growth of the community need not be limited (vide 6.4.1).

6.1. URBAN STRUCTURE

The urban structure is designed to provide a wide range of 'activity options' - community facilities and social intercourse (vide 5.5). These activities are to be easily and safely accessible for children and adolescents as well as adults, by reducing the need for car movement, and by promoting public transport and walking; at the same time, restrictions are not to be imposed on car movement. To achieve this, the population would have to live at fairly high densities, though adequate privacy and private open space would be provided and the majority of dwellings would be on the ground. Land use zoning would be minimal so that location could be determined, wherever possible, by convenience of access and sharing by adjacent urban functions of such facilities as parking areas (vide 5.2). Flexibility for future growth and change would be possible, providing it was not achieved to the detriment of the criteria outlined above. Diagram 6.1 illustrates the proposed urban structure.

6.1.1. Linear Grid

The long history of rectilinear and linear patterns of towns has been documented in detail (Tyrwhitt, op.cit.; Collins, 1968). In the fourth century B.C., Priene, a Greek colony in Asia Minor, was planned on a rectilinear grid, probably as much for aesthetic reasons as for the convenience of laying it out; this was the model for many subsequent new towns. Linear settlements have developed from early times as a result of topographical variations, such as a valley or ridge as in mediaeval Edinburgh; it has been suggested that Venice is a linear city, the spine of which is the Grand Canal (Collins, 1968, p.212). However, the concept of a town

deliberately built on a linear axis was the inspiration of Soria y Mata in 1882: Ciudad Lineal in Madrid was planned to take advantage of public transport operating most conveniently along a central spine.

In this century, many prototypes for urban development have been based on these forms: Garnier's Cite Industrielle, 1901; Edgar Chambless' 'Roadtown' 1910; Gonzales del Castillo's Belgian Linear City, 1919; Neutra's Rush City Reformed, 1923-1930; Benoit-Levy's Expansion of Paris, 1927; Le Corbusier's Ville Radieuse and Garden City for Algiers, 1930; Miliutin's Tractorstoi and Magnitogorsk, 1931; Stanley Freese's 'Ten Year Plan', 1932; Soetewey's plans for industrial regions in Belgium, 1935; the Mars Group's London Plan, 1937; Le Corbusier's Industrial Linear City, 1942; Jose Sert's Linear Plan, 1944; Hilberseimer's Linear Plan, 1944; Malcolmson's Metro-linear City 1956; Hillman and Lehrman's Linear New Town, 1956; Hugh Wilson's Cumbernauld, 1958; Shankland's Boston Manor, 1958; Backema's Noord-Kennermerland, 1959; Doxiadis' Dynapolis 1959; London County Council's Hook, 1961; Cullen and Matthews' Linear Circuit Town, 1964. In 1966, Van den Broek and Backema proposed a new town 'Stad op Pampus', adjacent to Amsterdam, in the form of a linear residential development for one hundred thousand persons, on either side of a fast urban motorway and monorail system to give easy access to the city (Hillman, 1966); in 1967, Ling produced the plan for Runcorn which was based on the linear principle, and focused the residential communities on stops along a rapid transit system (vide 5.6.3).

The linear form has many advantages: the capital investment in roads is less than two thirds of that for a ring and radial network (Jamieson, Mackay and Latchford, 1967); it provides a high level of accessibility and when combined with dispersal of traffic generators along its spine, represents the most efficient arrangement for private and public transport (Mackay, 1969);

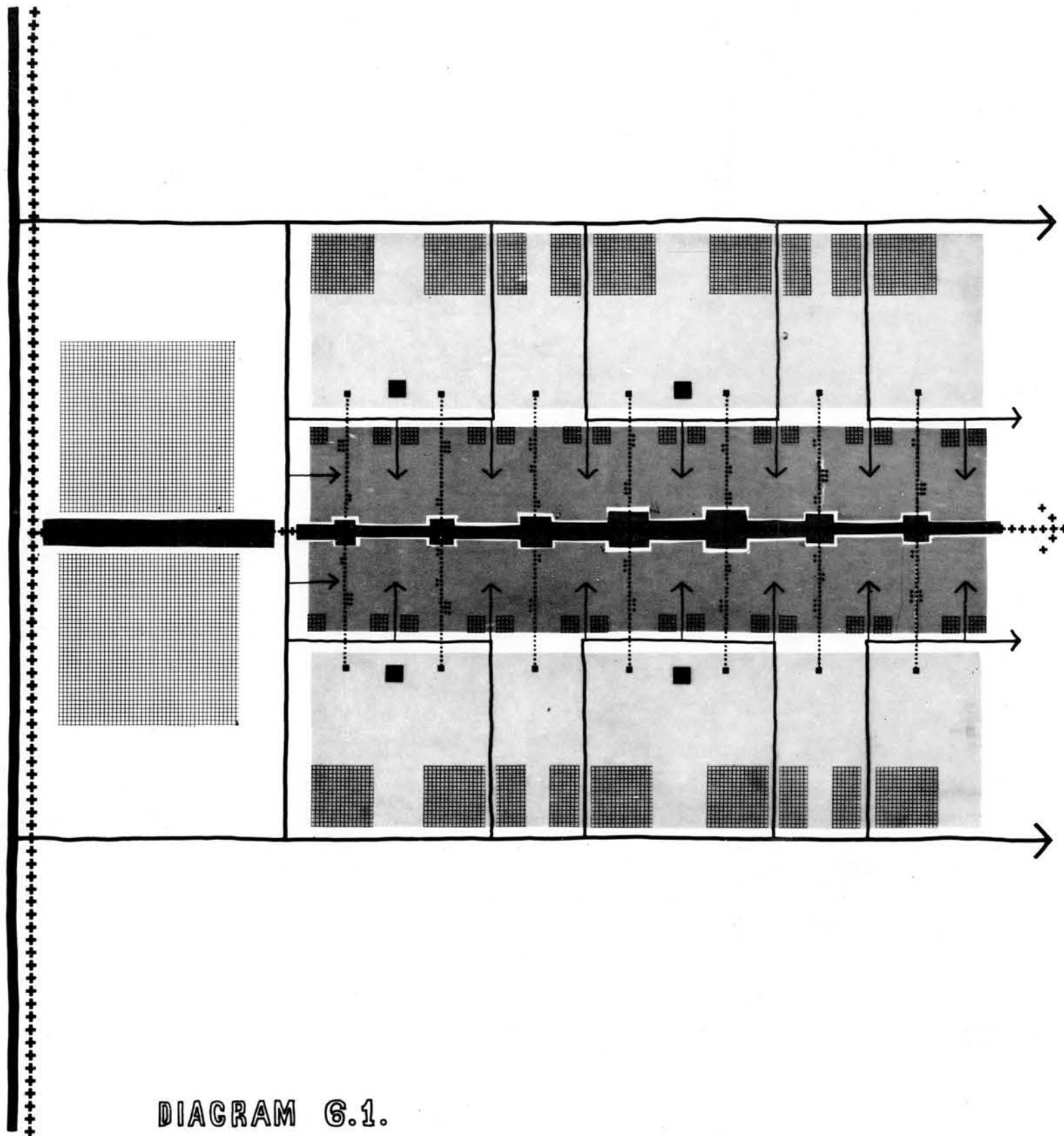


DIAGRAM 6.1.

- Miles
- 0 1 2
- CENTRAL AREA
 - RESIDENTIAL AREA
 - OPEN SPACE
 - HEAVY INDUSTRY
 - MEDIUM INDUSTRY
 - LIGHT INDUSTRY
 - COMPREHENSIVE SCHOOLS
 - PRIMARY SCHOOLS
 - PEDESTRIAN ROUTES
 - +++++ PUBLIC TRANSPORT ROUTE
 - +++++ REGIONAL P.T. ROUTE
 - DISTRIBUTOR ROADS
 - PRIMARY ROADS

moreover, it is an economical way of separating private cars, buses and pedestrians. Land values are more even than in towns with a radial structure, since the more attractive sites can be spread along the spine (Reiner, 1963). It is a fairly complete entity at each stage of its growth, permitting the development of the central area parallel with residential and industrial expansion, and is open ended thus avoiding interference with earlier construction. It can accommodate physical features and other site restrictions in New Town situations without impairing its advantages (Flowden, 1967a; Collins, 1968, p.3). Finally, it is an easily identifiable form. Criticism that it does not have a recognisable centre (Reiner, op.cit.) is more appropriate to the grid system which disperses facilities and land uses in order to even out traffic densities. Objections that it increases distances to the geographical centre (Keeble, 1964) and does not have an optimal form for the car (Llewelyn-Davies, 1967) are balanced by the improved accessibility by bus and on foot, for the majority of people (vide 6.3.4).

The proposed structure is based on a linear grid, with a central area along the spine containing intensively used facilities, which are located at nodal points to optimise access from residential pedestrian routes.

6.1.2. Compact Form

Compactness would be achieved by locating the more intensively used land, including residential areas, most social and commercial facilities, and some light industry, in a quarter of a mile wide strip on either side of the central urban spine. Fairly high densities (vide 6.2.1) would also contribute to the compact form. The less intensively used land, including

sites for primary and comprehensive schools, all playing fields, main public open spaces, and most industry, would be located outside the built-up areas: these uses cover the majority of land for New Towns (Stone, 1965, p.131).

Reference was made in the previous chapter to the relative advantages and disadvantages of high density residential development (vide 5.4.3): it was suggested that the relationship between density and accessibility had been largely ignored in view of the bias for mobility of car users. It was noted that, at higher densities, increased accessibility to social facilities was possible for the majority of the population, that opportunities for frequent social interaction were greater, and that there was less need for vehicular movement. On the other hand, it was not possible to provide a large private garden for each dwelling, nor to afford high levels of privacy, and these were seen to be the most important factors affecting area requirements. Nevertheless, in these proposals it might be reasonably anticipated that there would be less demand for large gardens since parks and playgrounds would be so easily and safely reached.

The benefits of high density, low rise residential housing have been well documented (Lehrman, 1966; Hoffmann, 1967; Haward et alia, 1967): a good microclimate can be established, land and servicing costs are low, and all dwellings are close to ground level, so that outdoor facilities are very accessible and within verbal and visual contact. Dwellings can be grouped flexibly and adapted easily to the terrain. In many recent high density, low rise schemes, it has been found that houses with small private gardens can be built at densities of up to 110 persons per acre (Stone, 1965, p.132); with favourable land use planning, densities as high as 200 persons per acre can be achieved with two storey houses (March, 1967; Hoffmann, 1967, p.22); indeed,

an average of 80-120 persons per acre is considered reasonable (ibid.), and 130 bedspaces per acre not "incompatible with satisfactory family life" (Ash, 1966).

Fewer journeys are likely to be undertaken by car in a compact town, and this would result in reduced road sizes and parking facilities than would otherwise be required. Even excluding any share of ancillary service roads, an area of one hundred and twenty five square feet per person for garage or parking space and apron is required at the recommended allocation of 1.75 spaces per dwelling in Washington (Llewelyn-Davies, Weeks and Partners, op. cit., p.72). This is almost exactly half of the living area per person, calculated from an average household of 3.13 persons (Beckermann, 1965), the predicted household structure (Roskill et alia, 1964) and the area recommended for accommodation, storage, access and ancillary uses (Ministry of Housing and Local Government, 1961).

The author's detailed study for a compact new town showed gross densities of over 150 persons per acre, with all dwellings having gardens or outdoor private terraces (vide Appendix 6.B); the residential community of eight thousand persons in Runcorn was planned at a density of sixty five persons per acre, yet provided 95% of the dwellings at ground level with their own private gardens (vide Appendix 6.F). Commended low rise high density residential schemes in Britain indicate that the amenity of housing, compatible with reasonable privacy, is more a function of design than of number of residents per acre (vide Appendix 6.D).

6.2. LAND USE

The location and intensity of land uses can strongly influence the types and levels of movement within a town (vide 5.2.2). In particular, they can affect the need to travel by car by raising or lowering the relative 'costs' of travel by other means. Much emphasis has been placed on the latter alternative in these proposals.

6.2.1. Housing

The average density of one hundred persons per acre is relatively high for a new town (vide Table 5.6), but by no means high compared with residential developments in existing towns, particularly in view of the proximity of open space. Housing would be served by culs-de-sac, spaced to limit walking distances to one hundred and fifty feet. The culs-de-sac would be interlocked with the pedestrian network, along which most movement would occur (vide 6.3). Maximum walking distances to and from schools, from areas near the central spine, would be a quarter of a mile, and no vehicular routes would have to be crossed.

6.2.2. Education

Primary and comprehensive schools and some nursery schools would be located on the edge of the built-up areas; the remainder of nursery schools would be sited in residential areas. Since the maximum distance would be only a quarter of a mile, even young children would be able to walk to them without difficulty (vide 5.3.3). The advantage of this arrangement is that playing fields, which take up most of the area of school sites, and which

are usually flat and featureless, would not extend walking distances within the built-up areas; furthermore, the effect of noise from them would be considerably reduced: this principle was applied in the linear new town proposal of Lehrman and the author (Hillman, 1957). As schools are located close together, children and adolescents would be able to follow common paths or accompany each other, thereby benefiting from shared experiences (vide 4.4.6). Equal use of some school facilities would also be made easier (vide 5.1.1).

6.2.3. Industry

Industry occupies large areas of land, and its location, therefore, has an important bearing on the structure of the town. Much of the industry in New Towns is light and clean (Clark, 1966), noise is rarely a major problem (McConnell, 1967) and manufacturing has declined to such an extent that only 38% of the total working population in New Towns are engaged in it (Orr, 1969). Consequently, much of it can be integrated into residential areas, thereby providing local employment, particularly for part-time workers (vide 1.4). Service industries which depend for their efficiency to a large extent upon personal contacts can be located in this way; 'nursery' factories providing employment in industries such as clothing or woodworking can be sited adjacent to residential areas, without loss of amenity. Since the majority of employees could walk to work, an increase in the recommended density of workers per acre could be anticipated: 17% of industrial areas are required for parking, and 21% for roads and open space (Needham, op.cit.). Only noisy or noxious industries, those requiring large sites, or those generating high levels of traffic, need be sited away from the town in areas zoned specifically for them, adjacent to regional transportation routes, and preferably separated from residential areas by a recreational parkway.

6.2.4. Central Facilities

It has been suggested that the optimal location of urban facilities can best be achieved by relating them to the method of access of users and the frequency of their visits (vide 5.2.2). For this reason, commercial, cultural and social facilities, are sited along the linear 'spine' of the town. These facilities may then form foci of informal activity around pedestrian squares adjacent to public transport stops; in this way, they would 'punctuate' the spine in a manner analogous to the pedestrian routes in the residential areas (vide 6.3.2), thereby contributing to the comprehensibility of the urban structure.

6.2.5. Open Space

Most outdoor recreational areas, including playing fields and parks, would be sited 'without the town', as in mediaeval towns (Mumford, 1966), in order to attain compactness. Nevertheless, in view of the layout, these open spaces and the countryside would be easily accessible. Only relatively small playspaces and public and private squares would be in the immediate vicinity of residential areas, to provide for the needs of children, their mothers, and old people - all of whom could enjoy the activity and visual stimulation of an urban environment (vide 1.1, 1.2 and 1.5).

The proposed allocation of land for various uses is shown in Table 6.1.

Table 6.1. Land Use for a New Community of 60,000 People

(area in acres)

Land Use	Intensity of Land Use	
	High	Low
Housing ¹ range of residential densities (average 100 persons per acre)	600	
Education ² nursery schools (1,250 persons per $\frac{1}{2}$ acre site)	8	16
primary schools (5,000 persons per 6 acre site)		72
comprehensive schools (15,000 persons per 40 acre site)		160
college of further education	10	
Industry ³ light at 80 employees per acre	42	
medium at 40 employees per acre		350
heavy at 30 employees per acre		250
Central Facilities shops (9 sq.ft. per person) ⁴	12	
commercial and public buildings	58	
sports centre		30
Open Space ⁵ town parks (2,000 persons per acre)	30	
children's playspaces ⁶ (2,000 persons per acre)	30	
public playing fields (400 persons per acre)		150
other open space (100 persons per acre)		600
Roads distributor roads (3 lane carriageway)	20	20
primary roads (4 lane carriageway)		80
Other Uses 10% of town area ²		250
Total	810	1978

Sources:

1. vide Appendix 6.4.
2. Author's analysis of proposed land use budgets for Mark 2 and 3 New Towns.
3. Orr, 1969.
4. Copcutt, 1960.
5. Winterbottom, 1967; Burnett, 1969.
6. Ministry of Housing and Local Government, 1967, p.14.

6.3. MOVEMENT SYSTEM

It has been stated earlier that only an appreciation of the importance of the influences affecting modal choice can provide a reliable basis for satisfying the travel needs of individuals, since decisions are made on the principle of minimising all the immediate 'costs' of reaching an objective. For this reason, it is necessary to establish that individual calculation of the relative benefits of travel by available methods will accord with the planner's intentions.

The aim of the proposed system would be to encourage movement by foot and public transport, by making them generally preferable to movements by car. A corollary of this would be that an optimal movement system should exploit the virtues of the main methods of movement without suffering from their limitations; only in these circumstances could it provide a high level of mobility to all. The proposed system is based on this principle. It would provide complete separation of pedestrians and motorised vehicles in order to permit uninterrupted and safe movement by both methods. It would be planned to be comprehensible to the traveller by the superimposition of linear grids for pedestrians and vehicles, on a hierarchical pattern of primary, secondary and tertiary networks. The components of the system are the public transport, pedestrian and private transport systems.

6.3.1. Public Transport

Pedestrian movement would be focussed on the central 'spine' of the town along which the public transport system would operate, in order to optimise its use. The function of this system would be to increase the range of pedestrian movement so that total journeys would rarely take longer

than equivalent car journeys. The maximum walking distance from the edge of the built-up area of the town to the spine would be about a quarter of a mile.

The public transport system would operate solely along the spine, and consist of a high speed bus service along an exclusive track. It could be similar to the one proposed for Runcorn, with an average speed of 21.6 m.p.h. (Ling et alia, op.cit., p.73). Access points would be sited at junctions of covered pedestrian ways and the central 'spine'. In view of the limited route, and the likely high passenger loads, services could probably be provided at a minimum of four minute intervals.

Alternatively, a new system which is being developed by the Battelle Research Institute, Geneva, and the Dunlop Company Ltd., Liverpool, with support from the National Research and Development Corporation, could be employed: this consists of a continuous two way pedestrian conveyor belt travelling at 10 m.p.h. - similar to a fantasy idea in science fiction in which a 'travelator' moved at 60 m.p.h. (Asimov, 1958). At quarter mile intervals access would be by means of 'integrators' which gradually accelerate passengers at twenty inches per second over a series of belts, from normal walking speed to that of the main belt, at which time they could board it; the reverse procedure would operate when leaving it. The belt has a high degree of vertical and horizontal flexibility so that it could pass through public or commercial buildings at convenient levels and positions, in the same way that the public transport system operated through the pavilions at the World Fair in Montreal in 1967; continuous weather protection is provided. The system is electrically driven and, therefore, silent. Moreover, there would be no difficulty for passengers of any age, who could maintain their equilibrium easily while standing or walking along it

(Bouladon, 1969). It would provide a similar freedom enjoyed by pedestrians, combined with the acceleration of public transport, but without the waste of time involved in waiting. In the past, moving pavements have been uneconomical unless large numbers of passengers were assured; furthermore, maximum speeds of only 3 m.p.h., could not compete with vehicular movement (Henderson, 1969).

6.3.2. Pedestrians

A comprehensive network of pedestrian and cycle routes, completely separated from motorised traffic, and designed to encourage walking would be provided; it is intended that disabled persons would use power operated wheelchairs on this network (Marsh, 1968). The routes are designed to be directional and consistent, with a hierarchical structure to establish a legible and easily perceived system, by signposting and lighting, and by providing a distinctive character to each nodal point. The central 'spine' of the town should add greatly to its clarity.

In view of the limited range of pedestrian movement, the routes would be short, and integrated with the fast public transport system operating along the central spine. Alternative covered ways would be provided throughout the town, for use in inclement weather. These are envisaged generally as arcades, to form an integral element of the higher density areas: the more intensively used could be enclosed, heated or even air conditioned at a later date.

Social activity would be focussed on pedestrian routes; facilities requiring road access would be sited at their junction with culs-de-sac. The routes would be planned as linear, transitional spaces with interval

nodes of activity, such as children's play areas, tennis courts and meeting places, designed to provide interest, contrast and surprise. They would be related to topographical features and prevailing winds to give weather protection, and landscaping would encourage the appreciation of nature throughout the year.

6.3.3. Private Transport

No restrictions on the use of private cars are proposed, as it is anticipated that it will be more convenient to travel by other methods within the town (vide 6.3.4). Cars would be used primarily for out-of-town journeys, and for some essential trips in town when, for instance, heavy shopping has to be carried. Since there would be little incentive for every adult to own a car, it is anticipated that their number and use and, therefore, the road and parking provision, would be considerably lower per capita than in New Towns proposed to date.

However, the need is acknowledged for the close proximity of roads: distances to dwellings would be no greater than one hundred and fifty feet. Parking bays are seen as an integral part of the road system, and would be provided on either side of the culs-de-sac leading into the housing areas from the local distributor roads. Distributor roads would lead to the main peripheral town roads, beyond the recreational and industrial areas surrounding the town. The junctions of the distributor roads with both culs-de-sac and primary roads, would be 't-junctions', thereby considerably reducing the risk of road accidents (Ritter, op.cit., p.306). The dimensions of the local areas bounded by the distributor and primary roads are close to the optimal ones proposed by the traffic engineers of Warrington New Town (Austin-Smith, Salmon, Lord Partnership, 1969).

6.3.4. The Movement System in Use

A calculation can be made of the distance above which it would be quicker to travel by car, rather than by foot and public transport. If a typical journey were made from a dwelling sited in the centre of the residential area to one of the social facilities on the central spine, and if we take the distance along the spine as 'x', then it can be seen from Diagram 6.1. that the journey time by car would be:

(1.5 + 'x') miles at 24 m.p.h. + 4 minutes time loss (vide Appendix 3F), and that by foot and bus, it would be:

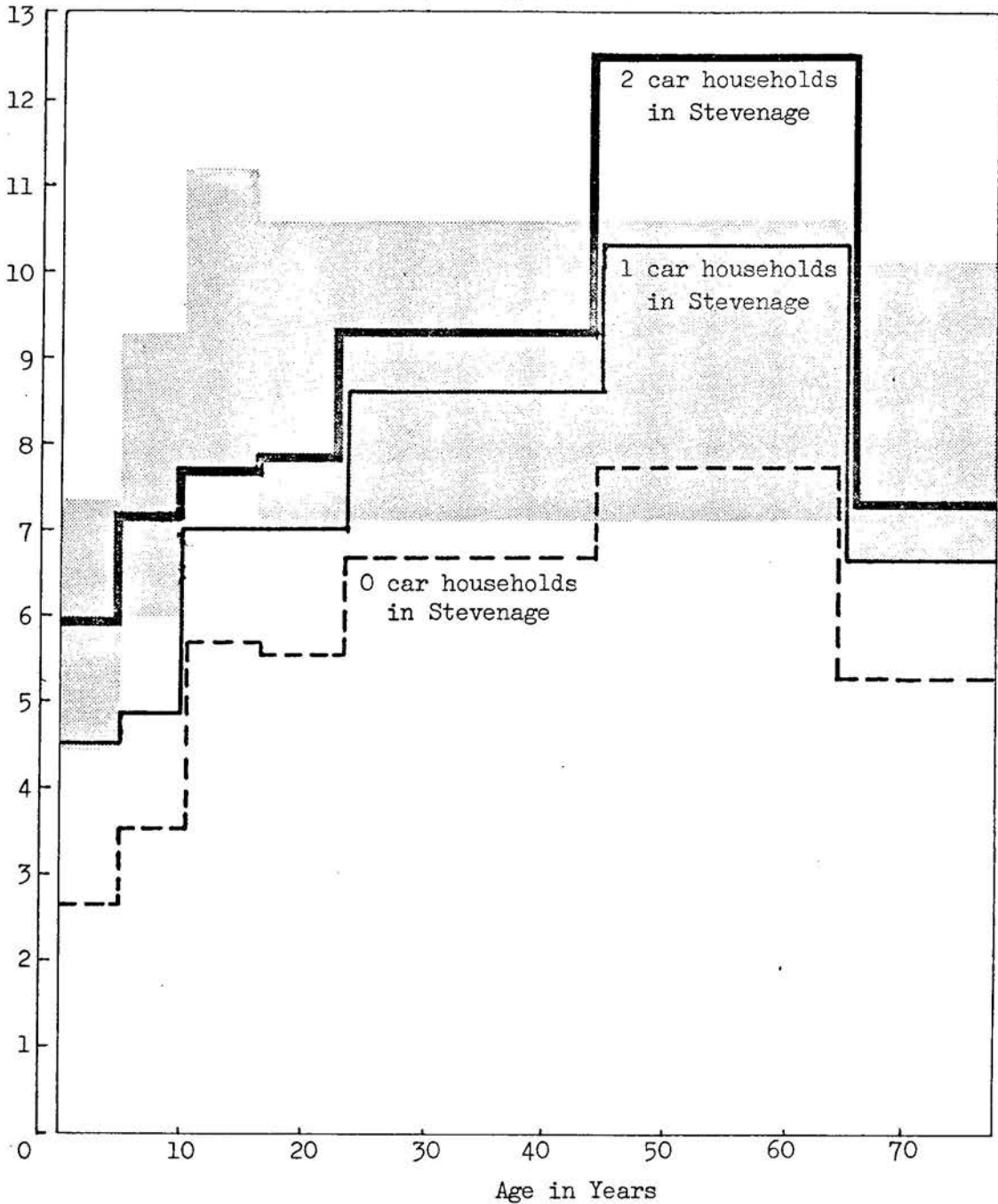
$\frac{1}{2}$ mile at 3.4 m.p.h. + 'x' miles at 21.6 m.p.h. + 2 minutes time loss (vide 6.3.1). On this calculation, it would only be quicker to travel by car for journeys where 'x' exceeded twelve miles. Since the maximum journey in the town is less than three miles, this indicates that it would be quicker to travel this journey by the latter method. Similar calculations can be made to show that if the continuously moving conveyor belt, previously described, were substituted for the bus, it would only be quicker to travel by car for journeys where 'x' exceeded two and three quarter miles. This latter system would have advantages over the bus for short journeys since no time would be lost in waiting.

Diagram 6.2 illustrates the speeds at which individuals in each age group would be able to travel from the centre of a residential area to a destination similarly placed, at distances of one mile and two miles, as compared with speeds according to age and household car ownership, found in the author's survey of Stevenage (vide 3.1.6). It can be seen that generally the speeds represent a substantial increase on those recorded in Stevenage, even of individuals in two car households. At these speeds most destinations could be reached within the average travel time in Stevenage

of eleven minutes. The effect of the proposed movement system is, therefore, to close up the gap between the levels of mobility according to age and household car ownership (vide 5.5), by raising the mean speeds of most age groups, whether in car owning households or not.

It has been argued that a system orientated to promote travel by foot and public transport could only be successful if the convenience of total journeys could compete with equivalent journeys by car (vide 5.6.4). The proposed system appears to meet this criterion: journeys would be quicker, cheaper, safer, and more visually stimulating than journeys by car, and covered routes could be taken in inclement weather. In these circumstances, it is felt that there would be little incentive for those with a car to travel by it.

Diagram 6.2. Mean Speeds According to Age of Typical Journeys in Proposed Community Compared With Mean Speeds Recorded in Stevenage
(miles per hour)



Shaded areas represent mean speeds for one and two mile journeys in proposed community

Sources:

Walking speeds according to age (vide 2.1, Diagram 2.1)

Public transport speeds (vide 6.3.4)

Mean speeds according to age and household car ownership in Stevenage (vide 3.1.6)

6.4. COMMUNITY SIZE AND REGIONAL CONTEXT

The size of population is a major factor affecting the level of work opportunities and social facilities that can be supported (vide 5.1 and 5.3.1), and the phasing of development is clearly important in this context. A new community also has a powerful social and economic influence on the region in which it is located.

6.4.1. Community Size

Although calculations in these proposals have been made for a population of sixty thousand persons, the community could expand: the comparison of distances travelled by car, with those by foot and public transport (vide 6.3.4) suggests that considerable growth could occur without invalidating the principles on which the proposals are based. Moreover, in view of the linear form, it can function as an entity at each stage of its development. This form and a flexible zoning of land would permit changes in floor space requirements for different uses, and in residential densities as and when necessary.

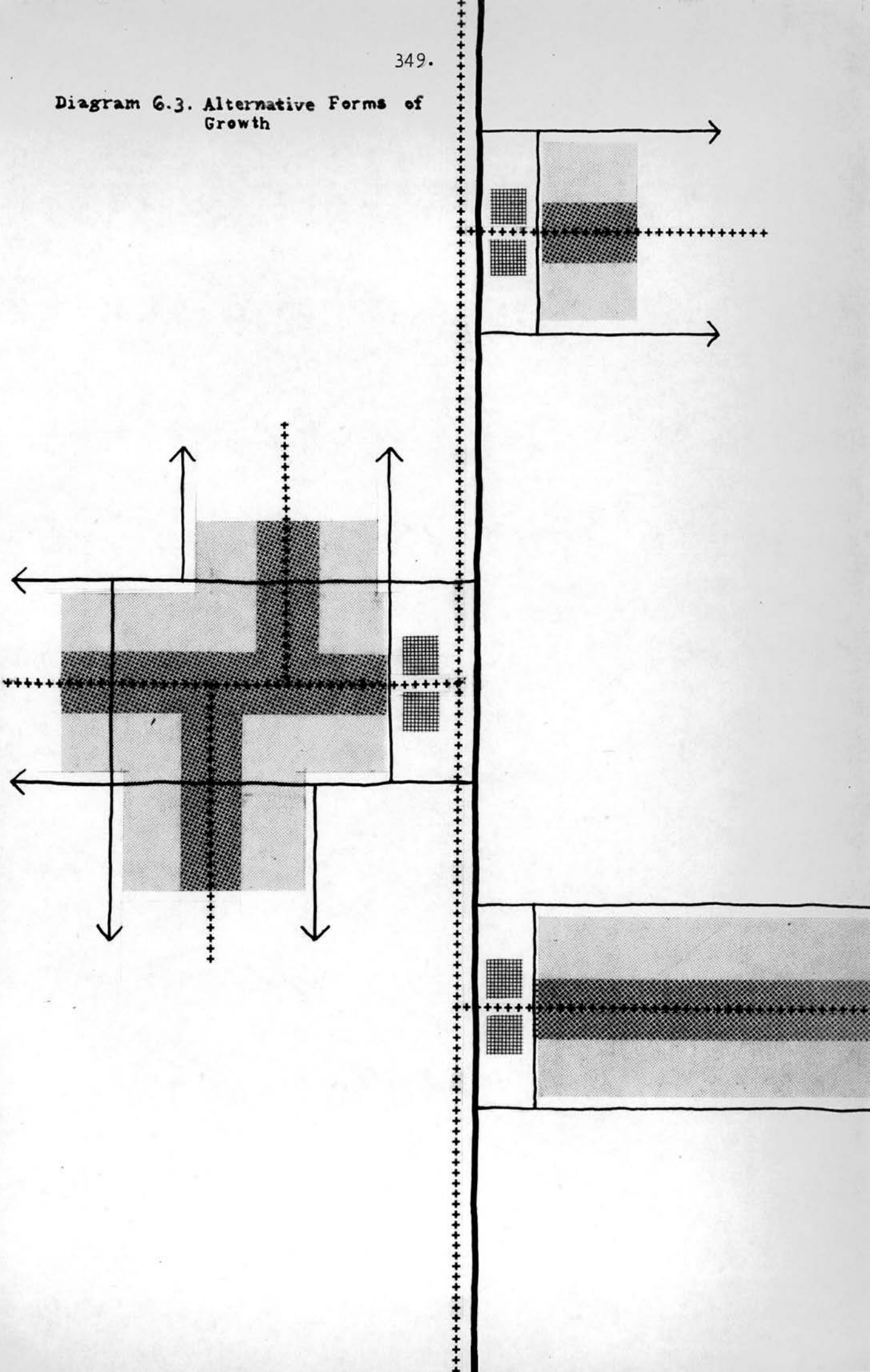
Increases in population could be met by the growth of new settlements adjacent to the regional transportation network, by linear expansion, or by 'off-shoots' of the main urban structure, similarly based on a corridor of accessibility on either side of the high speed public transport spine. The flexibility of these alternatives would permit increases in population on the most advantageous sites for the existing community, and on the most suitable topographical or economical area for expansion.

6.4.2. Regional Context

The relationship of such a community to its region must be the subject of further research at a later stage in the development of these proposals. However, it is clear that if the new community were sited adjacent to a regional motorway and railway line, so that growth could commence at this junction, these networks could provide a convenient link with its own public transport system. If developed on this principle, at a nodal point along the regional routes, it could incorporate major facilities serving regional catchment areas: people arriving by car could park at this interchange; they could then join those arriving by public transport, and transfer to the frequent and high speed public transport system along the town spine.

Diagram 6.3. illustrates alternative ways in which the community could grow, and how it would be related to its region.

Diagram 6.3. Alternative Forms of Growth



6.5. COSTS AND BENEFITS

A comprehensive study of the cost implications of this proposal, possibly in the form of a 'planning balance sheet' (Lichfield and Chapman, 1968), is beyond the scope of this study, and it is only possible to indicate some of the factors that could be considered in detail in further research. Moreover, the author is not persuaded that the efficacy of the proposals should be primarily evaluated in these terms; almost invariably more weight appears to be attached to those factors, such as car trips which can be assessed and predicted numerically. Since there are no reliable methods of measuring health improvement and social benefit, it does not necessarily mean that these considerations are not so important. Nevertheless, a preliminary assessment can be made of some of the additional expenses and likely savings that could be expected.

6.5.1. Public Costs

Although costs of construction would be increased at the proposed higher densities of development and in the construction of covered ways, substantial overall savings in private and public expenditure could be anticipated: these would result from the simplified public transport system operating only along the linear 'spine', and the lighter road infrastructure for the anticipated reduced use of cars.

6.5.2. Social Benefits

Many benefits to health could be expected from the reduction of air pollution, noise and stress associated with vehicular traffic; there would be greater incentives to walk and cycle, and individuals could travel more freely. In addition, savings in personal costs and time of travel are apparent (vide 6.3), in expenses otherwise involved in ultimate car ownership for each adult

and in the concomitant need for parking facilities.

Table 6.2. sets out the differences in costs and benefits between the present proposals and existing new towns, illustrated by reference to available data. This appears to justify further appraisal of the economic and social advantages of the proposals.

Table 6.2. Public Costs and Social Benefits of Proposed Community Compared with Existing New Towns

Public Costs

Housing (45% of total costs¹):
 Constructional costs are higher²; on the other hand, cross wall construction implicit in low rise building is cheaper³.
 Site development costs are lower⁴, and less land is required.
 Less parking provision is necessary⁵.
 Costs of heating and services are more economical at high densities.⁶

Roads and Sewers (10.5% of total costs¹):
 Less road construction, maintenance and management due to reduction in vehicular traffic and higher residential densities⁷.

Public Utilities (9.5% of total costs¹):
 Simplified bus service, or moving pavement⁸, operating on one route only instead of total town network.
 Extra arcading or covered ways integrated with building forms.

Commercial and Public Buildings (15% of total costs¹):
 Reduced parking provision due to reduction in vehicular use.

Variations in Social Benefits

Health Benefits (vide 4.3)
 Prophylactic value of more frequent regular walking⁹
 Less stress in urban movement.
 Less noise, vibration and air pollution.
 Reduced road accidents¹⁰.

Social Benefits (vide 2.8 and 4.4)
 Increased independence of movement and thereby reduced isolation.
 Greater social intercourse in travel.
 Greater contact with nature and increased visual stimulation.
 Reduced obligation to chauffeur those unable to drive.

Other Personal Benefits (vide 2.1 and 2.2)
 Costs and time of travel considerably reduced.
 Increased accessibility for majority of population.
 No incentive for each adult to ultimately own a car.

References to Table 6.2. on Previous Page

-
1. Elements of New Town Construction (Stone, 1964).
 2. 3 to 4 storey housing costs 20% more than 2 storey housing (Ministry of Housing and Local Government, 1967a, p.15)
 3. Hoffmann (op.cit., p.32).
 4. Stone (1965, pp.130, 134).
 5. Average cost of garaging is £200-£375 (Ministry of Housing and Local Government, 1967a, p.25, Appendix II).
 6. Haseler (1965); Elder (1969).
 7. One lane of carriageway costs £65,000 per mile (Roberts and Roberts (1969); costs of distributor roads and sewers per dwelling at eight dwellings to the acre are four times those at 40-50 dwellings (Stone, 1965).
 8. Installation of moving pavement and civil engineering £2.8 million per mile; depreciation £0.1 million per mile per annum (Dunlop Company Ltd., 1970).
 9. National Health Service costs of circulatory diseases alone are £83 million per annum (Office of Health Economics, 1969).
 10. Vide 4.2.1. for costs of accidents - in Stevenage, a new town of comparable population there were 563 road accidents in 1966 (Claxton, 1967).

6.6. CONCLUSIONS

The proposals contained in this chapter are in outline only, and clearly considerable research would have to be carried out to develop them to a stage at which they could be implemented. Studies would have to determine the influence of accessibility on patterns of friendship and frequency of use of facilities by different age groups. In this way, optimal ranges of population density and locations for social facilities could be determined. The comfort and effort involved in walking would have to be assessed more precisely physiologically; psychological influences, such as visual interest, sense of security, and convenience, would have to be measured as they affect the mobility of each age group. In this way, the physical characteristics of a community in which it would be clearly advantageous to travel by foot and public transport could be established. Subsequently these studies could be used in the design of buildings incorporating weather protection for pedestrians and of dwellings with adequate privacy and private open space.

The basic conclusions resulting from this thesis may be summarised:

Equal consideration should be given to satisfying the travel needs of all age groups (vide 1.8).

Although cars are the preferable form of movement, only a minority of the population can have optimal use of them. Mobility should, therefore, preferably not be dependent upon age, ability or income - three prerequisites of car ownership (vide 2.8).

Household car ownership improves the mobility of adults far more than children although the frequency of their journeys are similar (vide 3.4).

In view of the conflict that often arises between individual travel needs and community interests, it is desirable to reduce the need for motorised movement, particularly by car (vide 4.5).

A movement system can only be considered adequate if it raises the level of mobility of all age groups equitably and incurs a minimum of dependency on others (vide 5.7).

On the basis of these criteria and conclusions, it would seem that the proposals outlined in this chapter represent a preferable alternative to the urban forms currently in use or proposed.

Appendix 3.A. Pilot Travel Survey: Edinburgh Questionnaire

THE ATTITUDES TO JOURNEYS OF EDINBURGH RESIDENTS

TRAVEL SURVEY APRIL '69

(Only put ticks in boxes for those journeys YOU usually make)

Average Distance to Destination	Miles 3+ 1-3 1/2 1 0 1/2	Normal Method of Travel (Tick <u>major</u> method only)	Train Bus	Motor Car	Motor cycle	Cycle	Walk	SEX	Male Female
								STATUS	Single Married Other
		JOURNEY TO WORK						AGE	0-4 5-11 12-17 18-44 45-64 65+
		SHOPPING							
		JOURNEY TO SCHOOL							
		SOCIAL VISITS							
		RECREATION/ENTERTAINMENT							

Number of journeys made in last 7 days
(Count any journey back to work or school in afternoon separately)

Number of journeys made in last 7 days accompanied by another member of family

10	9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7

Relative Importance of Different Influences Listed Below On Your Journeys.
Please tick in appropriate box to represent its relative importance to you.
You might want to use the same column more than once.

	Very Important	Quite Important	Little Importance	No Importance
JOURNEY TO WORK				
Time				
Cost				
Safety				
Comfort, including weather protection				
Effort, such as carrying goods				
Visual and social interest of journey				
SHOPPING				
Time				
Cost				
Safety				
Comfort, including weather protection				
Effort, such as carrying goods				
Visual and social interest of journey				
JOURNEY TO SCHOOL				
Time				
Cost				
Safety				
Comfort, including weather protection				
Effort, such as carrying goods				
Visual and social interest of journey				
SOCIAL VISITS				
Time				
Cost				
Safety				
Comfort, including weather protection				
Effort, such as carrying goods				
Visual and social interest of journey				
RECREATION AND ENTERTAINMENT				
Time				
Cost				
Safety				
Comfort, including weather protection				
Effort, such as carrying goods				
Visual and social interest of journey				

Appendix 3.B. Travel Survey: Stevenage Questionnaire

TRAVEL SURVEY: STEVENAGE MAY 1989

(Please answer questions a,b,c,d,e,f - only tick journeys YOU have made in last SEVEN days)

(a) Number of journeys made in last SEVEN days (If you return home for lunch from work or school, add extra journey in the afternoon)												(b) Number of these journeys accompanied by one or more members of your household							
1	2	3	4	5	6	7	8	9	10	11	12+	0	1	2	3	4	5	6	7+

(c) Method of Travel (Only tick major method)												(d) Typical Distance (Home to Destination) Miles				
Train	Bus	Car	M/Cycl	Moped	Cycle	Walk	0- $\frac{1}{2}$	$\frac{1}{2}$ -1	1-2	2-4	4+					

(e)
Please tick in appropriate boxes how important you consider the factors listed below, on each type of journey YOU make (You might want to use the same column more than once)

JOURNEY TO/FROM WORK	Unimportant	Not very Important	Important	Very Important
Time				
Cost				
Safety				
Comfort, including weather protection				
Effort, such as carrying articles				
Visual interest of the journey				

SHOPPING

Time				
Cost				
Safety				
Comfort, including weather protection				
Effort, such as carrying goods				
Visual interest of the journey				

JOURNEY TO/FROM SCHOOL

Time				
Cost				
Safety				
Comfort, including weather protection				
Effort, such as carrying articles				
Visual interest of the journey				

SOCIAL VISITS

Time				
Cost				
Safety				
Comfort, including weather protection				
Effort, such as carrying articles				
Visual interest of the journey				

RECREATION AND ENTERTAINMENT

Time				
Cost				
Safety				
Comfort, including weather protection				
Effort, such as carrying articles				
Visual interest of the journey				

(f)
Please tick in appropriate boxes

SEX	Male	STATUS	Single	AGE	0-4	18-24	CARS IN HOUSEHOLD	None
	Female		Married		5-11	25-44		One
		Other	12-17	45-64	Two			
				65+				

Hertfordshire Express
 and
Stevenage Gazette

BEDFORDSHIRE EXPRESS · HITCHIN, LETCHWORTH & BALDOCK GAZETTE · NORTH HERTS. MAIL & NORTH HERTS. & SOUTH BEDS. JOURNAL

THURSDAY, MAY 1, 1969

TRAVEL SURVEY 'QUIZ' FOR 500 FAMILIES

LETTERS bearing a Scottish stamp will drop through the doors of 500 Stevenage New Town houses early next week. They will be posted on Monday by the Department of Urban Design and Regional Planning at Edinburgh University.

With each letter will be questionnaires for the family, and the answers may help travellers who live in the New Towns of the future.

Mr. Mayer Hillman, a Fellow of the Royal Institute of British Architects, who is conducting the survey, which will determine travel patterns many years ahead, hopes everyone in the 500 households will answer the questions carefully, ready for them to be collected personally on Monday evening, May 12.

"As the questionnaires are being sent only to a limited number of households," Mr. Hillman says, "it is of the

greatest importance to the accuracy of the survey to have a high response."

The purpose of the survey is to assess the extent to which different methods of travel satisfy the journey needs of persons of all age groups, and to use the information to help establish standards for the New Towns of the future.

As the size of the households is not known, six questionnaires are being sent to each address. Details of the journeys of each member of the household, including children, are being sought, in an attempt to find out the relative importance attached to the influences such as time, cost,

safety, comfort and effort on their journeys to work, school, shopping, and for leisure purposes. The questionnaires have been simply designed and only require ticks in the appropriate boxes.

"This survey," says Mr. Hillman, "forms part of a larger study which I have been undertaking for the last two years in the Department of Urban Design of Edinburgh University, and which should be completed by the end of this year. The study is concerned with an analysis of the travel needs of individuals through the life-cycle, and the relative advantages and disadvantages of the alternative forms of movement for meeting these needs.

"It is hoped that the findings of this survey, together with the current research study, will help in establishing a more equitably based form for New Towns of the future."

THURSDAY, MAY 29, 1969

Letters to the Editor

tioner of Scouts, Mr. V. Olley, to Mr. F. Taylor, and to all the Scouts who co-operated so magnificently in the organisation and collection of the questionnaires in the travel survey conducted in Stevenage. The data is now being coded on punch cards in the University of Edinburgh, and we hope to draw conclusions in the next few weeks.

When I telephoned Mr. Olley to ask if the local Scouts' Association could help us, he responded with enthusiasm, with the result that we now have a fairly representative sample of the attitudes of Stevenage residents to their regular journeys.

I would also like to take this opportunity of thanking all those who were kind enough to complete the questionnaires and so contribute to our research.

MAYER HILLMAN

Department of Urban Design
and Regional Planning,
University of Edinburgh

Questionnaires

SIR — I would like to express my thanks through your paper to the District Commis-

17 Chester-street,
Edinburgh.

Appendix 3.D. Travel Survey: Letter Accompanying Questionnaire



DEPARTMENT OF URBAN DESIGN AND REGIONAL PLANNING, EDINBURGH UNIVERSITY

TRAVEL SURVEY: STEVENAGE MAY 1969

Dear Resident,

You will probably have read in the local Press about a Survey of the regular journeys of residents, which is being undertaken in Stevenage. This Survey is being carried out within the Department of Urban Design and Regional Planning, University of Edinburgh, with the co-operation of Stevenage Development Corporation.

The purpose of the Survey is to assess the extent to which different methods of travel satisfy the journey needs of persons of all age groups, and to use this information to help us establish standards for the New Towns of the future. We would very much appreciate your completing the attached questionnaires, which only require ticks in the appropriate boxes. As we do not know the size of your household, six questionnaires are enclosed. If there are any children, they too should each complete a form about their own journeys, and give their own views, with the help of a parent if necessary. Would one parent kindly complete a form for any children under the age of 5 years.

This questionnaire has only been sent to a limited number of households, selected at random, and it is therefore of great importance to the accuracy of the Survey, to have a full response. Would you please complete the questionnaires before next Monday 12th May, and hand them in the enclosed envelope to a member of a local voluntary organisation who will call that evening to collect them.

We are most grateful for your help in this important research. Thank you.

Yours faithfully,

Mayer Hillman, BA(Arch), FRIBA, Dipl.TP.(Lond.)
Project Director, 'Travel Survey: Stevenage'

Please note:

1. Each question refers to the main purpose of the journey.
2. 'Journey to Work' also includes journeys to college or university.
3. 'Social Visits' refer to visits to friends and relations.
4. 'Recreation and Entertainment' includes all other leisure journeys such as to cinema, club, pub, restaurant, evening classes, Church, playground etc.

Appendix 3.E. Travel Survey: Printed Return Envelope

Mr Mayer Hillman
"TRAVEL SURVEY: STEVENAGE"
Department of Urban Design and Regional Planning
University of Edinburgh

Appendix 3.F. Journey Times and Speeds in Stevenage according
to Method of Travel and Purpose of Journey

CAR

Getting on to road	2.0 mins.
Parking and walking to work	3.0 mins.
Parking and walking to shops	2.0 mins.
Parking and walking to school	-
Parking and walking to social visits	1.0 min.
Parking and walking to recreation/entertainment	3.0 mins.
Average speed	24.0 m.p.h.

MOTOR/CYCLE

Getting on to road	1.0 min.
Parking and walking to work	2.0 mins.
Parking and walking to shops	2.0 mins.
Parking and walking to school	-
Parking and walking to social visits	1.0 min.
Parking and walking to recreation/entertainment	2.0 mins.
Average speed	27.0 m.p.h.

BUS

Walking to bus stop	2.5 mins.
Waiting at bus stop for half the time of service frequency (if service frequencies are in excess of 10 mins., timetables will probably be consulted).	5.0 mins.
Walking to destination	1.5 mins.
Average speed	14.0 m.p.h.

MOPED AND CYCLE

Getting on to road, parking and walking to destination	1 min.
Average speed	12 m.p.h.

WALK

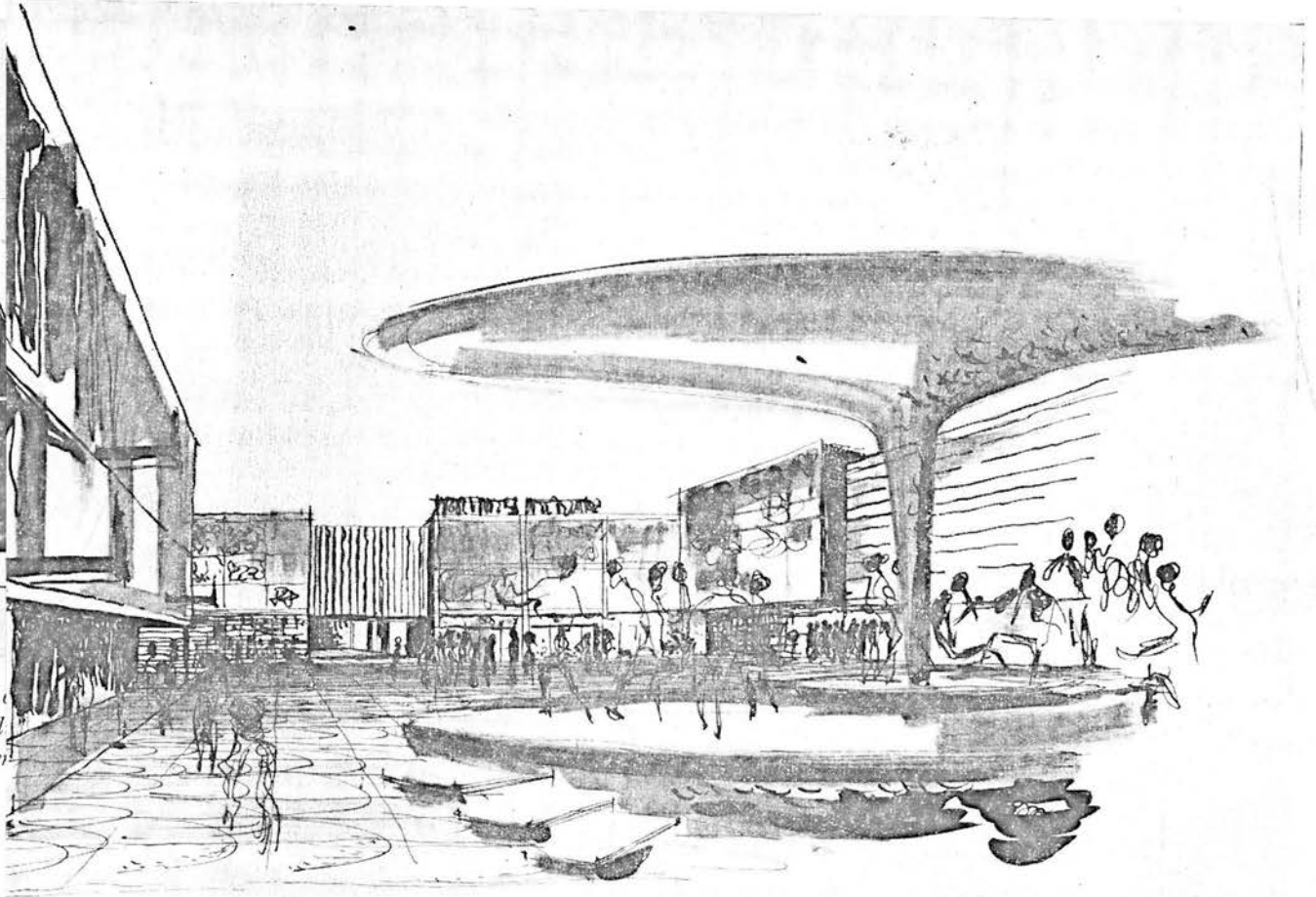
Average speed for children	2.5 m.p.h.
Average speed for adolescents	4.0 m.p.h.
Average speed for adults	3.0 m.p.h.

Source: Correspondence with E.C. Claxton, Chief Engineer:
Stevenage Development Corporation, September and October 1969.

Appendix 3.G. Journey Times in Stevenage according to Distance,
Method of Travel and Purpose of Journey

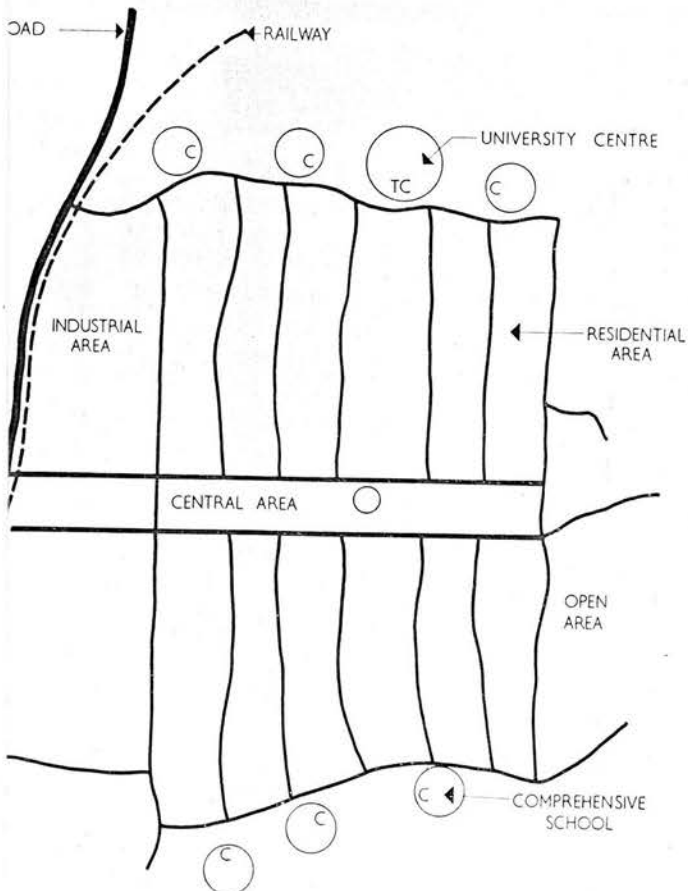
	Time in Minutes			
	1/4 mile	1/2 mile	1 1/2 miles	3 miles
WORK				
car	5.6	6.9	8.8	12.5
m/cycle	3.5	4.6	6.3	9.7
bus	10.1	12.2	15.4	21.9
cycle	2.2	4.7	8.5	9.5
walk	3.7	11.2	22.5	45.0
SHOP				
car	4.6	5.9	7.8	11.5
m/cycle	3.5	4.6	6.3	9.7
bus	10.1	12.2	15.4	21.9
cycle	2.2	4.7	8.5	16.0
walk (children)	6.0	18.0	36.0	72.0
(adolescents)	3.7	11.2	22.5	45.0
(adults)	5.0	15.0	30.0	60.0
SCHOOL				
car	2.8	3.9	5.8	9.5
m/cycle	1.5	2.6	4.3	7.7
bus	10.1	12.2	15.4	21.9
cycle	2.2	4.7	8.5	16.0
walk (children)	6.0	18.0	36.0	72.0
(adolescents)	3.7	11.2	22.5	45.0
(adults)	5.0	15.0	30.0	60.0
SOCIAL				
car	3.6	4.9	6.8	10.5
m/cycle	2.5	3.6	5.3	8.7
bus	10.1	12.2	15.4	21.9
cycle	2.2	5.7	8.5	16.0
walk (children)	6.0	18.0	36.0	72.0
(adolescents)	3.7	11.2	22.5	45.0
(adults)	4.4	13.2	26.5	53.0
RECREATION/ENTERTAINMENT				
car	5.6	6.9	8.8	12.5
m/cycle	3.5	4.6	6.3	9.7
bus	10.1	12.2	15.4	21.9
cycle	2.2	4.7	8.5	16.0
walk (children)	6.0	18.0	36.0	72.0
(adolescents)	3.7	11.2	22.5	45.0
(adults)	4.4	13.2	26.5	53.0

Source: Appendix 3.F.



amenities square in the central area.

PROJECT FOR A LINEAR NEW TOWN



map

When we published, on November 22, a project for a new town prepared by students of the Town Planning Department of University College, London, we referred briefly to an alternative project designed by a few students who disagreed about some of the ideas that had been put into the first scheme. A member of this minority group, Mayer Hillman, writes here about the alternative scheme—a scheme in which densities in the residential area are higher and the town is even more for pedestrians.

It is generally agreed that the time has come to reconsider the principles and practices followed in the planning of the new towns, as outlined in the New Towns Act, 1946, and as executed in Harlow, Crawley, Stevenage and elsewhere.

Some of the points criticised are as follows: Sprawl and long journeys—resulting from low density.

Lack of physical cohesion—due to the demarcation of neighbourhoods and the splitting of land uses.

Appendix 6.E. Central Borders Study: Urban Form Proposal
Extract from Report

This proposal is a trinitarian concept in terms of:

- a tiered structure on
- a linear grid on
- a tri-partite function pattern

It consists of a central elongated tiered spine with tiered 'vertebrae' and 'sub-vertebrae' forming a rectilinear network of tiered 'arenas' for residential, educational, administrative, or industrial uses or a combination of such uses. The tiered structures are cut lengthwise and separated out to accommodate the vehicular or pedestrian networks. This form is then adapted to the conditioning social, physical and economic factors. The basic advantages of the 'tiered structure on a linear grid' are set out briefly under various headings:

- 'social'
 1. The dual role of sociability and privacy are distinctly expressed.
 2. There is a positive progression - communal open/communal enclosed/private enclosed/private open.
 3. Types of housing accommodation are not segregated, so there is a mixture of family types.
 4. Arenas represent distinct structures which give them an identity.
- 'planning'
 5. Greater demands of land use at lower levels are catered for within the form and parking is contained within it.
 6. Natural features are accommodated without disruption of the form or loss of visual cohesion.
 7. Variations in user requirements are possible within the context of the form; in this way a compensatory flow and return of traffic can be encouraged and more double use of parking space is possible.
 8. There is a build up of tiers for increasing intensity of development, along the distributor roads and town centre.
- 'micro-climate'
 9. Shadow greatly diminished and more natural daylighting.
 10. Orientation less critical in siting.
 11. Greater solar gain.
 12. Climate control between tiers.
 13. Alternative open or covered pedestrian ways.
- 'infra-structure'
- 'construction'
 14. Hierarchical pedestrian and traffic networks.
 15. Pattern of services related to network.
 16. Tiered structures lend themselves to standardisation.
 17. Both linear grid and tiers provide flexibility for growth.
 18. Flexibility for qualitative improvement such as covering and heating pedestrian ways.
- 'aesthetics'
 19. Visual continuity in three dimensions.
 20. Visual containment in 'arenas'.
 21. Tiered structure clearly related to the scale of human beings.
 22. 'Architectural' context within structural context.
 23. Town/country contrast emphasised.
 24. Homogeneity to whole town.

The 'tri-partite' function pattern relates simply to a hierarchical planning network, into which the various 'elements' of the town - land use, movement systems, schools, housing, population densities, industry and open space - fit.

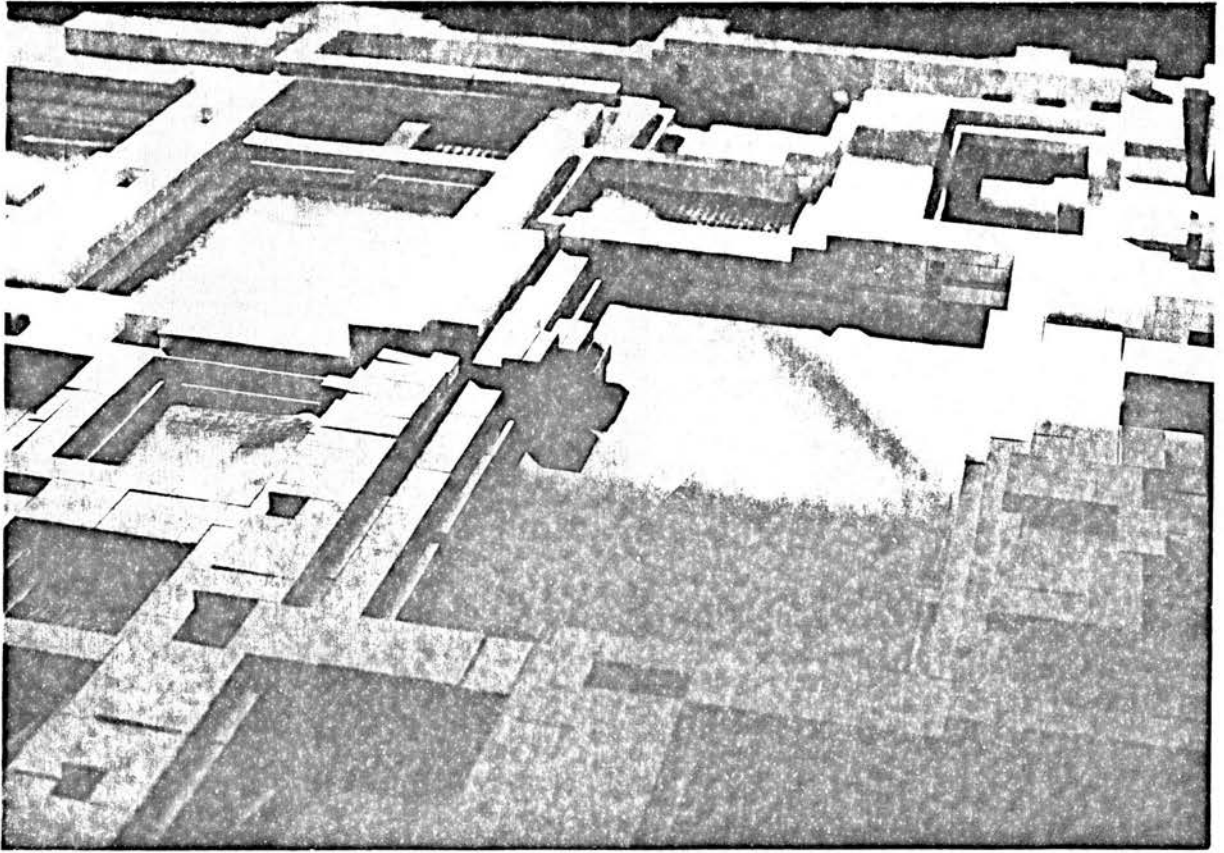
The following studies were undertaken:

1. Diagrammatic plans and sections of various tiered structures to determine a practical range of dimensions.
2. Diagrammatic 'arenas' plotted in relation to the structures.
3. Parking requirements determined as a figure related to the square footage of residential accommodation.
4. Footpath and cul-de-sac network established to provide a maximum eight minute walking distance to the centre.
5. Framework for a 4000 person environmental area (determined by the provision of basic community facilities).
6. Analysis of the various land use requirements.
7. Approach to the integration of open spaces with the arena pattern in which function and topography can be related.
8. Suggestion for the disposition of the various town functions.
9. Diagrammatic representation of an environmental area.

These studies have resulted in the preparation of a model to a scale of 1:500. This represents approximately 90 acres of development between two main spine roads, showing several residential areas with pockets of mixed land uses, along a pedestrian route leading to a section of the town centre.

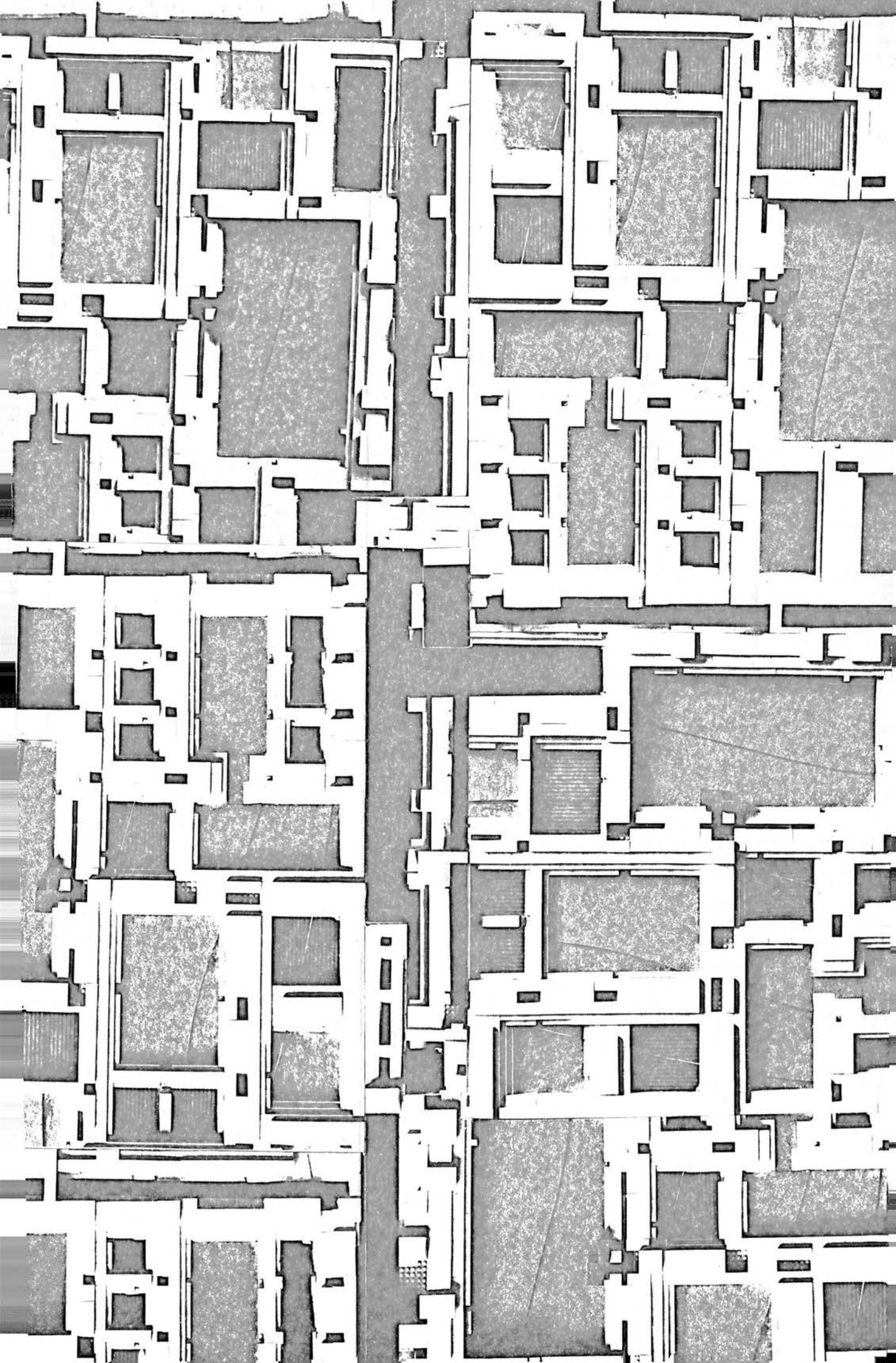
PHOTOGRAPHS OF THE MODEL ARE SHOWN ON THE NEXT TWO PAGES

Appendix 6.B. Central Borders Study: Urban Form Proposal, 1967.



Oblique View of Model

Next Page:
Aerial View of Model



Appendix 6.C. Brookvale Community, Runcorn: 1968
Architectural Competition Report

LAYOUT Eight factors have determined the form of the proposed community:

1. Convenience To provide the maximum number of dwellings on the ground, with immediately adjacent car parking and garages.
2. Safety To provide a safe environment by preventing any vehicles crossing the community and by laying down a straightforward traffic-free pedestrian network.
3. Economy To accommodate the parking requirements with the minimum length of service roads, and to lay out the dwellings for economy of construction.
4. Image To provide a clear image for the inhabitants and a direct relationship between dwelling and community.
5. Identity To express the identity of the individual dwelling within a rationalised building system.
6. Landscape To retain the existing woodland, as newly planted trees would take a generation to mature.
7. Orientation To ensure proper orientation for all dwellings.
8. Climate To meet the challenge of the unpredictable climate in this pedestrian-orientated community, by planning a clear network with potential for continuous sheltered routes.

These factors determined the structure of a spine and eight flexibly radiating ribs.

LAND USE Dwellings

1. To emphasise the image of the community there is an increase in building height from the patio houses around the periphery of the site, to two and three storey terrace houses along the ribs, which link to the four storey maisonettes along the public transit route.

2. Individual identity is expressed in the staggering of each dwelling and each group of dwellings.

3. Proven house types have been adopted.

4. Patio houses are grouped adjacent to the distributor road, to ensure the minimum of aural disturbance, and to enclose the community.

5. Houses are orientated so that living rooms face west and the majority of bedrooms face east. Maisonettes are orientated so that habitable rooms face south.

6. 95% of dwellings have been provided at ground level. 97.7% of persons will live on dwellings on the ground.

Open Space

7. The open space and play areas are conveniently sited at the rear of all dwellings. It is semi-private in character but related to the subsidiary pedestrian network.

Local Centre

8. The buildings in the local centre have been grouped to form the only enclosed space in the community.

Corner Shops

9. All corner shops and the four smaller public houses are situated at the junction of the pedestrian bridges and the main pedestrian east west route.

Schools

10. All school sites relate to their catchment areas; the two County Primary schools are closer to the centre, to provide a choice for all children in the community.

Industrial Area

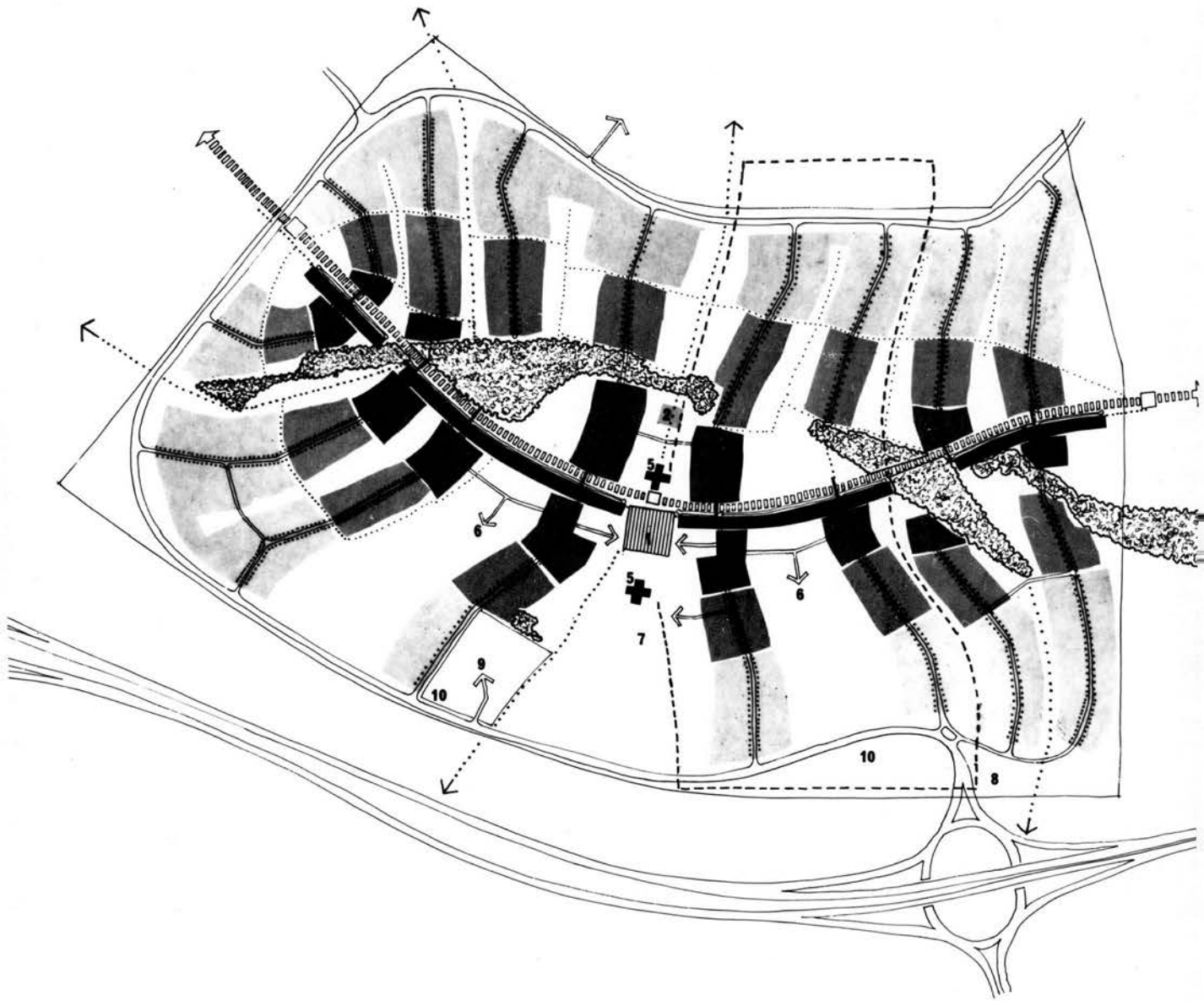
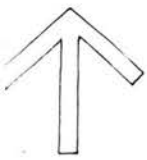
11. The industrial site has been located in a position where there should be minimum disturbance from vehicles using it, yet conveniently situated adjacent to one of the main pedestrian routes.

MOVEMENT

Vehicles

1. The peripheral distributor road carries the traffic from the sixteen service roads. Parking and garaging, as an integral part of the system, have been set out alternatively along their length.
2. The main pedestrian network is a direct image of the housing form, reflecting the build-up of movements. It follows desire lines towards the local centre. Subsidiary systems encourage cross movement to adjacent ribs and the public transit stops at either end of the community or along semi-private open spaces behind the dwellings.
3. Bridges have been provided at the junction of the main elevated pedestrian route and each rib.
4. The network will allow for an economical cover along the western side of all pedestrian 'rib' routes linking them to the main east-west way so that there would be continuous cover from outside each dwelling to anywhere in the community.

REPRODUCTIONS OF COMPETITION DRAWINGS ARE SHOWN ON THE NEXT FOUR PAGES



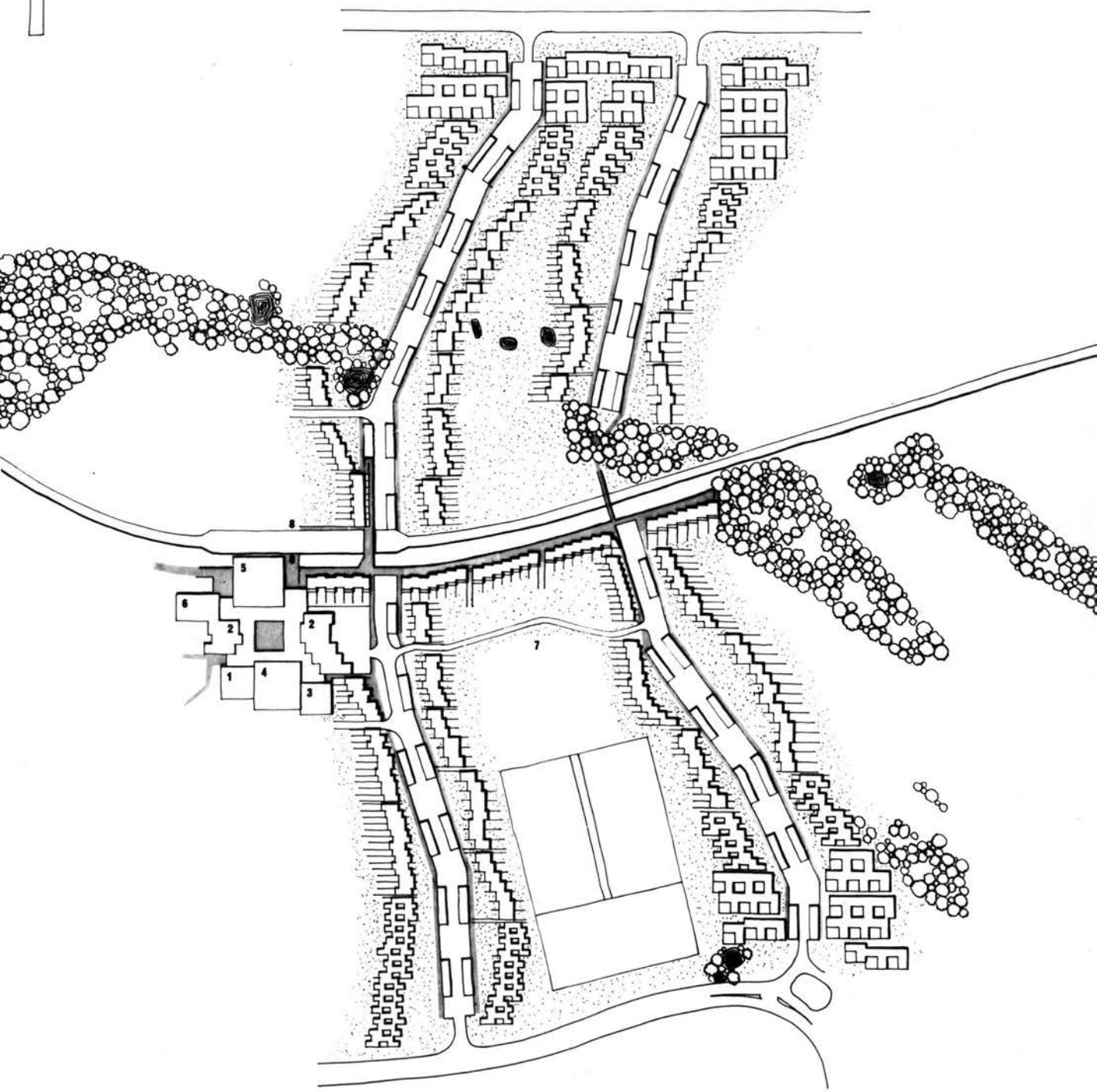
ROOKVALE

DRAWING A
SCALE 1:2500

- | | |
|--------------------------|-----------------------|
| 1 LOCAL CENTRE | 6 PRIMARY SCHOOL |
| 2 OLD PERSONS' DWELLINGS | 7 R.C. PRIMARY SCHOOL |
| 3 PUBLIC HOUSE | 8 ELEC. SUBSTATION |
| 4 CORNER SHOP | 9 INDUSTRIAL AREA |
| 5 CHURCH | 10 PETROL STATION |

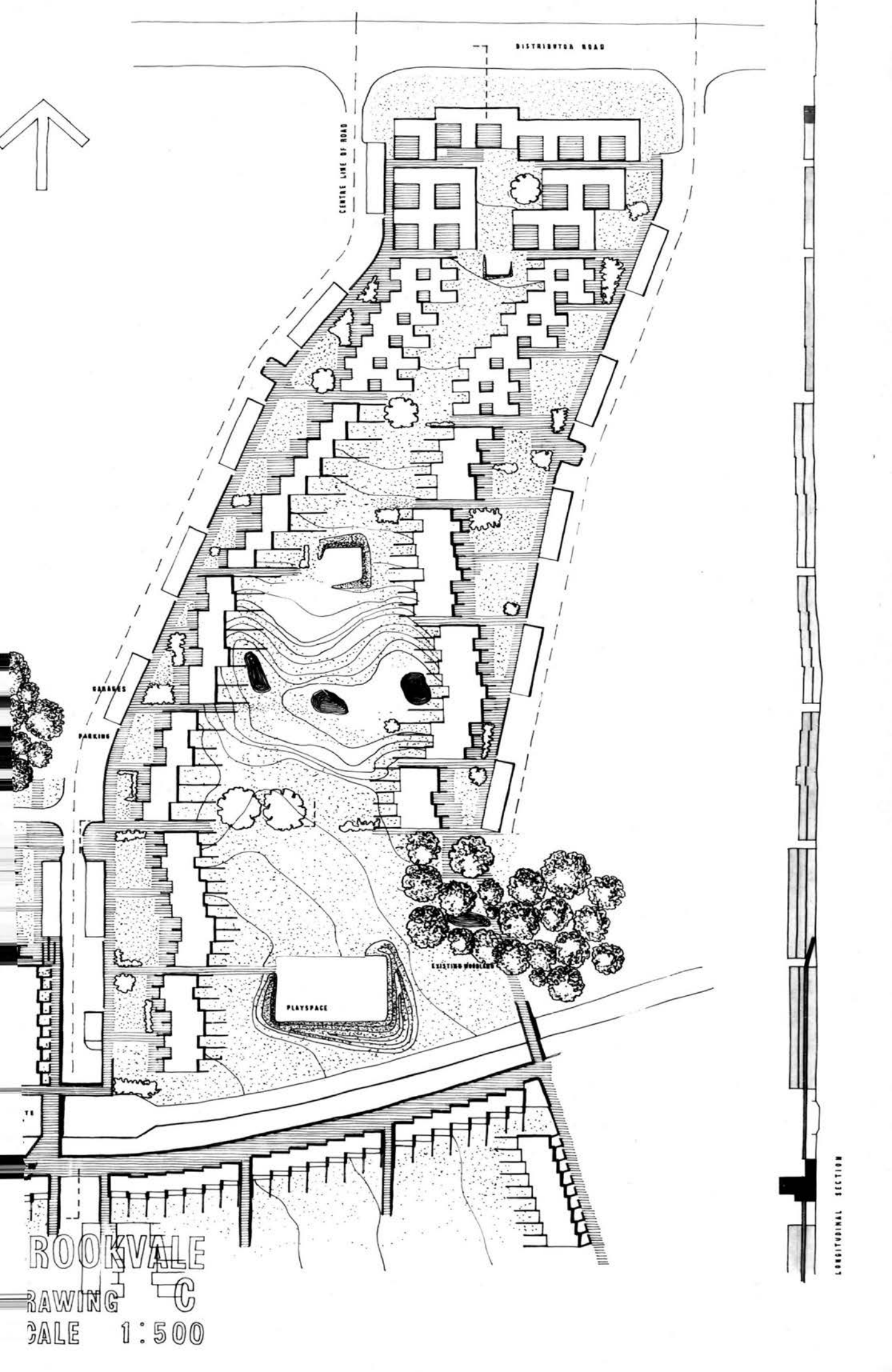
- | | |
|--|-----------------|
|  | 1 STOREY HOUSE |
|  | 2 STOREY HOUSE |
|  | 3 STOREY HOUSE |
|  | 4 STOREY DUPLEX |

- | | |
|---|--------------------|
|  | VEHICULAR ACCESS |
|  | PEDESTRIAN ROUTES |
|  | PUBLIC TRANSIT RTE |
|  | BUILDING PROJECT |



ROOKVALE
DRAWING B
SCALE 1:1250

- | | |
|-----------------|--------------------|
| 1 SUPERMARKET | 5 COMMUNITY CENTRE |
| 2 SHOP UNIT | 6 YOUTH CLUB |
| 3 PUBLIC HOUSE | 7 PRIMARY SCHOOL |
| 4 HEALTH CENTRE | 8 TRANSIT STOP |



DISTRIBUTOR ROAD

CENTRE LINE OF ROAD

GARAGES

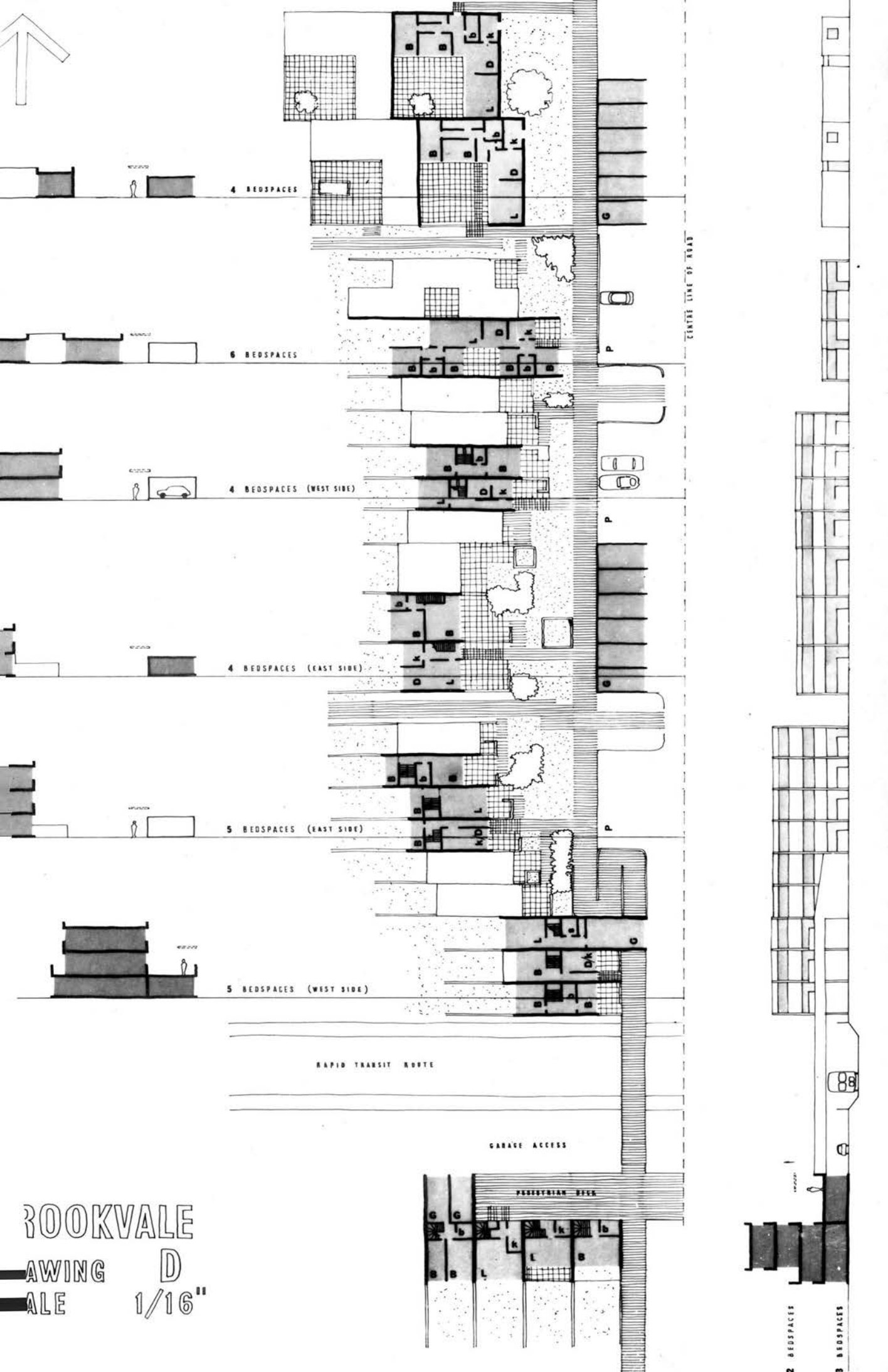
PARKING

PLAYSPACE

EXISTING WOODLAND

LONGITUDINAL SECTION

ROOKVALE
DRAWING C
SCALE 1:500



ROOKVALE
 DRAWING D
 SCALE 1/16"

2 BEDSPACES
 3 BEDSPACES

Appendix 6.D. High Density Low-Rise Residential Development
in Britain, 1966-1970.

(density in bedspaces per acre)

Location	Type of Housing	
Welsh Village Housing ¹ , Cefn-coed-y-cymer, Breconshire.	3 and 4 storey tiered flats	268
Billington Street ² , Westminster, London	4 and 5 storey maisonettes	254
Foundling Estate ³ , Marchmont Road, Camden, London.	5 storey tiered flats	210
Marquess Road ⁴ , Islington, London.	3 and 5 storey flats and maisonettes	200
Bonamy Street ⁵ , Southwark, London.	3 and 4 storey flats and maisonettes	173
Fleet Road ⁶ , Camden, London.	2 and 3 storey tiered flats	165 (gross)
King Street ⁷ , Cambridge.	2 and 3 storey tiered flats	152
Thamesmead ⁸ , Woolwich, London.	2 to 4 storey flats, tiered flats and maisonettes	140
Reporton Road ⁹ , Hammersmith, London.	4 storey tiered maisonettes	136
Edith Avenue ¹⁰ , Washington Durham.	3 to 5 storey flats and maisonettes	136
Gresham Road ¹¹ , Brentwood, Essex.	2 storey tiered flats	126
St. John's Housing ¹² , Cambridge.	4 storey tiered flats and maisonettes	120
St. Mary's Oldham ¹³ , Lancashire.	2 storey houses and 3 to 5 storey flats	110
Milton Road ¹⁴ , Haringey, London.	2 storey houses and flats	109
Housing at Ealing ¹⁵ , Middlesex.	3 storey houses	100
Linden Grove ¹⁶ , Southwark, London.	2 and 3 storey houses and flats	96
Central Hill ¹⁷ , Lambeth, London.	2 storey houses and 3 storey tiered flats	86
Coulsdon Woods ¹⁸ , Surrey.	2 storey houses	80
Clarkhill ¹⁹ , Harlow, Essex.	3 storey tiered flats and maisonettes and patio houses	80
Bishopsfield ²⁰ , Harlow, Essex.	4 storey tiered flats and patio houses	71

Appendix 6.D. High Density Low-Rise Residential Development
in Britain, 1966-1970.

(density in bedspaces per acre)

Location	Type of Housing	
Welsh Village Housing ¹ , Cefn-coed-y-cymer, Breconshire.	3 and 4 storey tiered flats	288
Lillington Street ² , Westminster, London	4 and 5 storey maisonettes	254
Foundling Estate ³ , Marchmont Road, Camden, London.	5 storey tiered flats	210
Marquess Road ⁴ , Islington, London.	3 and 5 storey flats and maisonettes	200
Bonamy Street ⁵ , Southwark, London.	3 and 4 storey flats and maisonettes	173
Fleet Road ⁶ , Camden, London.	2 and 3 storey tiered flats	165 (gross)
King Street ⁷ , Cambridge.	2 and 3 storey tiered flats	152
Thamesmead ⁸ , Woolwich, London.	2 to 4 storey flats, tiered flats and maisonettes	140
Reporton Road ⁹ , Hammersmith, London.	4 storey tiered maisonettes	136
Edith Avenue ¹⁰ , Washington Durham.	3 to 5 storey flats and maisonettes	136
Gresham Road ¹¹ , Brentwood, Essex.	2 storey tiered flats	126
St. John's Housing ¹² , Cambridge.	4 storey tiered flats and maisonettes	120
St. Mary's Oldham ¹³ , Lancashire.	2 storey houses and 3 to 5 storey flats	110
Milton Road ¹⁴ , Haringey, London.	2 storey houses and flats	109
Housing at Ealing ¹⁵ , Middlesex.	3 storey houses	100
Linden Grove ¹⁶ , Southwark, London.	2 and 3 storey houses and flats	96
Central Hill ¹⁷ , Lambeth, London.	2 storey houses and 3 storey tiered flats	86
Coulsdon Woods ¹⁸ , Surrey.	2 storey houses	80
Clarkhill ¹⁹ , Harlow, Essex.	3 storey tiered flats and maisonettes and patio houses	80
Bishopsfield ²⁰ , Harlow, Essex.	4 storey tiered flats and patio houses	71

Appendix 6.D. continued.

References: Architects and Sources.

1. Gammon, Williams & Associates (Architects' Journal, 25th March 1970. March 1970. pp.757-752).
2. Darbourne & Darke (Architects' Journal, 1st October 1969. pp.813-815).
3. Patrick Hodgkinson (Architects' Journal, 8th April 1970. p.842).
4. Darbourne & Darke (Architectural Review: Vol.143, January 1968. p.64).
5. P.O. Hayes, Southwark Borough Architect (Architects' Journal, 3rd September 1969. pp.573-576).
6. S.A.G. Cook, Camden Borough Architect (Architectural Review: Vol.143, January 1968. p.60).
7. Morton, Lupton & Smith (Architectural Design, September 1967. p.422).
8. Hubert Bennett, Architect to Greater London Council (Architectural Review: Vol.142, November 1967. p.386).
9. Higgins Ney & Partners (Architects' Journal, 24th July 1968. pp.129-142).
10. Napper, Errington & Associates (Architects' Journal, 9th July 1969. pp.56-58).
11. Associated Architects & Designers (Architectural Design, September 1967. p.416).
12. Colin Wilson (Architectural Design, September 1967. p.415).
13. Ministry of Housing and Local Government Research and Development Group (Architects' Journal, 9th July 1969. pp.43-46).
14. C.E. Jacob, Haringey Borough Architect (Architects' Journal, 11th June 1969. pp.1584-1586).
15. Ian Fraser & Associates (Architectural Design, April 1965. p.181).
16. Michael Neylan and William Ungless (Architectural Design, September 1967. p.409).
17. Edward Hollamby, Lambeth Borough Architect (Architectural Review: Vol.141, January 1967. p.23).
18. Team 4 (Architectural Design, September 1967. p.403).
19. Bickerdike, Allen & Rich (Architectural Design, September 1967. p.405).
20. Michael Neylan (Architectural Design, September 1967. p.401).

REFERENCESIntroduction

- Buchanan, Colin D. et alia. Traffic in Towns. London: H.M.S.O., 1963.
para. 59.
- Manners, Gerald. "Some Costs of Urban Growth Implications for S.E. Wales". Town and Country Planning, February 1965. pp.60-61.
- Stone, P.A. "Housing Needs, Cost and Policies: How Many Homes". Architects' Journal. 23rd October 1968. p.931.
- Wilson, L.H. "The Urban Environment: Problems and Opportunities". National Council of Social Service, Paper No. 6, February 1967. p.1.

REFERENCESChapter 1

- Aaron, David and Bonnie Winaver. Child's Play. New York: Harper and Row, 1965.
- Abernethy, W.D. "The Importance of Play". Town and Country Planning, October and November 1968.
- Abrams, Mark. "Britain: The Next 15 years". New Society, 7th November 1968. pp.670-673.
- Adams, Barbara. "Housing at Coventry". Report on Ministry of Housing and Local Government's Sociological Research Section Survey. Official Architecture and Planning, December 1967. p.1762.
- Agutter, Margaret. Leisure in Later Years. London: National Old People's Welfare Council, 1963.
- Albermarle, Lady Diana, et alia. The Youth Service in England and Wales. London: H.M.S.O.: (Cmd. 929), 1960.
- Ambrose, Anthony. "Seven Ages of Man: Infancy". New Society. London: New Science Publications, 1969.
- Anderson, Nels. Work and Leisure. London: Routledge and Kegan Paul, 1961.
- Antony, Ruth, Shirley Beckingham et alia. "Where Can Children Play". New Society, 15th April 1968. pp.19-20.
- Arkley, Joyce. Over Sixties: Survey of Social Problems and Unmet Needs. London: National Council of Social Service, March 1965.
- Ash, Joan. "Families Living at High Density". Official Architecture and Planning, January 1966.
- Barr, John. "Free Time Britain". New Society, 15th April 1965, pp.5-7.
- Beckermann, W. et alia. The British Economy in 1965. National Institute of Economic and Social Research. Cambridge University Press, 1965.
- Beyer, Glenn H. and Margaret E. Woods. Living and Activity Patterns of the Aged. Centre for Housing and Environmental Studies. Ithaca, New York: Cornell University Press, 1963.
- Blau, Zena Smith. "Structural Constraints on Friendship in Old Age". American Sociological Review: Vol. 26, No.3, 1961. pp.429-439.
- Bloom, Benjamin S. Stability and Change in Human Characteristics. New York: John Wiley, 1964.

- Boston, Richard. "What Leisure". New Society, 26th December 1968. pp.937-938.
- Boucher, C.A. The Social Medicine of Old Age. In A.T. Welford ed. Society: Problems and Methods of Study. London: Routledge and Kegan Paul, 1962. p.476.
- Bracey, Harold E. Neighbours. London: Routledge and Kegan Paul, 1964. p.14.
- Bracey, Harold E. In Retirement: Pensioners in Great Britain and the United States. London: Routledge and Kegan Paul, 1966.
- Brierley, Susan. Social Development in Young Children. London: George Routledge, 1933.
- British Broadcasting Corporation. The People's Activities. London: B.B.C. Publications 1965.
- British Epilepsy Association. Information contained in letter to the author from Miss M. Lloyd, regarding the mobility of epileptics. 9th January, 1969.
- British Epilepsy Association. People with Epilepsy. Report of the Joint Sub-Committee of the Standing Medical Advisory Committee and the Advisory Committee on Health and Welfare of Handicapped Persons. H.M.S.O. 1970.
- Brockington, C.F. and S.M. Lempert. Social Needs of the Over Eighties. Manchester: Manchester University Press, 1966. p.59.
- Bruner, J.S. The Cognitive Consequences of Early Sensory Deprivation. In P. Solomon ed. Sensory Deprivation. Cambridge, Massachusetts: Harvard University Press, 1961. pp. 195-207.
- Caplan, G. Principles of Preventive Psychiatry. London: Tavistock Publications Ltd., 1964.
- Central Office of Information. Rehabilitation and Care of the Disabled in Britain. London: H.M.S.O. 1965. p. 48.
- Central Statistical Office. Statistical Review: England and Wales for 1967. Part I, Medicine. London: H.M.S.O., 1968. Table A.3.
- Central Statistical Office. Annual Abstract of Statistics, 1968. London: H.M.S.O., 1969.
- Challman, R.C. "Factors Influencing Friendships among Pre-School Children". Child Development: Vol.3, 1932. pp.156-158.
- Clark, P. le Gros. Pensioners in Search of a Job. London: Pre-Retirement Association, 1969.
- Comfort, Alex. Process of Ageing. London: Weidenfeld and Nicholson, 1965, p.1.

- Comfort, Alex. "Biology of Ageing". Report of the Research Group of the M.R.C. London: Medical Research Council, 1969.
- Consumer's Association. "Shopping". Which, November 1969. p.138.
- Crowther, G. et alia. Out of School. Vol.II. Report of the Central Advisory Council for Education (England). London: A.M.S.O., 1959.
- Department of Education and Science. Information contained in letter to the author from W.M. Caldow, 21st October 1968.
- Department of Education and Science. Statistics of Education, 1968. Vol.I: Schools. London: H.M.S.O. 1969. p.20.
- Department of Employment and Productivity. Employment and Productivity Gazette. London: H.M.S.O. August 1968. Table 2. p.632.
- Department of Employment and Productivity. Information contained in letter to the author from Information Section, 20th February 1969.
- Department of Health and Social Security. Annual Report for 1968. London: H.M.S.O., 1969.
- Douglas, J.W.B. and J.M. Blomfield. Children Under Five. London: Allen and Unwin, 1958. p.118.
- Dubos, Rene. Man Adapting: His Limitations and Potentialities. In William R. Ewald ed. Environment for Man: The Next Fifty Years. Bloomington and London: Indiana University Press, 1967. pp.17-18.
- Fuhl, L.J. The Urban Condition: People and Policy in the Metropolis. New York: Basic Books, 1963. p.143.
- Dumazedier, Joffre. Towards a Society of Leisure. New York: The Free Press, 1967. p.95
- Erikson, E.H. Childhood and Society. Harmondsworth, Middlesex: Penguin Books Ltd., 1965.
- Eversley, David. "Life, Leisure and Houses". Architects' Journal 29th November 1967.
- Festinger, Leon, Stanley Shachter and Kurt Back. Society Pressures in Informal Groups. New York: Harper and Row, 1950. pp.33-59.
- Flavell, John Harley. The Developmental Psychology of Jean Piaget. Princeton, New Jersey: Princeton University Press, 1963.
- Fowler, P. "Cognitive Learning in Infancy and Early Childhood". Psychological Bulletin: Vol.59, 1962. p.140.
- Fromm, Erich. The Fear of Freedom. London: Routledge and Kegan Paul, 1960.

- Gans, Herbert J. Levittowners: Anatomy of Suburbia. London: Allen Lane, 1967. pp.207-209.
- Gans, Herbert J. People and Plans: Essays on Urban Problems and Solutions. New York: Basic Books Inc., 1968.
- Gavron, Hannah. The Captive Wife. London: Routledge and Kegan Paul, 1966.
- Gesell, Arnold. The First Five Years of Life: A Guide to the Study of the Pre-School Child. London: Methuen, 1954.
- Gesell, Arnold and Frances Ilg. The Child from Five to Ten. New York: Harper and Bros., 1946.
- Gesell, Arnold, F. Ilg and L. Ames. Youth: The Years from Ten to Sixteen. London: Hamish Hamilton, 1956.
- Gewirtz, Jacob L. A Learning Analysis of the Effects of Normal Stimulation, Privation and Reprivation on the Acquisition of Social Motivation and Attachment. In B.M. Foss ed. Determinants of Infant Behaviour. Vol.I. London: Methuen and Co., 1961. pp.37-49.
- Gibson, J.J. and R.D. Walk. "The Effect of Prolonged Exposure to Visually Presented Patterns". Journal of Comparative Physiological Psychology: Vol.49, 1956. pp.239-242.
- Gibson, J.J. Perception as a Function of Stimulation. In S. Koch ed. Psychology: A Study of a Science. Vol.I. New York: McGraw Hill, 1959. pp.457-495.
- Gist, Noel and Sylvia Fava. Urban Society. New York: Thomas Y. Crowell, 1967.
- Goldsmith, P. Selwyn. Designing for the Disabled (2nd ed.). London: Architectural Press, 1967.
- Goldsmith, P. Selwyn. "Housing for the Disabled". Official Architecture and Planning, May 1968a. pp.647-649.
- Goldsmith, P. Selwyn. Disabled Drivers in Norwich. Draft Report, unpublished, 1968b.
- Gray, P.G. and J. Todd. Survey of Mobility and Reading Habits of Registered Blind in England and Wales. London: H.M.S.O., 1966. p.33.
- Greater London Council. Surveys of the Use of Open Spaces. Research Paper No.2, Vol.1. Greater London Council, 1968.
- Hadfield, J.A. Childhood and Adolescence. Harmondsworth, Middlesex: Penguin Books Ltd., 1962. p.55.

- Halmos, Paul. Privacy and Solitude: A Study of Social Isolation. London: Routledge and Kegan Paul, 1948.
- Harlow, Harry. "Love in Infant Monkeys". Scientific American: Vol.200, No.6, 1959. pp.68-74.
- Harlow, Harry and Margaret Harlow. "Social Deprivation in Monkeys". Scientific American: Vol.207, No.5, 1962. pp.138-146.
- Harris, Amelia I. Social Welfare for the Elderly. Vol.I. Government Social Survey. London: H.M.S.O., 1968. p.83.
- Kasselmeyer, E.C. "The Premature Neonate's Response to Handling". American Nurses Association: Vo.II. 1964. pp.15-24.
- Hauser, Richard. The Fraternal Society. London: Bodley Head, 1962.
- Haynes, K.J. and J. Raven. Living Pattern of Some Old People: Survey 1962-1963. Miscellaneous Paper. Garston, Herts: Building Research Station, 1963.
- Himmelweit, Hilde, A.N. Oppenheim and P. Vance. Television and the Child. For Nuffield Foundation. London: Oxford University Press, 1958.
- Hinchcliffe, R. "Ageing and Sensory Thresholds". Journal of Gerontology: Vol.17, No.1, 1962. p.50.
- Hobson, W. Modern Trends in Geriatrics. London: Butterworth and Co., 1956. p.71.
- Hobson, W. Biology of Ageing. London: Institute of Biology, 1957.
- Hoffmann, H. "Stress at the Wheel". In Symposium on the Human Factors in Road Accidents. Geneva: World Health Organisation, 1969. p.8.
- Hole, Vere. Children's Play in Housing Estates. National Building Studies Research Paper 39. London: H.M.S.O. 1966.
- Hole, Vere and P.G. Allen. Rehousing of Old People: Some Planning Implications. Miscellaneous Paper. Garston, Herts.: Building Research Station, 1962.
- Hole, Vere and John Attenburrow. Houses and People. London: H.M.S.O. 1967
- Holt, John. How Children Learn. London: Pitman, 1968.
- Hopkinson, Anne. Women at Work. London: Industrial Christian Fellowship, 1961. pp.10-16.

- Huizinga, Johan. Homo Ludens: A Study of the Play Element in Culture. Routledge and Kegan Paul, 1949. p.9.
- Hunt, Audrey. Survey of Women's Employment. Vol.1. Government Social Survey. London: H.M.S.O., 1968.
- Hunt, J. McV. Intelligence and Experience. New York: Ronald Press 1961.
- Lucas, Nathan. The Growth of Understanding in the Young Child. London: Educational Supply Association Ltd., 1961. p.33.
- Jacobs, Jane. The Death and Life of Great American Cities. Harmondsworth, Middlesex: Penguin Books Ltd., 1964. pp.85-98.
- Jephcott, Pearl. Time of One's Own. University of Glasgow. Social and Economic Studies Occasional Paper No.7. Edinburgh: Oliver and Boyd, 1967.
- Jones, H.A. Quoted in Article "Old Age". Times, 7th May 1969.
- Kallio, Pauli. "Boredom and Fatigue in School Children". Educational Research: Vol.6, No. 3, June 1964. p.238.
- Katz, Alfred. "Social Causes of Disease". New Society, 23rd January 1969. pp.124-125.
- Kavanagh, J.L. "Confinement, Adaptation and Compulsory Regimes". Science: Vol.143, 1964. p.490.
- Kreps, Juanita M. Lifetime Allocation of Work and Leisure. Department of Health, Education and Welfare. Washington, D.C.: U.S. Government Printing Office, 1968. p.2.
- Langner, G. and S.J. Michael. Life Stress and Mental Health: Midtown Manhattan Study. Vol.2. New York: Free Press of Glencoe, 1963. pp.94-97.
- Leighton, Alexander. "Psychiatric Disorder and Social Environment". Psychiatry: Vol.18, No.4, 1955. p.374.
- Levin, P.H. and A.J. Bruce "Location of Primary Schools". Journal of the Town Planning Institute. February 1968. p.60.
- Lewin, Kurt. Field Theory in the Social Sciences. London: Tavistock Publications Ltd., 1952.
- Middle, Donald. "Mobility: Blind People in the External Environment". New Beacon: The Journal of Blind Welfare: Vol.49, 1965. p.180.
- Munzer, E.A. "The Seven Ages of Man: Childhood, 6-12 Years". New Society. London: New Science Publications Ltd., 1969.

- MacArthur, B. "University Growth Shock". Times, 22nd October, 1969.
- Maddi, S.R. Exploration Behaviour and Variation Seeking in Man.
In D.W. Fiske and S.R. Maddi ed. Function of Varied Experience.
Illinois: Dorsey Press, 1961. p.264.
- Madge, John. "Privacy". In Transactions of the Bartlett Society,
No.3. London: University College, London, 1965. p.124.
- Masser, Ian. "The Use of Outdoor Recreational Facilities".
Town Planning Review: Vol.37. April, 1966. pp.44-45.
- McIntock, F.E. and N. Howard Avison. Crime in England and Wales.
London: Heinemann, 1968. p.180.
- Mead, Margaret. "Child Rearing and the Family". Ekistics:
Vol.28, No.167, October 1969. p.323.
- Mental Health Research Fund. Problems of Old Age. Pamphlet No.4.
London: Mental Health Research Fund, 1966.
- Mental Health Research Fund. Depression and Suicide. Pamphlet No.2.
London: Mental Health Research Fund, 1968. pp.12-13.
- Miller, Derek. The Age Between. London: Cornmarket Hutchison Ltd., 1969.
- Ministry of Health. The State of Public Health: Annual Report of the
Chief Medical Officer, for the Year 1966. London: H.M.S.O.
1967. p.175.
- Ministry of Health. The State of Public Health: Annual Report of the
Chief Medical Officer, for the Year 1967. London: H.M.S.O.
1968. p.31.
- Ministry of Housing and Local Government. Meeting Places for Hire in
New Towns. A Social Survey. London: Ministry of Housing
and Local Government, 1966. p.8.
- Ministry of Labour. Introduction to Shift Working. Survey at the
Request of the National Joint Advisory Council. London:
H.M.S.O., 1967. pp.14-15.
- Morris, Desmond. The Naked Ape. London: Corgi Books, 1967.
pp.123-124.
- Morris, Desmond. The Human Zoo. London: Jonathan Cape, 1969.
- Mussen, P.H. et alia. Child Development and Personality. 2nd Edition.
New York: Harper and Row, 1963.

- Narajan, D. "Infant Development Under Environmental Handicap". Psychological Review Monograph, Vol. 71, No.7, 1957. p.12.
- National Association for Mental Health. Annual Report for the Year 1966/1967. 1967. p.2.
- National Council of Social Service. The Elderly: Handbook on Care and Services. 1968. pp.105-106.
- Newson, John H. et alia. Half Our Future: Report of the Central Advisory Council for Education (England). London: H.M.S.O., 1963. p.51.
- Newson, John and Elizabeth. Infant Care in an Urban Community. London: Allen and Unwin, 1963. p.76.
- Newsweek. "Editorial". November 1968. p.15.
- Norman, L.G. ed. Medical Aspects of Fitness to Drive Vehicles. The Medical Commission on Accident Prevention. London: Royal College of Surgeons, 1968. p.38.
- O'Callaghan, John. "Focus on Shift Work: A Guardian Enquiry". Guardian, 30th May 1968.
- Office of Health Economics. Old Age. London: Office of Health Economics, March 1968.
- Office of Health Economics. The Age of Maturity. London: Office of Health Economics, 1969. p.5.
- Olsson, Tommy. Town Planning for the Disabled. National Swedish Institute for Building Research, 1969.
- Opie, Iona and Peter. Children's Games in Street and Playground. London: Oxford University Press, 1969.
- Osborne, B.M. Social Survey Studies for Town Planning: Some Implications for Town Planning. London: Social Survey, 1950. p.12.
- Outdoor Recreation Resources Review Commission. Outdoor Recreation for America. Washington, D.C.: U.S. Government Printing Office, 1962. pp.24, 31.
- Farr, A.E. "Psychological Aspects of Urbanology". Journal of Social Issues: Vol.22, 1966. p.43.
- Farr, A.E. "Problems of Reason, Feeling and Habitat". Architectural Association Quarterly. July 1969. p.5.
- Pickard, F.M. Activity of Children. London: Longmans, 1965.

- Sheldon, J.H. Social Medicine of Old Age. Oxford: Oxford University Press, 1948.
- Sheldon, J.H. Problems in the Care of the Elderly. In W. Hobson ed. Modern Trends in Geriatrics. London: Butterworth and Co., 1956.
- Sheridan, Mary H. The Developmental Progress of Infants and Young Children. Report on Public Health and Medical Subjects, No.102. Ministry of Health. London: H.M.S.O., 1968. p.6.
- Short, Edward. Secretary of State for Education and Science quoted in "School at Two Years Possible by 1980". Times, 5th January 1970.
- Sillitoe, K.K. Planning for Leisure. Government Social Survey. London: H.M.S.O. 1969.
- Slataper, F.J. "Age Norms of Refraction and Vision". Archives of Ophthalmology: Vol.43, 1950. p.466.
- Soddy, Michael. Men in Middle Life - Cross Cultural Studies in Mental Health. London: Tavistock Publications. 1967.
- Spencer, John. Stress and Release in an Urban Estate: A Study in Action Research. London: Tavistock Publications, 1964.
- Spock, Benjamin. Baby and Child Care. New York: Pocket Books, 1966. p.318.
- Stevenage Development Corporation. Survey of Children's Play, 1968/9: First Report. Stevenage Development Corporation, 1969.
- Stewart, M. The Leisure Activities of School Children. London: Workers Educational Association, 1960. pp.2-3.
- Storr, Anthony. Human Aggression. London: Allen Lane, 1968. p.54.
- Sykes, A.J.M., J.M. Livingstone and M. Green. Cumbernauld 1967: A Household Survey and Report. Occasional Paper No.1, Department of Sociology, University of Strathclyde. p.33.
- Tanner, J.C. Forecasts of Vehicle Ownership in Great Britain. Ministry of Transport: Road Research Laboratory, 1965.
- Tarrant, Mollie and Timothy Joyce. New Housewife Survey. London: J. Walter Thompson Ltd., 1967.
- Thomas, Ray. London's New Towns: A Study of Self-Contained and Balanced Communities. Vol.XXIV. Broadsheet 510. London: Political and Economic Planning, 1969.
- Thomas, Ray. Aycliffe to Cumbernauld: A Study of Seven New Towns in Their Regions. Vol.XXIV. Broadsheet 516. London: Political and Economic Planning, 1969a.

- Times. Report on Proceedings in the House of Commons on 21st February, 22nd February 1969a.
- Times. "Special Report on Supermarkets". 25th April 1969b.
- Times. Report of Proceedings in the House of Commons on 5th December 1969: 2nd Reading of the Chronically Sick and Disabled Persons Bill, 6th December 1969c.
- Townsend, Peter. Family Life of Old People. Institute of Community Studies. London: Routledge and Paul, 1957.
- Townsend, Peter and Dorothy Wedderburn. The Aged in the Welfare State. London: G. Bell & Sons, 1965.
- Townsend, Peter. "The Disabled Need Help". New Society, 28th September 1967a. pp.432-433.
- Townsend, Peter. The Disabled in Society. London: Royal College of Surgeons, 1967b.
- Townsend, Peter. "Social Planning for the Mentally Handicapped". Foreward to P. Morris. Put Away. London: Routledge and Kegan Paul, 1969. p.XXVIII.
- Treasler, G. The Formative Years. London: B.B.C. Publications, 1968.
- Tunstall, Jeremy. Old and Alone: A Social Study of Old People. London: Routledge and Kegan Paul, 1966.
- United States Committee on Ageing. Housing for the Elderly. Report of Sub-Committee to the Special Committee on Ageing. Washington, D.C.: U.S. Senate, 1962. p.62.
- U.N.E.S.C.O. Influence of Home and Community on Children Under Thirteen Years of Age, 1952. p.45.
- Valentine, C.W. The Normal Child. London: Penguin Books Ltd., 1956. p.169.
- Waldorf, Dan. "Recreational Facilities in a New Town". Official Architecture and Planning: Vol.29, November 1966.
- Wall, W.D. The Adolescent Child. London: Methuen and Co.Ltd., 1952.
- Wall, W.D. Enrichment of Childhood. London: Nursery School Association, 1960.
- Wall, W.D. "Intellectual and Emotional Care". Journal of the Pre-School Playgroups Association, May 1969. p.22.
- Wall, W.D. "How Significant are the Years before Five". Journal of the Pre-School Playgroups Association. June 1969. p.4.

- Webber, Melvin. "Planning in an Environment of Change: Part 1: Beyond the Industrial Age". Town Planning Review: Vol.39, No.3. December 1968. p.187.
- Welford, A.T. Ageing and Human Skill: An Introduction to the Problems of Ageing: Nuffield Unit for Research. London: Nuffield Foundation, 1958.
- Welford, A.T. Society: Problems and Methods of Study. London: Routledge and Kegan Paul, 1962. p.161.
- Wilkins, Leslie T. The Adolescent in Britain. A Social Survey. London: Central Office of Information, 1955. p.85, Table 101.
- Willmott, Peter. "Some Social Trends". Urban Studies: November 1969.
- Wilner, Daniel M., Rosabelle Price, Walkley Thomas and Mathew Taybeck. Housing Environment and Family Life: A Longitudinal Study of the Effect of Housing on Morbidity and Mental Health. Baltimore: The John Hopkins Press, 1962. pp.243-244.
- Wiseman, Stephen. Environmental and Innate Factors and Educational Attainment. In J.E. Meade and A.S. Parkes eds. Genetic and Environmental Factors in Human Ability. Edinburgh: Oliver and Boyd, 1966.
- Wolff, Sula. Children under Stress. London: Allen Lane, 1969. p.186.
- Wooly, J.M. "What Can Be Done to Further the Independence of Blind People in the Demands of Daily Living". Proceedings of the 26th Convention of the American Association for the Welfare of the Blind, 1952. p.50.
- World Health Organisation. Annual Epidemiological and Vital Statistics: Report for 1968. Geneva: World Health Organisation, 1969.
- Wright, B.A. Physical Disability: A Psychological Approach. New York: Harper and Brothers, 1960. p.179.
- Young, Michael and Peter Willmott. Family and Kinship in East London Harmondsworth, Middlesex; Penguin Books Ltd., 1957.
- Yudkin, Simon. 0-5: A Report on the Care of Pre-School Children. London: National Society of Children's Nurseries, 1967.

REFERENCESChapters 2-4

- Abel-Smith, Brian and Peter Townsend. The Poor and the Poorest. London: Bell and Company, 1965.
- Abrahams, Adolphe. Exercise and Sports. In Ogilvie, Heneage ed. Fifty - An Approach to the Problems of Old Age. London: Max Parrish, 1962. pp.95, 103.
- Abrams, Mark. "Britain: The Next 15 Years". New Society, 7th November, 1968a. pp.670-673.
- Abrams, Mark. Consumption in the Year 2000. In Young, Michael. ed. Forecasting and the Social Sciences. London, Heinemann, 1968b, p.37.
- Aitken, Jonathan. "Hell is a City". Evening Standard. 13th March 1968.
- Ambrose, P.J. "An Analysis of Intra-Urban Shopping Patterns". Town Planning Review, January 1968. pp.327-334.
- Antrobus, John. "Information Theory and Stimulus - Independent Thought". British Journal of Psychology: Vol.59, No.4, November 1968. pp.423-430.
- Architects' Journal, 17th July 1968. p.68.
- Ardrey, Robert. Territorial Imperative: A Personal Investigation into the Origins of Property and Nations. London: Collins, 1967.
- Ash, Maurice. Regions of Tomorrow: Towards the Open City. London: Evelyn, Adams and Mackay, 1969.
- Ashworth, Graham. "Planning Your Environment". Guardian, 18th November 1969.
- Atkins, Colin K. People and the Motor Car. Vol.1. Department of Transportation and Environmental Planning. University of Birmingham, 1964.
- Atkins, W.S. Harlow Transportation Study: Vol.1. Survey and Basic Analysis. Harlow Development Corporation, 1968.
- Austin, Michael. Accident Black Spot. Harmondsworth, Middlesex: Penguin Books Ltd., 1966.
- Automobile Association. The Motorist Today. London: Automobile Association, 1967a.
- Automobile Association. Drive. Spring 1969. p.27.

- Automobile Association. Information contained in letter to author from Public Affairs Officer, 13th February 1970.
- Bagley, Christopher. "Society at work". New Society, 6th March 1969. pp.365-366.
- Baily, Michael. "Future of London Transport". Times, 3rd September 1968.
- Baird, I. McClean. Obesity in Adults. In Baird, I. McClean and A.M. Howard ed. Obesity: Medical and Scientific Aspects. Edinburgh: E. and S. Livingstone, 1969. p.24.
- Beckermann, W. et alia. The British Economy in 1965. National Institute of Economic and Social Research. Cambridge: Cambridge University Press, 1965.
- Beesley, M.E. "The Value of Time Spent in Travelling: Some New Evidence". Economica, May 1965. p.182.
- Beesley, M.E. and J. Politi. "A Study of the Profits of Bus Companies". Economica, May 1969. pp.161-170.
- Bello, Francis. Exploding Metropolis. Garden City, New York: Doubleday and Co., 1958. p.38.
- Benjamin, Bernard. "The Role of Statistics in Planning for Recreation." Greater London Council Quarterly Bulletin Issue 3. London: Greater London Council, July 1968. p.13.
- Bennett, R.F. "Urban Transport in the Developed City". In Report of the Town and Country Planning Summer School, Manchester University, 1968. London: Town Planning Institute, 1968. pp.39-43.
- Birmingham Junior Chamber of Commerce. Forward into Chaos: Report on the Staggering of working Hours. 1968. p.2.
- Black, Stephen. Man and Motor Cars: An Ergonomic Study. London: Secker and Warburg, 1966. pp.65-77.
- Blanden, Michael. "Higher Car Insurance Rates". Guardian, 14th June 1969.
- Blee, Michael J. The Meeting: Man and Man-Made Object. In Kepes, G. ed. The Man-Made Object. New York: George Braziller, 1966. pp.79-81.
- Bliss, D.S. "Inter-City Transport of the Future". Proceedings of Symposium on the Compatibility of Urban Transport Systems. Department of Transportation Technology, University of Loughborough, 1969. para. 2.9.6.
- Blumenfeld, Hans. Why Pay to Ride. In Spreiregen, Paul D. ed. Modern Metropolis: Its Origin, Growth, Characteristics and Planning. Cambridge, Mass: Massachusetts Institute of Technology Press, 1967. p.167.

- Bouladon, Gabriel. "The Transport Gaps". Science Journal, October 1967. p.93.
- Bracey, H.E. In Retirement: Pensioners in Great Britain and the United States. London: Routledge and Kegan Paul, 1966. p.235.
- Breach, Ian. "The Steam Engine Rehabilitated". Guardian, 19th May, 1969. p.7.
- Brenner, Marjorie. Dependency of the Family. Research Monograph No. 16. London: Institute of Economic Affairs, 1968. p.12.
- Brenkov, Paul. "Land Use Transportation Studies - Methods and Limitations." Report of Proceedings of Town and Country Planning Summer School. London: Town Planning Institute, 1969.
- British Broadcasting Corporation. The Peoples Activities. London: B.B.C. Publications, 1965.
- British Cycle and Motor-Cycle Industries Association. The Case for the Two-wheeler. Memorandum for Submission to Ministry of Transport for Cars in Cities. 1967. p.2.
- British Insurance Association. Information contained in letter to the author from the Secretary, 15th April 1969.
- British Medical Association. The Drinking Driver. London: British Medical Association, 1965a. p.13.
- British Medical Journal, 20th November 1965b. pp.1204-1205.
- British Road Federation. London on the Move. London: British Road Federation, 1968a.
- British Road Federation. Basic Road Statistics: 1967. London: British Road Federation, 1968b. p.21.
- British Road Federation. Basic Road Statistics: 1969. London: British Road Federation, 1969.
- British Road Federation. Finance and Roads. London: British Road Federation, 1969a.
- Brooks, C.E.P. The English Climate. London: English University Press, 1954. Chapter 4.
- Brown, I.D. Paper read at The Annual Clinical Meeting of the British Medical Association, Malta. 10th April 1969.
- Bruce, F.M., W.F. Floyd and J.S. Ward. "Oxygen Consumption and Heart Rate During Stair Climbing". Journal of Physiology: Vol.191, 1967. pp.90-92.
- Buchanan, Colin et alia. Traffic in Towns. London: H.M.S.O., 1963.

- Bunker, R.C. Travel and Land Use in Stevenage. Birmingham: Department of Transportation and Environmental Planning, University of Birmingham, 1966.
- Bunker, R.C. "Travel in Stevenage". Town Planning Review: Vol. 38, No.3. October 1967.
- Burns, Wilfred. Traffic and Transportation in Newcastle-Upon-Tyne. City of Newcastle-Upon-Tyne, 1967.
- Burns, William. Noise and Man: Summary of Medically Established Facts. London: John Murray, 1968.
- Byron, Carole H. Basildon: Shopping, Work for Women, Leisure. Basildon Development Corporation, 1967.
- Callow, Clive. "Cleaner Petrol would Cost More". Times. 11th February 1970.
- Campbell, M.E. "Transportation Quality: Research Challenge and Promise". Traffic Quarterly, July 1963. pp.395-407.
- Camps, Francis E. and Desmond R. Laurence. Drugs. In Norman L.G. ed. Medical Aspects of Fitness to Drive Vehicles. The Medical Commission on Accident Prevention. London: Royal College of Surgeons, 1968. pp.29-31.
- Capener, Norman. Chairman of Medical Commission in Accident Prevention. Quoted in Times, 11th September 1969.
- Capital and Counties Property Company Limited. Shopping for Pleasure. London: Capital and Counties Property Company Limited, 1969.
- Carr-Saunders, A.M. Foreward to K.K. Liepmann. Journey to Work: Its Significance for Industrial and Community Life. London: Routledge and Kegan Paul, 1944.
- Carter, Alan Barham. All About Strokes. London: Nelson, 1968.
- Central Statistical Office. Annual Abstract of Statistics. London: H.M.S.O. 1969.
- Central Office of Information. The New Towns of Britain. Pamphlet No.44. London: H.M.S.O., 1969.
- Centre for Environmental Studies. Second Annual Report: April 1968 - March 1969. Details of Project by Michael Young and Peter Willmott. London: Centre for Environmental Studies, 1969.
- Chambers, T. Information contained in letter to the author, 11th March 1969.
- Chanoit, P. Accidents Rarely Accidental. In Symposium on the Human Factors of Road Accidents. Geneva: World Health Organisation. February 1969. pp.20-24.

- Chapman, Denis. "Convenience - the Measurement of a Desirable Quality in Town Planning". Human Relations: Vol. 3, 1950, pp.77-88.
- Charles, Geoffrey. "New York Puts Its Trust in Meters". Times, 22nd April 1969a.
- Charles, Geoffrey. "Mr. Nader's Billion-Dollar Legacy". Times. 2nd June 1969b.
- Charles, Geoffrey. "High Cost of Safety". Times, 19th August, 1969c.
- Cherns, A.B. Accidents at Work. In Welford, A.T. ed. Society: Problems and Methods of Study. London: Routledge and Kegan Paul, 1962.
- Clark, Colin, and Hans Roeske. "The 'Interviewing Opportunities' Method: West Midlands Study." Traffic Quarterly: Vol. 23, No. 3, July 1969.
- Claxton, E.C. Stevenage Traffic Survey.
Part I. 1964-1965. Stevenage Development Corporation, 1966.
Part II. 1965-1966. Stevenage Development Corporation, 1967.
- Claxton, E.C. Stevenage Traffic Accident Survey 1957-1966. Stevenage Development Corporation, 1967a.
- Claxton, E.C. "The Future of the Bicycle in a Modern Society". Journal of The Royal Society of Arts, January 1968.
- Claxton, E.C. Information contained in letter to the author, 19th September 1969.
- Claxton, E.C. Information contained in letter to the author, 16th February 1970.
- Cohen, J., C.E.M. Hansel and J.D. Sylvester. "Mind Wandering". British Journal of Psychology, Vol.47, 1956. pp.61-62.
- Cohen, John and Barbara Preston. Causes and Prevention of Road Accidents. London: Faber and Faber, 1968.
- Commissioner of Police at Public Carriage Office, London. Information contained in letter to the author from Assistant Commissioner, 26th February, 1969.
- Committee on London Roads. Report. Cmd. 812, Vol.19 Sessions, 1958-1959, para. 39.
- Connell, John. Report of Chairman of Noise Abatement Society. Times. 18th October, 1968.
- Constantine, T. The Citizen and Transportation. In Millward, S. ed. Urban Renewal 1968: Symposium. Department of Civil Engineering, University of Salford, 1968. p.93.

- Constantine, T. and A.P. Young. "Existing and Proposed Bus Priority Schemes". Traffic Engineering and Control, Vol.11. no.1, May 1969. p.36.
- Consumers Association. "Costs of Running a Car". Which, October 1968.
- Consumers Association, Owning a Car. / Consumer Publication. Consumers Association, 1969. p.194.
- Consumers Association. "Shopping". Which, November 1969a.
- Cowan, Peter. "Milton Keynes: the Creation of a City". New Society, 13th February, 1969.
- Craddock, Denis. Obesity and Its Management. Edinburgh: E. & S. Livingstone, 1969. p.92.
- Crompton, L.H. "Traffic in Guildford". Traffic Engineering and Control. Vol. 7, No. 10. February 1966. p.615.
- Crowther, G. et alia. Traffic in Towns: A Study of the Long Term Problems of Traffic in Urban Areas. Report of the Steering Group. London H.M.S.O. 1963.
- Culpin, C. and Partners. Mosbrough Master Plan: Interim Report. Sheffield City Council, 1968.
- Cumbernauld Development Corporation. Report on Road Accidents, 1968. Cumbernauld Development Corporation, 1969. p.3.
- Cureton, T.K. The Relative Value of Various Exercise Programmes to Protect Adult Human Subjects from Regenerative Heart Disease. In Raab, W. ed. Prevention of Ischaemic Heart Disease: Principles and Practice. Springfield, Illinois: Charles C. Thomas, 1966. p.329.
- Davies, Mervyn, of the Medical Research Council Environmental Physiology Research Unit. "Case for Taking More Physical Exercise." Times, 9th March 1968.
- Dawson, R.F.F. Cost of Road Accidents in Great Britain. Road Research Laboratory Report LR 79. Ministry of Transport, 1967.
- Dawson, R.F.F. Vehicle Operating Costs: Cost of Congestion and Cost of Accidents. Road Research Laboratory Technical Note TN 176. Ministry of Transport, April 1967b. p.3.
- Dawson, R.F.F. The Value of Time Saving in Transport Investment. Economics Planning Directorate Technical Note No. 3. Ministry of Transport. Unpublished, 1969. para. 10.
- Day, Alan. Roads. London: Mayflower Books, 1963. p.78.
- Leen, T.B., W.D. Merts and N.A. Irwin. "Development of Model for Forecasting Travel Mode Choice in Urban Areas". Highway Research Record: No. 38. 1963. p.81.

- De Fonseka, C.P. Human Engineering. In Doganis, R.S. and G.M. Mackay eds. Department of Transportation and Environmental Planning Research Journal, 1966, Part 1. Birmingham: University of Birmingham, April 1967.
- De Lauwe, Paul Chombart. "The Social Sciences, Urbanism and Planning". International Journal of Comparative Sociology: Vol. 4, 1963. p.29.
- De Lauwe, Paul Chombart. Famille et Habitation: Un Essai d'Observation Experimentale. Paris: Centre Nationale de la Recherche Scientifique 1960.
- Department of Economic Affairs. The Task Ahead. Government Green Paper. London: H.M.S.O., February 1969. Chapter 4. para. 23.
- Department of Employment and Productivity. Employment and Productivity Gazette. London: H.M.S.O., August 1968a. p.632.
- Department of Employment and Productivity. Family Expenditure Survey: Report for 1968. London H.M.S.O., 1969.
- Derbyshire, Andrew. "New Town Plans: A Critical Review". Journal of the Royal Institute of British Architects, October, 1967. p.436.
- Dubos, Rene Jules. Man Adapting: His Limitations and Potentialities. In Ewald, William R. Jnr. ed. Environment for Man: The Next 50 Years. Bloomington and London: Indiana University Press, 1967.
- Dumasiedier, Joffre. Towards a Society of Leisure. New York: The Free Press, 1967. p.14.
- Dunn, J.B. and P. Sheppard. 50-Point Traffic Census Results for 1967. Road Research Laboratory Report, No. LR 222. Ministry of Transport, 1968. p.20, Table 11.
- Duthie, J.J.R. Rheumatic Diseases Unit, Northern General Hospital, Edinburgh. Information contained in letter to the author, 19th March 1969.
- Everall, P.F. Effect of Road and Traffic Conditions on Fuel Consumption. Road Research Laboratory Report, No. LR 226. Ministry of Transport, 1968. p.10.
- Eyles, D. and C.J. Spiller. "Modal Choice and the Pedestrian". Traffic Engineering and Control. September 1969. p.230.
- Fairley, Alisdair. "Licenced to Kill". Listener: Vol. 80, No.2070, 28th November 1968.
- Fairthorne, D. "Town Planning and Trip Length". 2nd International Symposium on the Theory of Road Traffic Flow, 1963. Paris: Organisation of Economic Cooperation and Development, 1965.
- Festinger, Leon, Stanley Shachter and Kurt Back. Social Pressures in Informal Groups. New York: Harper and Bros., 1950.

- Flowerdew, A.J. International Road Traffic Conference. London, 1969.
- Foster, C.D. Transport Problem. Glasgow: Blackie, 1963. p.307.
- Frank, C. et alia. "Physical Inactivity as a Lethal Factor in Myocardial Infarction in Men". Circulation. New York: Vol.34, December 1966. p.1028.
- Freeman, Fox and Partners. London Traffic Survey: Vol.I. Existing Traffic and Travel Characteristics in Greater London. London County Council, 1964. Vol.II. Future Traffic and Travel Characteristics in Greater London. Greater London Council, 1966.
- Freeman, Fox, Milbur-Smith and Associates. Land Use Transportation Study for East Central Scotland. Edinburgh: Scottish Development Department, Vol. 1, 1968a. Vol.2, 1968b.
- Gallup. Gallup Shopping Basket. London: Association of Point Sale Advertising, 1968.
- Gans, Herbert J. Levittowners: Anatomy of Suburbia. London: Allen Lane, 1967.
- Garwood, F. Road Accidents. In Welford, A.T. ed. Society Problems and Methods of Study. London: Routledge and Kegan Paul, 1962. p.275.
- Gavron, Hannah. The Captive Wife. London: Routledge and Kegan Paul, 1966. pp.80, 133.
- General Register Office. Sample Census 1966: Great Britain. Summary Tables. London and Edinburgh: H.M.S.O., 1967.
- General Register Office. Sample Census 1966: England and Wales. Workplace and Transport Tables, Part 2. London: H.M.S.O., 1967a.
- Gist, Noel and Sylvia Pava. Urban Society. New York: Thomas Y. Crowell Co., 1967. p.452.
- Godber, G.E. On the State of Public Health: Annual Report of Chief Medical Officer of Health for the Year 1966. London: H.M.S.O., 1967. p.29.
- Goldsmith, P. Selwyn. Designing for the Disabled. London: Architectural Press, 2nd edition, 1967. para.9108.
- Goldstein, A. "Motorway Route Location Studies". Report of Town and Country Planning Summer School, University of Keele. London: Town Planning Institute, 1966.
- Gratton, E. and G.O. Jeffcoate. Medical Factors and Road Accidents. Road Research Laboratory Report R.L. 143. London: Ministry of Transport, 1967.
- Gray, P.G. Private Motoring in England and Wales. A Government Social Survey, London: H.M.S.O., 1969.

- Greater London Council. Greater London Development Plan: Draft Report.
Greater London Council, 1967.
- Greater London Council. Annual Report of the Scientific Adviser, 1967.
London: Greater London Council, 1969.
- Greater London Council. Movement in London. Transport Research Studies
and their Context. London: Greater London Council, 1969a.
- Gregory, P.G.M. Flight of the Motorist. London: Conservative Political
Centre, 1968. p.20.
- Gruen, Victor. The Heart of Our Cities: The Urban Crisis, Diagnosis and Cure.
London: Thames and Hudson, 1965.
- Guardian. Article on Insurance Brokers. 5th June 1968.
- Gutman, Robert. "Site Planning and Social Behaviour". Ergonomics. March 1967.
- Haar, Charles M. Tomorrow's Transportation: New Systems for the Urban Future.
Washington: United States Department of Housing and Urban Development,
1968.
- Haar, Charles M., and Cole and H.L. Merritt. "Tomorrow's Transportation".
Ergonomics, February 1969. p.108.
- Haggett, Peter. Locational Analysis in Urban Geography. London: Edward
Arnold, 1965. p.42.
- Hall, Edward T. The Hidden Dimension. New York: Garden City, 1966.
Chapter 12.
- Harlow, . "Love in Infant Monkeys". Scientific American: Vol.200,
December 1959. p.72.
- Haynes, K.J. and J. Raven. Living Pattern of Some Old People: Survey 1962-
1963. Building Research Station Miscellaneous Paper No. 4. London:
Ministry of Public Building and Works, 1963. p.15.
- Her Majesty's Chief Inspector of Constabulary. Report for the Year 1967.
London: H.M.S.O., 1968.
- Hobson, . Modern Trends in Geriatrics. London: Eutterworth and Co., 1956.
pp.19, 378.
- Hoffmann, J. "Stress at the wheel". In Symposium on the Human Factors of
Load accidents. Geneva: World Health Organisation, February 1969.
- Holden, H. "Effects of Noise". Environmental Health: Vol.77, No.3,
March 1969. p.67.
- Hole, Vere. "The Social Effects of Planned Rehousing". Town Planning
Review: Vol.30, No.2, July 1953. p.171.

- Holroyd, E.M. and D.A. Scraggs. "Journey by Car and Bus in Central London". Traffic Engineering and Control: Vol.32, July 1964.
- Home Office. Criminal Statistics, England and Wales, 1968. Cmd.4098. London: H.M.S.O., 1969.
- Horton, F.E. and R.I. Wittick. "A Spatial Model for Examining Journey-to-work in a Planning Context". Professional Geographer: Vol. 21, No.1, July 1969.
- Humpidge, Chaceley T. Public Transport Priority. London: Public Transport Association Incorporated, May 1963. p.4.
- Hutchings, Ken. Urban Transport: Public or Private. Fabian Research Series No.261. London Fabian Society, 1967.
- Institut for Center-Planlaegning, By Centre Menneske. Denmark: Institut for Centre-Planlaegning, 1965. p.106.
- Inwood, J. Interim Report on Traffic and Safety Characteristics of Some Types of Pedestrian Crossings. Road Research Laboratory, Technical Note, TN 256. Unpublished, 1968.
- Israel Institute of Urban Studies. Irvine New Town: Planning Study. London: P.A. Management Consultants Ltd., 1969.
- Jackson, O.P. and Palmer, R.W. "Car and Bus Travel in Central Edinburgh". Traffic Engineering and Control, November 1968.
- Jamieson, G.B. and W.K. Mackay. "Urban Roads in the Buchanan Tradition". Institute of Municipal Engineers Journal: Vol.92, March 1965.
- Jamieson, G.B. and W.K. Mackay. Perth Case Study: Traffic Study. Edinburgh: Scottish Development Department, January 1969. p.67.
- Johnson, H.D. Road Accident and Casualty Rates Based on the 1300 Point Census. Road Research Laboratory Report, No. LR 283. Ministry of Transport, 1969. p.3.
- Kain, J.P. A Contribution to the Urban Transportation Debate: An Econometric Model of Urban Residential and Travel Behaviour. Washington: The Rand Corporation, 1962.
- Katz, Alfred. "The Social Causes of Disease". New Society, 23rd January, 1969. pp.124-125.
- Keeble, Lewis. Principles and Practice of Town and Country Planning. London: Estates Gazette Ltd. 1964.
- Keefer, L.E. "Illusory Demand for Mass Transit". Traffic Engineering. January 1966.

- Kerensky, C... Urban Motorways and Their Environment. Rees Jeffreys Triennial Lecture. London: Town Planning Institute, 1968.
- Kirwan, R.M. "Economics and Methodology in Urban Transport Planning". In Cullingworth, J.D. and S.C. Orr. Regional and Urban Studies. London: Allen and Unwin, 1969. p.202.
- Kuper, Leo. Living in Towns. London: Cresset Press, 1953.
- Lamb, G.M. Parking Generation and the Characteristics of Shoppers Arriving by Car in Bromsgrove. In Loganis, R.S. and G.M. Mackay eds. Department of Transportation and Environmental Planning Research Journal, 1966, Part 1. Birmingham: University of Birmingham, April 1967.
- Langdon, F.J. "Social Nuisance Caused by Traffic Noise". Environmental Health: Vol. 77, No.3, March 1969.
- Larsen, R.Y. "Motor Vehicle Emissions and Their Effects". Public Health Report: Vol. 77, No.11, 1962. Washington: United States Public Health Service.
- Lederberg, Joshua. Paper read at the Fourteenth Nobel Symposium: 1969 Stockholm: Nobel Foundation, September 1969.
- Lee, Terence. "Relation between School Journey and Social and Emotional Adjustment in Rural Infant Children". British Journal of Educational Psychology: Vol. 127, June 1957. p.101.
- Lee, Terence. "Erennan's Law of Shopping Behaviour". Psychological Reports: Vol.II, 1962. p.662.
- Lee, Terence. "Human Needs and the Built Environment". British Journal of Educational Psychology: Vol.XXVI, February 1966. p.2.
- Lee, Terence. "Concept of Space and Control of the Environment". Journal of the Architectural Association: Vol. 82, July 1967a.
- Lee, Terence. Paper read at the Alcan Universities Conference Programme: University of Newcastle. 1967b. pp.18-26.
- Lennox, S.G. and J.M. Clark. "Urban Transport Systems Analysis". Proceedings of Symposium on Urban Transport Systems. Department of Transportation Technology, University of Loughborough. 1969. para. 4.1.1.
- Levin, P.H. and A.J. Bruce. "Location of Primary Schools". Journal of the Town Planning Institute, February 1968.
- Lichfield, Nathan and Associates. Stevenage Public Transport: Cost Benefit Analysis: Vol.1. Stevenage Development Corporation, 1969.
- Lewis, J. et alia. "Traffic Pollution and Mental Efficiency". Nature: Vol. 225, 3rd January 1970. p.96.

- King, Arthur and Associates. Runcorn New Town. Runcorn Development Corporation, 1967.
- King, Arthur. "Public Transport Planning: The Runcorn Example": Town and Country Planning: Vol. 35, January 1967. p.15.
- Lintas. Food, Women and Shops. Vol.2. London: Lintas Special Projects, 1956.
- Llewellyn-Jones, Richard. "Some Further Thoughts on Linear Cities". Town Planning Review: Vol.38, No.3, October 1967. p.202.
- Llewellyn-Jones, Richard. "Town Design". In Lewis, L. ed. Urban Structure. Architects Year Book 12. London: Elek Books, 1963. p.47.
- Llewellyn-Jones, Weeks and Partners. Washington New Town. Washington Development Corporation, 1967.
- Llewellyn-Jones, Weeks, Forestier-Walker & Hor. Milton Keynes: Interim Report. Milton Keynes Development Corporation, 1968.
- Lloyd, J.K. Obesity in Childhood. In Baird, I. McClean and A.A. Toward eds. Obesity: Medical and Scientific Aspects. Edinburgh: E. and S. Livingstone, 1969. p.32.
- Local Government Operational Research Unit at Reading. "Report on Study by a Research Unit of Royal Institute of Public Administration". Times, 9th April 1969.
- London County Council. The Planning of a New Town. London: London County Council, 1961.
- London Transport, Complete Local Road and Rail Timetables. 1969.
- Lorenz, Konrad. On Aggression. London: Methuen and Co., 1963. p.208.
- Lukas, Jerome. Stanford Research Institute. Study in article by Anthony Bailey. "Leafened New Yorkers to Go Battle Against Noise". Times, 29th November 1969.
- Lynch, Kevin. Site Planning. Cambridge, Mass: Massachusetts Institute of Technology Press, 1962. p.160.
- Lynn, Richard. Paper read at the Annual Conference of the British Association 1969. 8th September 1969.
- Lyons, J.J. "Bus Travel in Town Centres". Traffic Engineering and Control, 11th May, 1969. p.21.
- Mackay, William K. "Town Form and Transportation". in Proceedings of Symposium on the Compatibility of Transport Systems. Department of Transportation Technology Loughborough University of Technology, 1969. para. 4.3.7.

- Backay, G.M. Review of Road accident Research. Project Report No.5, Department Publication No.18, Department of Transportation and Environmental Engineering, University of Birmingham, 1967.
- Martin, J.P. and Gail Wilson. The Police: A Study in Manpower. London: Heinemann, 1969. pp.280, 195 and Table 3.
- Mayer, Jean. Overweight: Causes and Control. New Jersey: Prentice Hall, 1966.
- McFarland, Ross and R.C. Moore. "Human Factors in Highway Safety". New England Journal of Medicine: Vol. 256, 1957.
- Meier, Richard and T. Blumenfeld. "Discussion on Forthcoming Technological Changes likely to have a bearing on Accidents". Ergonomics: Vol.22, No.133, December 1966. p.417.
- Mental Health Research Fund. The Psychosomatic Disorders. Pamphlet 5. Mental Health Research Fund, 1967. pp.9-10.
- Menzies, Isobel. Report of consultant at the Centre for Applied Social Research, Tavistock Centre for Human Relations. Guardian. 19th February 1969.
- Meteorological Office. Information contained in letter to the author, 10th November 1969.
- Metropolitan Police: Public Carriage Office. Information contained in letter to the author, 16th February 1969.
- Meyer, J.F., J.F. Kain and W. Kohl. The Urban Transportation Problem. Cambridge, Mass: Harvard University Press, 1965.
- Midland Northern and Scottish Insurance Association. Insurance premiums 1969.
- Miller, M. and M.J. Starks. Ejection in Car accidents. Road Research Laboratory Report LR 190. London: Ministry of Transport, 1968. p.5.
- Ministry of Health. Annual Report for the Year 1967. Cmd. 3702. London: H.M.S.O., 1968. Table 17.
- Ministry of Housing and Local Government. Homes for Today and Tomorrow. Barker Morris Report. London: H.M.S.O. 1961. p.35.
- Ministry of Housing and Local Government. Highway Requirements for New Towns. Unpublished Circular 1969.
- Ministry of Labour. "Shift work". Ministry of Labour Gazette, April 1965. p.148.
- Ministry of Social Security. Annual Report of National Insurance, 1967. London: H.M.S.O. 1968.

- Ministry of Social Security. Earnings Related to Social Benefits.
White Paper, Cmnd.3883. London: H.M.S.O., January 1969.
- Ministry of Transport. Road Pricing: The Economic and Technical Possibilities. (Smeed Report). London: H.M.S.O., 1964.
- Ministry of Transport. Research on Road Traffic. Road Research Laboratory. London: H.M.S.O., 1965.
- Ministry of Transport. Roads in Urban Areas. London: H.M.S.O. 1966a.
- Ministry of Transport. Motor Vehicles (Construction and Use) Regulations Part IIIA. London: H.M.S.O., 1966b.
- Ministry of Transport. A Fresh Approach. White Paper on Road Safety, Cmnd.3339. London: H.M.S.O., 1967a.
- Ministry of Transport. National Travel Survey 1964. Preliminary Report: Part 1, Household Vehicle Ownership and Use. London: H.M.S.O., 1967b.
- Ministry of Transport. Cars for Cities: A Study of Trends in the Design of Vehicles. London: H.M.S.O., 1967c.
- Ministry of Transport. Public Transport and Traffic. Cmnd.3481, London: H.M.S.O., 1967d.
- Ministry of Transport. Information contained in letter to the author from Directorate of Statistics regarding traffic movement in urban and rural areas, 23rd April, 1968a.
- Ministry of Transport. Highways Statistics for the Year 1967. London: H.M.S.O., 1968b.
- Ministry of Transport. Road Track Costs. London: H.M.S.O., 1968c.
- Ministry of Transport. Road Accidents for the Year 1967. London: H.M.S.O., 1968d.
- Ministry of Transport. Highway Code. London: H.M.S.O., 1968f.
- Ministry of Transport. Highway Statistics for the Year 1968. London: H.M.S.O., 1969a.
- Ministry of Transport. Traffic Management and Parking. London: H.M.S.O. 1969b.
- Ministry of Transport. Information contained in letter to the author from Department of Statistics, 2nd June, 1969c.
- Ministry of Transport. Information contained in letter to the author from Driving and Motor Licences Division, 30th July, 1969d.

- Ministry of Transport. Passenger Transport in Great Britain for the Year 1967. London: H.M.S.O., 1969e.
- Ministry of Transport. Road Accidents for the Year 1968. London: H.M.S.O., 1969f.
- Mishan, E.J. The Costs of Economic Growth. Harmondsworth, Middlesex: Penguin Books Ltd., 1969.
- Molyneux, A. "Working for Recreation". Journal of the Town Planning Institute. April 1968.
- Moore, A. and S.J. Elder. "Pedestrians and Vehicles". Traffic Engineering, September 1965.
- Morris, Desmond. The Urban Zoo. London: Jonathan Cape, 1969. p.67.
- Morris, J.C. "Recent History of Coronary Disease". Lancet, 6th and 13th January, 1951. pp.1, 69.
- Moser, C. Survey Methods in Social Investigation. London: Heinemann Educational Books, 1967.
- Moses, Leon and Harold Williamson. "Value of Time in Choice of Mode of Travel". Journal of Political Economy, no.71, June 1963. para.262.
- Munden, J.W. Some Recent Trends in the Road Accident Pattern in Great Britain. Road Research Laboratory Report LR 168. London: Ministry of Transport, 1968.
- Nyasnikov, . . . Prevention of Ischemic Heart Disease. In Kaab . ed. Prevention of Ischemic Heart Disease: Principles and Practice. Springfield, Illinois: Charles C. Thomas, 1968. p.375.
- Myers, Sumner. "Soft Revolution". Architectural Forum, January 1968. p.67.
- National Board for Prices and Incomes. Pay and Conditions of Busmen: Report No. 16, Cmd.3012. London: H.M.S.O., May 1966.
- National Board for Prices and Incomes. Proposals by the London Transport Board for Fare Increases: Report No. 112, Cmd.4036. London: H.M.S.O., 1969.
- Neal, A.F. Motor Car and Motor Bus. London: Public Transport Association Incorporated, May 1965.
- Needham, Barrie. "The Density of Industrial Estates". Journal of the Town Planning Institute: Vol.53, no.10, December 1967. p.456.
- Observer Report on Medical Study by Metropolitan Police and Medical Research Council, 13th October 1968.

- Offences Related to Motor Vehicles in England and Wales for the Year 1968.
London: H.M.S.O., 1969.
- Office of Health Economics. The Common Illness of Our Time.
London: Office of Health Economics, May 1966a.
- Office of Health Economics. Alive to Forty-Five: Proceedings of a Symposium. London: Office of Health Economics, November 1966b.
- Office of Health Economics. Disorders Which Shorten Life: A Review of Mortality Trends for Those Between 15 and 44. London: Office of Health Economics, 1966c. p.9.
- Office of Health Economics. Old Age. London: Office of Health Economics, March 1968.
- Office of Health Economics. Obesity and Disease. London: Office of Health Economics, 1969a. p.33.
- Office of Health Economics. The Age of Maturity. London: Office of Health Economics, 1969b. p.15.
- Osborn, Frederic and Arnold Whittick. The New Towns. New Edition
London: Leonard Hill, 1969. p.317.
- Owens, D. Estimates of Proportions of Space Occupied by Roads and Footpaths in Towns. Road Research Laboratory Report RL 154.
London: Ministry of Transport, 1968.
- Fahl, Ray. "Paradoxes of Mobility". Alcan Broadsheet No. 2, 1968.
- Parr, A.E. "Environmental Design and Psychology". Landscape: Vol.14, No. 2, 1965. p.18.
- Parr, A.E. "Psychological Aspects of Urbanology". Journal of Social Issues: Vol.22, October 1966. pp.42-45.
- Parr, A.E. "The Child in the City: Urbanity and the Urban Scene". Landscape: Vol.16, No. 3, 1967. pp.3-5.
- Parry, Meyer. Aggression on the Road. London: Tavistock Publications, 1968.
- Paterson, J.L. "Human Response to the Environment". Meeting of the Scottish Environmental Group. University of Edinburgh, December 1969.
- Patey, I.R. Problems of Peak Travel. London: Public Transport Associated Incorporated, May 1964. p.6.
- Payne, J.P. "The Drugged Driver". Drive, winter 1968/69. London: Automobile Association, 1968. p.30.

- Pease, Kenneth and Barbara Preston. "Road Safety Education for Young Children". British Journal of Educational Psychology. November 1967. p.312.
- Perraton, J.K. "Planning for the Cyclist in Urban Areas". Town Planning Review, July 1968.
- Peters, P.E. Vehicle Occupancies in Birmingham. In Loganis, R.S. and G.M. Mackay ed. Department of Transportation and Research Journal, 1966, Part 1. Transportation. University of Birmingham, April 1967. p.66.
- Platt, F.W. "Operation Analysis of Traffic Safety". International Road Safety and Traffic Review: Vol.VI, No.2, Spring 1958. p.8. Table 1.
- Powell, Geoffrey, of Gerald Eve and Partners. Lecture at George Square, University of Edinburgh, 30th May, 1969.
- Pratt, P. "Are you Safe to Have Children". Drive. Winter, 1970. p.16.
- Quarby, D.A. "Relating Public Transport to Urban Planning". Journal of the Institute of Transport: Vol.30, No.12, September 1964. p.435.
- Quarby, D.A. "Travel Mode for the Journey to Work". Journal of Transport Economics and Policy: Vol.1, No.3, Vol.1, No. 3, September 1967. p.297.
- Quensult, S.W. Safe and Unsafe Drivers. Road Research Laboratory Report No.146. London: Ministry of Transport, 1968. p.10.
- Raab, W. ed. Prevention of Ischemic Heart Disease: Principles and Practice. Springfield, Illinois: Charles C. Thomas, 1966. (Relevant references in papers: D. Brunner, p.243; T.K. Cureton, p.327; T.R. Lawber, W.B. Kannel and G.D. Friedman, pp.254-264; V. Gottheiner, pp.314, 338; H. Kraus, p.308; A.L. Myasnikov, p.374; W. Raab and H.J. Krzywanski, p.121; P.D. White, p.444).
- Reeder, L.G. "Social Differentials in Modes of Travel Time and Cost in the Journey to Work". American Sociological Review: Vol.21, February 1956. pp.62-63.
- Registrar General. Sample Census 1966: Private Households by Number of Cars, Great Britain. Summary Tables. London and Edinburgh: General Register Office, H.M.S.O., 1967. p.89. Table 13.
- Reports of the Development Corporation. London: H.M.S.O., 1969.
- Reynolds, D.J. Economics, Town Planning and Traffic. London: Institute of Economic Affairs, 1966.
- Richards, O.W. "Motorists Vision and the Driver's Licence". Traffic Quarterly, January 1966. p.17.

- Ritter, Paul. Planning for Man and Motor. Oxford: Pergamon Press, 1964. Section 5.2.
- Road Research Laboratory, Department of Scientific and Industrial Research. Research on Road Traffic. London: H.M.S.O., 1965.
- Road Safety Act. Ch.30, Part I, 1967.
- Rodgers, H.B. Pilot National Recreation Survey: Report No.1. London: British Travel Association, 1967.
- Roskamm, H. "Optimum Patterns of Exercise for Healthy Adults". Proceedings of the International Symposium on Physical Activity and Cardiovascular Health. Canadian Medical Association Journal: Vol.96, 25th March, 1967. pp.895-898.
- Roskill, O.W. et alia. Housing in Britain. London: Town and Country Planning Association, 1964. pp.35, 37, Tables 2.12, 2.14.
- Roth, Gabriel J. Parking Space for Cars: Assessing the Demand. Occasional Paper No. 5, University of Cambridge, Department of Applied Economics. Cambridge University Press, 1965. p.59.
- Royal Automobile Club. Information contained in letter to the author from National Organiser, Royal Automobile Club Training Scheme, 10th April, 1969a.
- Royal Automobile Club. Parking Meter Survey. London: Royal Automobile Club, 1969b.
- Royal Automobile Club. Schedule of Estimated Vehicle Running Costs. London: Royal Automobile Club, 1970.
- Royal Commission on the Distribution of Industrial Population. (Barlow Report). Cmd.6153. London: H.M.S.O., 1940.
- Royal Insurance Company Ltd. Insurance Premiums 1969.
- Royal Society for the Prevention of Accidents. Road Accident Statistical Review: Vol.3, No.44, 1968.
- Royal Society for the Prevention of Accidents. Road Accident Statistics, 1969. Royal Society for the Prevention of Accidents, 1969.
- Rubinstein, D. and C. Speakman. Leisure, Transport and the Countryside. Fabian Social Research Series No. 277. London: Fabian Society, 1969. p.21.
- Russell, W.M.S. and C. Russell. Violence, Monkeys and Man. London: Macmillan, 1968.
- Rushton, R. et alia. "Equivalence and Persistence of the Effects of Psychoactive Drugs and Past Experience". Nature: Vol.220, 30th November, 1968. p.888.

- Schnore, Leo F. "Separation of Home from work: A Problem for Human Ecology". Social Forces. May 1954. p.342-343.
- Scott, Christopher, "Research on Mail Surveys". Journal of The Royal Statistical Society, A. 1961.
- Scott, Wilson, Kirkpatrick and Partners. Greater Glasgow Transportation Study. Vol.1., 1967. p.75. Table 28.
- Scottish Bus Group Ltd. Information given to author by Group's Commercial Manager. 7th February, 1969.
- Seeborn Report. Report of the Committee in Local Authority and Allied Personal Social Services. Cmd.3703. London: H.M.S.O., 1968. para.477.
- Selye Hans. University of Montreal. Stress of Life. London: Longmans Green & Co., 1957. pp.130, 274.
- Shanas, Ethel, Peter Townsend et alia. Old People in Three Industrial Societies. A Cross-National Study of the Elderly Populations of Britain, Denmark and the United States. London: Routledge and Kegan Paul, 1968.
- Sharp, Clifford. Problems of Urban Passenger Transport. Leicester: Leicester University Press, 1967.
- Shearer, Ann. "500 Thousand May be Driving Blind". Guardian, 1st May, 1969.
- Shoe and Allied Trades Research Association. Information contained in letter to the author. 14th November 1968.
- Shops, Offices and Railways Premises Act, 1963. Ch.41. Section 5.
- Silcock, Bryan. "Exhaust Gases May Cause Heart Attack". Sunday Times. 22nd February 1970.
- Sillitoe, K.K. Planning for Leisure. Government Social Survey. London: H.M.S.O., 1969.
- Skelly, G.B. Aspects of Driving Experiences. Road Research Laboratory Report No.149. London: Ministry of Transport, 1968.
- Skelmersdale Development Corporation. Traffic Generated by Schools. Skelmersdale Development Corporation, January 1968. p.44.
- Smeed, R.J. "Road Space Requirements for Traffic in Towns". Town Planning Review: Vol.33, January 1963.
- Smeed, R.J. "Traffic Problems in Towns: A Review of Possible Long Term Solutions". Town Planning Review: Vol.35. July 1964.

- Smeed, R.J. "Traffic Studies and Urban Congestion". Journal of Transport Economics and Policy: January 1968a.
- Smeed, R.J. "Some Aspects of Pedestrian Safety". Journal of Transport Economics and Policy: September 1968b.
- Smeed, R.J. and J.G. Wardrop. "An Explanatory Comparison of the Advantages of Cars and Buses for Travel in Urban Areas". Journal of the Institute of Transport: Vol.No. 9, 1964.
- Smigielaki, Konrad. "Urban Form in the Motor Age". Town Planning Institute Conference, Newcastle, 15th May 1968.
- Sommer, Robert. "Alien Building". Arts and Architecture. April 1966. pp.18-19.
- Stafford Clark, David. "How Tycoons and Tigers Respond to Stress and Tension". Times, 25th January, 1968.
- Stephen, P.R. "Factors Affecting Choice of Mode of Transport". Traffic Engineering and Control: Vol.9, No.10. February 1968. pp.499-502.
- Stevenage Development Corporation. Survey of Children's Play 1968/9. First Report. Stevenage Development Corporation 1969.
- Storm, Michael. The Changing World: Urban Growth in Britain. London: Oxford University Press, 1965. p.22. Fig. 19.
- Storr, Anthony. Human Aggression. London: Allen Lane, 1968.
- Street, Harry and D.W. Elliott. Road Accidents. Harmondsworth, Middlesex: Penguin Books Ltd., 1968.
- Susser, M.W. Social Medicine in Britain. In Welford, A.T. ed. Society: Problems and Methods of Study. London: Routledge and Kegan Paul, 1962. p.138.
- Tanner, J.C. Factors Affecting the Amount of Travel. Road Research Laboratory, Technical Paper No.51. London: H.M.S.O. p.8.
- Tanner, J.C. Forecasts of Vehicle Ownership in Great Britain. Road Research Laboratory Report. London: Ministry of Transport 1965.
- Tanner, J.C. Revised Forecasts of Vehicles and Traffic in Great Britain. Road Research Laboratory Technical Note TN 189. London: Ministry of Transport, June 1967.
- Tatai, Yoshinosuke. "Biorythm Theory". Traffic Engineering and Control. November 1969. p.337.
- Taylor, H. "Road Safety". Road Research Laboratory. Ministry of Transport, 1969. Table 1.

- Technical Committee of National Society for Clean Air. Air Pollution from Road Vehicles. London National Society for Clean Air, 1967.
- Tetlow, John and Noel Antony Goss. Homes Towns and Traffic. London: Faber and Faber, 1965. p.78.
- Teraslina, P. et alia. "Relationship Between Physical Fitness and Susceptibility to Cardiovascular Disease". Research Quarterly of American Association for Health, Physical Exercise and Recreation: Vol.39. October 1968. p.746.
- Thomas, Ray. Journeys to Work. Political and Economic Planning: Broadsheet 504, November 1968.
- Thomas, Ray. London's New Towns: A Study of Self Contained and Balanced Communities. Broadsheet 510. Political and Economic Planning, April 1969.
- Thomson, Arthur. Health. In Ogilvie, Heneage ed. Fifty - An Approach to the Problems of Old Age. London: Max Parrish, 1962. p.138.
- Thomson, J.M. Some Characteristics of Motorists in Central London. Greater London Papers. London: London School of Economics, 1968.
- Time Magazine. "Age of Effluence". 10th May 1968. pp.42-43.
- Times. Report on International Health Congress, London. 14th August, 1968a.
- Times. Report on Casualties and Breath Tests in Previous Twelve Months. 12th December 1968b.
- Times. "Costs of Adding Battery Powered System to Car". 12th December 1968c.
- Times. Report of Mass Observation Survey. 16th December 1968d.
- Times. "Coin-in-Slot Bus for London". 18th April 1969a.
- Times. "Special Report on Supermarkets". 25th April 1969b.
- Times. "London Fares Go Up Again". 16th May 1969c.
- Times. "Labour Force Cut of 50% Forecast" 17th June 1969d.
- Townsend, Peter. "The Disabled Need Help". New Society, 28th September 1967. pp.432-433.
- Townsend, Peter. "Programme 13: Urban Sociology". Radio 3 Broadcast, 30th January 1969.

- Townsend, Peter and Dorothy Hedderburn. The Aged in the Welfare State. London: Bell and Sons, 1965.
- Traffic Research Centre. Data in Official Architecture and Planning. February and March 1968.
- Traffic Research Corporation. A Model for Estimating Travel Mode Usage in Washington D.C. Washington: Traffic Research Corporation, 1962.
- Transportation Research Institute. Latent Demand for Transportation. Transportation Research Institute Research Report, Carnegie-Mellon University, Pittsburgh, Pennsylvania, 1968.
- Travers Morgan, R. and Partners. Travel in Belfast. Belfast Corporation, 1968.
- Travers Morgan, R. and Partners. Belfast Transportation Plan. Belfast Corporation, 1969.
- Tressider, J.O. "Transport Plans Need Economic Facts" Guardian 19th September 1968.
- Tulpule, A.H. Forecasts of Vehicles and Traffic in Great Britain. Road Research Laboratory Report No. LR 288. Ministry of Transport, 1969. pp.4-5.
- Vincent, Leonard C. Stevenage Master Plan 1966. Vol.1., Planning Proposals. Stevenage Development Corporation, 1967.
- Vorhees, Alan. Factors Affecting Growth in American Cities. In William, T.H. and D. Munby ed. Urban Survival and Traffic: Economics of City Traffic. London: E. & M. Spon, 1962.
- Vorhees, Alan. "Land Use Transportation Studies". Journal of Planning Institute: August 1968.
- Vulkan, G.H. "Symposium on The Effects of Noise". Environmental Health: Vol.77, No.3, March 1969. p.106.
- Ward, J., Department of Ergonomics and Cybernetics: University of Technology, Loughborough. Information contained in letter to the author, 14th May 1968.
- Warner, S.L. Stochastic Choice of Mode in Urban Travel. Illinois: Northwestern University Press, 1962.
- Waterhouse, Robert. "150 Miles a Gallon". Guardian, 16th June 1969.
- Webber, Melvin. Order in Diversity: Community without Proximity. In Wingo, Lowden ed. Cities and Space. Baltimore: The John Hopkins Press, 1963. pp.37-39.

- Webber, Melvin. The Urban Place in the Non Place Urban Realm in Explorations in Urban Structure. Philadelphia University of Pennsylvania Press, 1964. p.109.
- Webber, Melvin and Etlomo Angel. "The Social Context for Transport Planning". Ergonomics: Vol.29, No.170, January 1970. p.27.
- Webster, F.V. A Theoretical Estimate of Effect of London Commuters Transferring to Bus Travel. Road Research Laboratory Report LR 165, 1968.
- Weiner, J.S. Alcan Conference, University of Newcastle, 1967. Universities Conference Programme. London Alcan, 1967.
- Welford, A.T. Ageing and Human Skill: An Introduction to the Problems of Ageing. Nuffield Unit for Research. London: Nuffield Foundation, 1958. pp.107-120.
- Welford, A.T. The Seven Ages of Man: Beyond Sixty. London: New Science Publications, 1969.
- Wilbur Smith and Associates. Future Highways and Urban Growth. New Haven, Connecticut: Automobile Manufacturers Association, 1961.
- Willett, T.C. Criminal on the Road. London: Tavistock Publications, 1964.
- Williams, Penelope M. "Low Fares and the Urban Transport Problem". Urban Studies: Vol.6, No.1, February 1969.
- Williams, T.E.H. and D.M. Robertson. "Traffic Generated by Households: Peak Period". Traffic Engineering and Control, March 1965. pp.668-671.
- Willmott, Peter. "Social Research and New Communities". Journal of the American Institute of Planners. November 1967, p.36.
- Wilson, F.R. Journey to Work: Modal Split. London: MacLaren and Sons, 1967.
- Wilson, L. Hugh and Lewis Womersley. Skelmersdale: New Town Planning Proposals. Skelmersdale Development Corporation, 1964.
- Wolff, Sula. Children Under Stress. London: Allen Lane, 1969. pp.75-92.
- Wolffe, J.B. Situational Stresses as Cause of Cardiovascular Disease. In Raab A. ed. Prevention of Ischemic Heart Disease: Principles and Practice. Springfield, Illinois: Charles C. Thomas, 1966.
- Woodward, Christopher. Cycling for Health. Cyclists Touring Club, 1965. pp.2-5.

- Woolgrove, F.A. The Pricing of Vehicle Operating Costs with Special Reference to Economic Assessment. In Doganis, R.S. and G.M. Mackay eds. Department of Transportation and Environmental Planning Research Journal, 1966. Part 1. Transportation. University of Birmingham, April 1967. pp.4-6.
- Wooton, H.J. and G.W. Pick. "A Model for Trips Generated by Households". Journal of Transport Economics and Policy, May 1967a.
- Wooton, H.J. and G.W. Pick. "Travel Estimates from Census Data". Traffic Engineering and Control, July 1967b.
- World Almanac 1968.: Centennial Edition. New York: Newspaper Enterprises Association, 1968.
- World Health Organisation. Trends in the Study of Morbidity. Public Health Paper No. 27. Geneva: United Nations World Health Organisation, 1965. p.159. Table 1.
- Wynne-Edwards, V.C. Animal Dispersion in Relation to Social Behaviour. Edinburgh: Oliver and Boyd Ltd., 1962. p.39.
- Young, A.P., D. Maltby and T. Constantine. "Urban Transit Systems: Choice for Investment". Official Architecture and Planning, December 1969. p.1457.
- Yudkin, John. Report in Times, 30th May 1969.
- Zander, Luke. Information from physician in Department of General Practice, University of Edinburgh, 8th December 1969.
- Zipf, George Kingsley. Human Behaviour and Principles of Least Effort. New York: Hafner Publishing Co., 1965.

REFERENCESChapters 5 - 6

- Abel, Christopher. "Educational Parks". Journal of the Royal Institute of British Architects: Vol.77, No.2, February 1970. p.61.
- Abercrombie, Patrick. Greater London Development Plan. London: H.M.S.O., 1945. pp.169, 172.
- Abrams, Mark. "Social Aspects of Leisure". In Report of the Proceedings of the Town and Country Planning Summer School: University of St. Andrews. London: Town Planning Institute, 1960. p.32.
- Alderson, Stanley. Britain in the Sixties: Housing. Harmondsworth, Middlesex: Penguin Books Ltd., 1962. p.59.
- Alexander, Christopher. "The City as a Mechanism for Sustaining Human Contact". Transactions of the Bartlett Society: Vol.4, 1964-1965. pp.95-115.
- Allen, Neil. "More Use of Sports Facilities Urged". Review of Report of the Central Council for Physical Recreation. Times, 9th October 1969.
- Antony, Ruth, Shirley Beckingham et alia. "Where Can Children Play". New Society, 15th April 1968. pp.19-20.
- Architectural Research Unit. Low Rise High Density Housing Study. Edinburgh: University of Edinburgh 1968.
- Ardill, John. "New Town Plans for the Motorist". Guardian, 15th January 1969. p.170.
- Ash, Joan. "Families Living at High Density". Official Architecture and Planning, January 1966. pp.68-71.
- Ash, Maurice. Regions of Tomorrow: Towards the Open City. London: Evelyn, Adams and Mackay, 1969.
- Asimov, Isaac. The Caves of Steel. London: Panther Books Ltd., 1958. p.19.
- Atkins, C.K. People and the Motor Car. Vol.1. Birmingham: University Department of Transportation and Environmental Planning, 1964. p.41.
- Austin-Smith, Salmon Lord Partnership. Warrington New Town. Consultants Proposals for the Draft Master Plan. Warrington Development Corporation, 1969. p.296.
- Bauer, Catherine. Social Questions in Housing and Town Planning. London: University of London Press, 1952. p.28.

- Beckermann, W. et alia. The British Economy in 1965. National Institute of Economic and Social Research. Cambridge: Cambridge University Press 1965. p.370, Table 12.3.
- Best, Robin H. "Against High Density". New Society, 24th November 1966. p.787.
- Best, Robin H. "Extent of Urban Growth and Agricultural Displacement in Post-war Britain". Urban Studies: Vol.5, No.1, February 1968. p.21.
- Bouladon, Gabriel. "Future Transportation in Cities as Reconsidered Around Man". High Speed Ground Transportation Journal: Vol.III, No.1, January 1969. p.158.
- Bracey, H.E. In Retirement: Pensioners in Great Britain and the United States. London: Routledge and Kegan Paul, 1966. p.264.
- Browne, Michael. University Planning and Design. London: Lund Humphries, 1967. pp.49, 69, 74, 98.
- Broadly, Maurice. Planning for People. London: National Council of Social Service, 1968. p.14.
- Brooke-Taylor, G. "Social Objectives of Planning". Proceedings of the Town and Country Planning Summer School, University of Cambridge. London: Town Planning Institute, 1963.
- Brooke-Taylor, G. "New New Towns". Housing Review: Vol.15, January/February, 1966. p.30.
- Brown, Colin. "Successful Features in the Planning of New Town Industrial Estates". Journal of the Town Planning Institute: Vol.52, 1966. p.17.
- Brown, Ian. "Cumbernauld: A New Urbanity". New Society, 9th July 1964. p.12.
- Brown, Maurice. "Urban Form". Journal of the Town Planning Institute: Vol.52, 1966a. p.3.
- Buchanan, Colin. Urban Structures. In David Lewis ed. Architects Year Book 12. London: Elek Books, 1968. p.29.
- Buchanan, Colin et alia. Traffic in Towns. London: H.M.S.O., 1963. para. 114.
- Buchanan, Colin and Partners. South Hampshire Study. Supplementary Vol. No.2. London: H.M.S.O., 1968.
- Buckingham, James Silk. National Evils and Practical Remedies. London: Carlton Press, 1859. pp.183-184.
- Burnett, F.F. "Open Space in New Towns". Journal of the Town Planning Institute: Vol. 55, No. 6, June 1969. pp.258-259.

- Burns, Wilfred. "The Future Pattern of Towns". In Report of Proceedings at the Town and Country Planning Summer School, University of St. Andrews. London: Town Planning Institute, 1965. p.34.
- Burns, Wilfred. "The Relationship Between Town and Country Planning". Journal of the Town Planning Institute: Vol.52, No. 5, May 1966. pp.179-180.
- Burns, Wilfred. Traffic and Transportation in Newcastle-upon-Tyne. City of Newcastle-upon-Tyne, 1967. p.40.
- Byron, Carole H. Basildon: Shopping, Work for Women, Leisure. Basildon Development Corporation, 1967.
- Calhoun, John B. "Population Density and Social Pathology". Scientific American: Vol.206, No. 2, February 1962. p.148.
- Caplan, G. Principles of Preventive Psychiatry. London: Tavistock Publications Ltd., 1964. p.140.
- Carr, Stephen. The City of the Mind. In Ewald, William R. Jnr. ed. Environment for Man: The Next 50 Years. Bloomington and London: Indiana University Press, 1967, p.220.
- Carr-Saunders, Sir Alexander Morris. The Population Problem: A Study in Human Evolution. Oxford: Oxford University Press, 1922.
- Centre for Urban Studies. Housing in Camden. Vol.2. London: Borough of Camden, 1969. p.6.
- Chalkley, J.N. and H.R. Cater. Thermal Environment. London: Architectural Press, 1968. p.40.
- Chermayeff, Serge and Christopher Alexander. Community and Privacy: Towards a New Architecture of Humanism. Harmondsworth, Middlesex: Penguin Books Ltd., 1963. p.122.
- Chesler, Julia. Satisfaction and Rehousing. London: Institute for Social Research, 1965.
- Childe, Vere Gordon. The Prehistory of Scotland. London: Kegan Paul, Trench, Trubner and Co., 1935. p.217.
- Clark, Colin. "Employment in New Towns". Journal of the Town Planning Institute: Vol.52, No.1, January 1966. p.11.
- Claxton, E.C. Stevenage Road Accident Survey, 1957-1966. Stevenage Development Corporation. 1967. Appendix 'B'.
- Cohen, Lord of Birkenhead. Introduction to British Medical Journal ed. Health Centres and Group Practices. London: British Medical Association, 1966. p.2.

- Collins, George R. "The Linear City". In Lewis, David. The Pedestrian in the City. Architects' Year Book II, London: Elek Press, 1965.
- Collins, George R. "Linear Planning". Forum: Vol. XX, No. 5, March 1968.
- Committee on the Problem of Noise. Noise. Part Paper 15, 1962-1963, X:II (Wilson Report). London: H.M.S.O., 1963. para. 87.
- Consumers' Association. "Shopping". Which, November 1969. pp.338-340.
- Cook, J.A. "Gardens in Housing Estates: A Survey of Uses, Attitude and Behaviour". Town Planning Review. Vol.39, No.3, October 1968.
- Copcutt, Geoffrey. "Cumbernauld New Town Central Area". Architectural Design, May 1963. p.225.
- Council for Children's Welfare. The Playground Study: Preliminary Analysis. London: Council for Children's Welfare, 1966.
- Cowan, Peter. "Milton Keynes: The Creation of a City". New Society, 13th February 1969. p.277.
- Crow, G.P. "Traffic Planning in Cumbernauld New Town". Traffic Engineering and Control: Vol. 3, No. 2. June 1961.
- Cullingworth, J.B. et alia. The Needs of New Communities. A Report on Social Provision in New and Expanding Communities. London: H.M.S.O., 1967.
- Cumbernauld Development Corporation. Origin and Destination Survey Procedure. Addendum 9. Cumbernauld Development Corporation, December 1966.
- Cumbernauld Development Corporation. Report on Road Accidents 1966-1968. Unpublished Report. Cumbernauld Development Corporation, 1969.
- Ienby, Elizabeth. "Oversprawl". Architectural Review: Vol. 120, December 1956. p.430.
- De Lauwe, Paul Chombart. "The Social Sciences, Urbanism and Planning". International Journal of Comparative Sociology: Vol.4, 1963. p.128.
- Department of Education and Science. "Dual Use of Community Facilities". Circular, Department of Education and Science, February 1970.
- Department of Employment and Productivity. Family Expenditure Survey for 1967. London: H.M.S.O., 1968. p.130.
- Department of Health and Social Security. Report of the Central Health Services Council: The Functions of the District General Hospital. London: H.M.S.O., 1969.
- Design. "Projects and Developments: Moving Pavements". Vol.242, February 1969. p.66.

- Loxiadis, C.A. Between Dystopia and Utopia. London: Faber and Faber, 1968. p.72.
- Loxiadis, C.A. "Man's Movement and the City". Ekistics: Vol.29, No.159, February 1969. p.84.
- Dunlop Company Ltd. Passenger Conveyors: Present and Future. The Dunlop Belting Division, Liverpool, 1969.
- Dunlop Company Ltd. Letter from Manager of Transportation Projects to the author, 12th March 1970.
- Lyckman, John. W. "Transportation in Cities". Scientific American, September 1965. p.166.
- Elder, A.J. "Domestic Heating". Architects' Journal, 9th April 1969. p.1002.
- Fanning, L.M. "Families in Flats". British Medical Journal, 18th November 1968.
- Forster, Frederick. A Study of Family Visiting to In-Patients at the Royal Hospital for Sick Children. Thesis to be presented for Degree of Doctor of Philosophy, University of Edinburgh: Faculty of Medicine, Department of Social Medicine, 1970.
- Gans, Herbert J. People and Plans: Essays on Urban Problems and Solutions. New York: Basic Books, 1968.
- Gavron, Hannah. The Captive Wife. London: Pelican Books Ltd., 1968. pp.104-105.
- General Register Office. Census 1961. Great Britain Summary Tables. London: H.M.S.O., 1962. p.3. Table 3.
- Gibbs, A.K. "Cumbernauld New Town, Mark II: The New Road Plan". Architects' Journal, October 1959, p.278.
- Ginsberg, Leslie. Foreward to F.L. Hobbs, and B.D. Richardson. Traffic Engineering: Volume 1. Oxford: Pergamon Press, 1967.
- Gist, Noel and Sylvia Fava. Urban Society. New York: Thomas Y. Crowell and Co., 1967.
- Greater London Council. Greater London Development Plan. Greater London Council, October 1967. p.19.
- Greater London Council. Research Paper No.2. Surveys of the Use of Open Spaces. Vol.1. London: Greater London Council, 1968.
- Greater London Council. Movement in London: Transport Research Studies and Their Context. London: Greater London Council, 1969. p.91.

- Griffiths, F.D. and F.J. Langdon. Subjective Response to Road Traffic Noise. Building Research Station Paper No. 37/68. London: Ministry of Building and Public Works, 1968. p.16. Fig.7.
- Gruen, Victor. The Heart of Our Cities: The Urban Crisis, Diagnosis and Cure. London: Thames and Hudson, 1965.
- Hagerstrand, Torsten. "The Computer and the Geographer". Transactions and Papers of the Institute of British Geographers: No. 42, 1967.
- Hall, Peter. "Planning Priorities for Shopping Centres". Design: Vol. 232, April 1968. p.46.
- Hall, Peter. "Transportation". Urban Studies: Vol.6, No.3, p.420.
- Haseler, J.E. "District Heating in New Cities". Journal of the Institute of Heating and Ventilating Engineers, September 1965. p.16.
- Haward, Birkin et alia. "Housing Primer: Low and Medium Rise Housing". Architectural Design, September 1967. pp.395-397.
- Healy, Pat. "New City with a Population of 250,000 in 30 Years". Times, 18th March 1970.
- Henderson, Arthur. "Moving Pavements". Official Architecture and Planning: Vol.32, No.2, February 1969. p.168.
- Hillman, Mayer. "Project for a Linear New Town". Plan prepared in conjunction with J.B. Lehrman. Architects Journal, 4th April 1957. pp.503-507.
- Hillman, Mayer. "Towards the Linear New Town" In Hillman, E.S. Essays in Local Government: New Towns and New Cities. Vol.2. London: Merlin Press, 1965.
- Hillman, Mayer. "Stad op Pampus - Linear Town Expansion". Architects' Journal, 29th June 1966. p.1585.
- Hillman, Mayer. "Urban Form for the Central Borders". Unpublished Report. Planning Research Unit: Department of Urban Design and Regional Planning, University of Edinburgh, 1967.
- Hillman, Mayer and Ivor Samuels. Competition Entry for Brookvale Community: Euncorn New Town. June 1968.
- Hirsch, J.Z. "Expenditure Implication of Metropolitan Growth and Consolidation". Review of Economics and Statistics: Vol.41, No.3, 1959.
- Hobbs, F.D. and B.D. Richardson. Traffic Engineering. Vol.1. Oxford: Pergamon Press, 1967. p.125.
- Hoffmann, Hubert. One Family Housing: Solutions to an Urban Problem. London: Thames and Hudson, 1967.

- Hole, Vere. "Social Effects of Planned Rehousing". Town Planning Review: Vol.30, No.2, July 1959.
- Hole, Vere. Children's Play on Housing Estates. National Building Studies Research Paper No.39. London: H.M.S.O., 1966.
- Hole, Vere and P.G. Allen. A Survey of Housing for Old People. Current Papers: Design Series No.33, Department of Scientific and Industrial Research, 1962.
- Hole, Vere and A. Miller. "Children's Play on Housing Estates". Architects' Journal, 22nd June 1966.
- Holroyd, E.M. "Polar and Rectangular Road Networks for Circular Sites". Transportation Science: Vol.3, No.1, February 1969. p.86.
- Hubert, J. "Kinship and Geographical Mobility in a Sample from a London Middle Class Area". International Journal of Comparative Sociology: Vol.6, No.1, March 1965. pp.49-74.
- Hunt, Audrey. Survey of Women's Employment. Vol.1. Government Social Survey. London: H.M.S.O., 1968. p.20.
- Jamieson, G.B. and W.K. Mackay. "Urban Roads in the Buchanan Era". Journal of the Institute of Municipal Engineers: Vol.92, March 1965. pp.108-110.
- Jamieson, G.B., W.K. Mackay and J.C.R. Latchford. "Transportation and Land Use Structures". Urban Studies: Vol.4, No.3, November 1967. p.202.
- Jennings, Hilda. Societies in the Making: A Study of Development and Redevelopment within a County Borough. London: Routledge and Kegan Paul, 1962. p.160.
- Jones, Ron. "Urban Development and Its Impact on Retail Distribution" Proceedings of One Day Study Conference: Department of Adult Education and Extra-Mural Studies, University of Edinburgh, 6th December 1969.
- Jung, Carl Gustav. "The Needs for Roots". In interview recorded in Landscape: Vol.14, No.2, 1965.
- Keeble, Lewis. Principles and Practise of Town and Country Planning. London: Walker and Co., 1964. pp.96, 176.
- Keefer, L.E. "Illusory Demand for Mass Transit". Traffic Engineering, January 1966.
- Langdon, F.J. Modern Offices: A User Survey. London: H.M.S.O., 1967.
- Langer, J. et alia. "Apparent Speed of Walking Under Conditions of Danger". Journal of General Psychology: Vol.73, 1965. p.291.
- Lee, Terence. "Psychology and Living Space". Transactions of the Bartlett Society: Vol.2, 1963-1964. p.29.

- Lee, Terence. "Null Relationships between Ecology and Adult Education". British Journal of Educational Psychology: Vol. XXXVI, February 1966.
- Lee, Terence. Proceedings of the Alcan Conference. Newcastle, September 1967.
- Lehrman, Jonas. "Housing: Low Level, High Density". Architectural Design. February 1966. pp.80-85.
- Levin, P.H. and A.J. Bruce. "Location of Primary Schools". Journal of the Town Planning Institute: Vol.54, No.2. February 1968.
- Lewin, Kurt. Field Theory in the Social Sciences. London: Tavistock Publications Ltd., 1952.
- Lichfield, Nathan and Associates. Public Transport: Stevenage. Vol.1. Cost Benefit Analysis. Stevenage Development Corporation, 1969.
- Lichfield, Nathan and Honor Chapman. "Cost Benefit Analysis and Road Proposals for a Shopping Centre". Journal of Transport Economics and Policy: Vol.2, No.3, September 1968. pp.280-320.
- Ling, Arthur and Associates. Runcorn New Town. Runcorn Development Corporation, 1967.
- Lintas. Food women and Shops. Vol.2. London: Lintas Special Projects, 1968. p.16.
- Mlewelyn-Davies, Richard. "Some Further Thoughts on Linear Cities". Town Planning Review: Vol.38, No.3. October 1967. p.202.
- Mlewelyn-Davies, Weeks, Forestier-Walker and Bor. Milton Keynes: Interim Report to Development Corporation. London: Milton Keynes Development Corporation, 1968.
- Mlewelyn-Davies, Weeks and Partners. Washington New Town. Washington Development Corporation, 1967.
- London County Council. The Planning of a New Town. London County Council, 1961. p.37.
- Lynch, Kevin. Site Planning. Cambridge: Massachusetts Institute of Technology Press, 1962. p.29.
- Mackay, William. "Town Form and Transportation". In Proceedings of Symposium on Urban Transport Systems. Department of Transportation Technology. University of Loughborough, 1969.
- Mann, P.B. An Approach to Urban Sociology. London: Routledge and Kegan Paul, 1965.
- Manthorpe, Walter. "The Machinery of Sprawl". Architectural Review: Vol.120, December 1956. p.409.

- March, Lionel. "Let's Build in Lines". New Society, 20th July 1967. p.76.
- Marsh, Richard. Report of Proceedings in the House of Commons on 9th December 1968. Times, 10th December 1968.
- Martin, R.J. The Correlates and Significance of Settlement Size. Research Study, Number One. Edinburgh College of Art, School of Town and Country Planning. Unpublished Thesis, 1967.
- Matthew, Robert, S. Johnson-Marshall and Partners. Central Lancashire Study. London: H.M.S.O., 1967.
- McConnell, Shean. "Planning for Industry". Official Architecture and Planning: Vol.30, July 1967. p.1011.
- Meyer, J.R., J.K. Kain and M. Wohl. The Urban Transportation Problem. Cambridge, Massachusetts: Harvard University Press, 1965, p.105.
- Ministry of Health. A Hospital Plan for England and Wales. Cmd. 1604. London: H.M.S.O., January 1962. p.6, para.20.
- Ministry of Health and Social Security. Buildings for General Medical Practice. London: H.M.S.O., 1967a.
- Ministry of Health and Social Security. Health Centres. Circular, July 1967. London: H.M.S.O., 1967b.
- Ministry of Housing and Local Government. Homes for Today and Tomorrow. (Parker Morris Report). London: H.M.S.O., 1961. para.169.
- Ministry of Housing and Local Government. Meeting Places for Hire in New Towns. A Social Survey. London: Ministry of Housing and Local Government, 1966. p.34.
- Ministry of Housing and Local Government. The Needs of New Communities: A Report on Social Provision in New and Expanding Communities. London: H.M.S.O., 1967.
- Ministry of Housing and Local Government. "Housing Standards, Costs and Subsidies". Circular No.36/37. London: H.M.S.O., 1967a.
- Ministry of Town and Country Planning. Site Planning in Relation to Housing. Report of Study Group. In Ministry of Health Central Housing Advisory Committee. Design of Dwellings (Ludley Report). London: H.M.S.O., 1946. p.59.
- Ministry of Town and Country Planning. Design of Dwellings. London: H.M.S.O., 1952.
- Ministry of Transport. Roads in Urban Areas. London: H.M.S.O., 1966. p.7, Tables 1 - 4.
- Ministry of Transport. Highway Statistics 1968. London: H.M.S.O., 1969.

- Morris, Desmond. The Naked Ape. London: Corgi Books, 1967.
- Morris, Desmond. The Human Zoo. London: Jonathan Cape, 1969. pp.182, 186.
- Mumford, Lewis. The City in History. Harmondsworth, Middlesex: Penguin Books Ltd., 1966. p.262.
- National Board for Prices and Incomes. Proposals by the London Transport Board for Fare Increases. Report No.112, Cmd.4036. London: H.M.S.O., 1969. p.37.
- Needham, Barrie. "Density of Industrial Estates". Journal of the Town Planning Institute: Vol.53, No.10, December 1967. p.457, Tables 1-4.
- New Towns Committee. Final Report. (Reith Report). Cmd. No.6876. London H.M.S.O., 1946.
- Nicholson, J.H. New Communities of Britain. London: National Council of Social Service, 1961. p.77.
- Office of Health Economics. Sickness Absence. London: Office of Health Economics, 1969.
- Ogilvy, G.A. "Self Contained New Town: Employment and Population". Town Planning Review: Vol.39. No.1, April 1968. p.2.
- Orr, Sarah. "Regional Economic Planning and Location of Industry". In J.D. Cullingworth and Sarah Orr eds. Regional and Urban Studies. London: Allen and Unwin, 1969. p.23.
- Osborn, Frederic and Arnold Whittick. The New Towns. London: Leonard Hill, New Edition, 1969.
- Owens, D. Estimates of the Proportion of Space Occupied by Roads and Footpaths. Road Research Laboratory Report, R.L. 154. London: Ministry of Transport, 1969. p.5, Table 5.
- Parr, A.E. "Environmental Design and Psychology". Landscape: Vol.14, No.2, 1964-1965. p.15.
- Parr, A.E. "Problems of Reason, Feeling and Habitat". Architectural Association Quarterly, July 1969. pp.5-7.
- Pearse, Innes H. and Lucy H. Crocker. The Peckham Experiment: A Study in the Living Structure of Society. London: George Allen and Unwin, 1943. pp.289-298.
- Pickard, F.M. Activity of Children. London: Longmans, 1965. p.110.
- Planning and Research Department, London Borough of Brent. Survey of Children's Playgrounds. London Borough of Brent, 1966.

- Flowden, Lady Anne et alia. Children and Their Primary Schools: Report of the Advisory Council for Education: Vol.1. London: H.M.S.O., 1967.
- Flowden, S.P.C. "Transportation Studies Examined". Journal of Transport Economics and Policy: Vol.1, No.1, January 1967a. p.14.
- Redcliffe-Maud, The Right Hon. (Chairman). Royal Commission on Local Government in England, 1966-1969. Vol.1, Report. Cmd.4040. London: H.M.S.O., 1969.
- Reiner, Thomas. Place of the Ideal Community in Urban Planning. Philadelphia: University of Pennsylvania, 1963. p.116.
- Ritter, Paul. Planning for Man and Motor. Oxford: Pergamon Press, 1964.
- Road Research Laboratory. Research on Road Traffic. Department of Scientific and Industrial Research. London: H.M.S.O., 1965. p.78.
- Roberts, John. "Computer-Aided Analysis". Official Architecture and Planning: Vol.32, No.10, October 1969. p.1187.
- Roberts, John and Margaret Roberts. "Costs and Social Benefit Study: An Auto Taxi System". Official Architecture and Planning: Vol.32, No.2, February 1969. p.174.
- Robertson, D.J. The City and the Region. Edinburgh: Oliver and Boyd, 1964. p.17.
- Rock, Tim. "Manplan:3". Architectural Review: Vol.146, November 1969. p.395.
- Rodgers, H.B. Pilot National Recreation Survey: Report No.1. London: British Travel Association, 1967.
- Roskill, C... et alia. Housing in Britain. London: Town and Country Planning Association, 1964.
- Rosner, Rolf and H.H. Meyer. "Town Planning in Hamburg". Journal of the Town Planning Institute: Vol.46, No.7, June 1960.
- Rosner, Rolf. Neue Stadte in England. Munich: Georg Callwey, 1962. p.147.
- Rosow, Irving. "The Social Effects of the Physical Environment". Journal of the American Institute of Planners: Vol.27, 1961. p.13.
- Scottish Development Department. The Central Borders: A Plan for Expansion. Vol.1. Edinburgh: H.M.S.O., 1968. p.100, Diagram V.

- Seeborn Report. Report of Committee in Local Authority and Allied Personal Social Services. Cmd. 3703. London: H.M.S.O., 1968.
- Shanas, Ethel and Peter Townsend et alia. Old People in Three Industrial Societies: A Cross-National Study of the Elderly Populations of Britain, Denmark and the United States. London: Routledge and Kegan Paul, 1968. p.425.
- Shankland, Cox and Associates. Private Housing in London. London: Estates Housing, 1969.
- Shannon, Gary, Rashid Bashur and Charles Metzner. "The Concept of Distance as a Factor in Accessibility and Utilisation of Health Care". Medical Care Review: Vol.26, No.2, February 1969. pp.150-152.
- Sillitoe, Kenneth K. Planning for Leisure. Government Social Survey. London: H.M.S.O., 1969.
- Simmie, J.M. "Housing and the Elderly: A Study of Walton Manor". Journal of the Town Planning Institute: Vol.55, No.9, October 1969.
- Sneed, Reuben J. "Road Space Requirements for Traffic in Towns". Town Planning Review: Vol.33, January 1963.
- Sneed, Reuben J. "Traffic Problems in Towns: A Review of Possible Long Term Solutions". Town Planning Review: Vol.35, July 1964. p.157.
- Sneed, Reuben J. "Some Aspects of Pedestrian Safety". Journal of Transport Economics and Policy: Vol.11, No.3, September 1968. p.266.
- Spencer, John. Stress and Release in an Urban Estate: A Study in Action Research. London: Tavistock Publications, 1964.
- Sports Council. Planning for Sport. London: Central Council of Physical Recreation, October 1968.
- Sports Council. Review for 1966-1969. London: Central Council of Physical Recreation, 1969. p.13.
- Stegman, Michael. "Accessibility Models and Residential Location". Journal of the American Institute of Planners: Vol.XXXV, No.1, January 1968. pp.22-29.
- Stevenage Development Corporation: Social Relations Department. Survey of Children's Play, 1968/1969. First Report 1969. Stevenage Development Corporation, 1969.
- Stevenson, Anne et alia. High Living: A Study of Family Life in Flats. London: Cambridge University Press, 1969.

- Stoller, Alan. "Urbanisation and Mental Health". Medical Journal of Australia: Vol.2, No.5, 2nd August 1969. p.225.
- Stone, P.A. "The Economics of Housing and Urban Development". Journal of the Royal Statistical Society: Series A (Gen), Vol.122, Part 4, 1959.
- Stone, P.A. Housing, Town Development: Land and Costs. London: Estates Gazette Ltd., 1962.
- Stone, P.A. "Financing the Construction of New Towns". Paper No. 7. United Nations Symposium on Planning and Development of New Towns. Moscow, 1964.
- Stone, P.A. In Report of Proceedings of the Town and Country Planning Summer School, University of St. Andrews. London: Town Planning Institute, 1965.
- Stone, P.A. "Housing Needs, Costs and Policies". Architects' Journal 30th October 1968. pp.999-1000.
- Storr, Anthony. Human Aggression. London: Allen Lane, 1968. p.115.
- Sykes, A.J.M., J.M. Livingstone and M. Green. Cumbernauld 1967: A Household Survey and Report. Occasional Paper No.1, University of Strathclyde. 1968.
- Taylor, M.A. Studies of Travel in Gloucester, Northampton and Reading. Road Research Laboratory Report RL 141. London: Ministry of Transport, 1968. p.112.
- Taylor, Lord S.J. and S.P. Chave. Mental Health and Environment. London: Longmans, 1964. p.168.
- Thomas, Ray. London's New Towns: A Study of Self Contained and Balanced Communities. Broadsheet 510. London: Political and Economic Planning, 1969.
- Times. Article on Report of the Medical Officer of Health for Staffordshire. 3rd June 1968.
- Times. "Special Report on Supermarkets". 25th April 1969.
- Tyrwhitt, Jacqueline. "Shape of Cities that can Grow". Journal of the Architectural Association: Vol.79. November 1963.
- United Nations. "Symposium on New Towns". Ekistics: Vol.18, No.108, November, 1964. p.286.
- Vorhees, Alan. "Land Use Transportation Studies". Journal of the Town Planning Institute: Vol.54, No.7, August 1968. p.333.

- Waldorf, Dan. "Recreational Facilities in a New Town". Official Architecture and Planning: Vol.29, November 1966. pp.1699-1700.
- Waters, C.M. and D.M. Waters. "Transport Noise Problems". In The Impact of the Environment. Loughborough University of Technology. Proceedings of Symposium of Compatibility of Transport Systems, 26th - 28th March 1969. para.5.5.9.
- Waters, Lewis. Urban Form Systems in Physical Planning: A Case Study of Cumbernauld New Town. Thesis presented for Degree of Doctor of Philosophy, University of Edinburgh: Faculty of Social Sciences, Department of Urban Design and Regional Planning, 1970.
- Webber, Melvin M. "Culture, Territoriality and the Elastic Mile". Papers of the Regional Science Association: Vol.13, 1964a.
- Webber, Melvin M. The Urban Place in the Non-Place Urban Realm. In Explorations in Urban Structure. Philadelphia: University of Pennsylvania, 1964b.
- Webber, Melvin and Schlomo Angel. "The Social Context for Transport Policy". Ekistics: Vol.29, No.170, January 1970. p.25.
- West, Gerald. "Washington New Town". Northern Architect: Vol.34, April 1967. p.812.
- Whittle, Jack. "Size of New Towns". Paper read at Town and Country Planning Association Forum. Town and Country Planning. February 1965. p.76.
- Whyte, William. The Organisation Man. New York: Simon and Shuster, 1956. p.346.
- Wilbur Smith and Associates. Future Highways and Urban Growth. New Haven, Connecticut: Automobile Manufacturers Association, 1961.
- Willis, Margaret. "Siting of Sportsgrounds". Town and Country Planning. April 1968. p.233.
- Willis, Margaret. "Sociological Aspects of Urban Structure". Town Planning Review: Vol.39, No.4, 1969. p.301.
- Willmott, Peter. "Housing Density and Town Design in a New Town". Town Planning Review: Vol.33, No.2, July 1962.
- Willmott, Peter. Evolution of a Community: A Study of Eagenham after 40 Years. London: Institute of Community Studies, 1963.
- Willmott, Peter. "Some Social Trends". Urban Studies: Vol.6, No.3, November 1969. p.296.
- Wilson, G. Hugh. Cumbernauld New Town. Cumbernauld Development Corporation: Preliminary Planning Proposals, 1958.
Planning Proposals: First Revision, 1959.
Planning Proposals: Second Revision, 1962.

Wilson L. Hugh and Lewis Womersley. Skelmersdale New Town Planning Proposals: Report on Basic Plan. Skelmersdale Development Corporation, 1964.

Wilson, L. Hugh and Lewis Womersley. Northants, Bedford and North Bucks Study: An Assessment of Interrelated Growth. London: H.M.S.O., 1965.

Wilson, L. Hugh and Lewis Womersley. Irvine New Town: Final Report on Planning Proposals. Scottish Development Department. Edinburgh: H.M.S.O., 1967.

Winterbottom, D.M. "Urban Open Spaces". Journal of the Town Planning Institute: Vol.53, No.2, February 1967.

Wynne-Edwards, V.C. "The Social Group and the Status of the Individual". Chapter 4 of Animal Dispersion in Relation to Social Behaviour. Edinburgh: Oliver and Boyd Ltd., 1962. pp.127-144.