

WORK-RESIDENCE RELATIONS IN VANCOUVER

by

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(ii)

ABSTRACT

Among the literature on work-residence relations two perspectives contribute to a potential geographical point of view. Of these, the demographic approach has been largely descriptive in its attempt to distinguish areas which are deficient in labour from those which have a labour surplus. The ecological approach is considered to be more promising but in its present form has certain inadequacies.

In essence, this approach proposes a theory of urban spatial structure in terms of a priori assumptions. The major assumption with respect to the journey to work is that the frictional effect of distance results in the residential concentration of workers about their place of work. It then follows that the residential distribution of urban populations will be determined by the dominance of the central district relative to peripheral workplaces.

The major thesis of this study is that the efforts of workers to minimize the costs of work-travel operates within the context of an existing urban spatial structure, which is itself uniquely determined by the conditions of site and the sequence of growth.

The ecologist's argument is that workers of high socioeconomic standing will travel further to work than those of low socioeconomic standing because of their enhanced ability to bear the cost of work-travel. In Vancouver, variation in the length of the journey to work is shown to be a function of the relative concentration of workplaces and residences for each occupational

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group, rather than of the socioeconomic standing of the worker.

A model is developed to describe the orientations of commuting patterns in Vancouver for each major occupational group. This suggests that these are the results of the varying quality of residential space rather than a crude distance determinism.

Downtown Vancouver employs a growing proportion of the city's labour force as Vancouver increasingly assumes the role of regional capital. Although the residential distribution of the labour force embraces the entire city as ecological theory suggests, each occupational group is drawn from a distinct residential area. More rigorously, a high correlation is found between the income of workers and costs of housing in the residential area from which they come. In contrast, the correlation between the worker's income and the distance he travels to work downtown is not clear.

These findings throw some light on the variation in automobile work-trips generated to downtown from each residential zone. A greater proportion of automobile work-trips originate in those high-cost residential areas in which the majority of the high-income downtown workers live. Not only are the origins of these trips locally concentrated, but they are generated more strongly to certain parts of downtown than others.

The residential distribution of the workers of peripherally located workplaces is clustered in the way suggested by ecological theory. However, clustering occurs only in areas of uniformly low housing costs and only for industrial workers. Office workers of peripheral workplaces are drawn from a generally

city-wide residential distribution.

In Vancouver, it would appear that distance from the workplace is a less important determinant of residential location than the costs of housing. The concentrative effects of the cost-minimization process have less relevance than has been supposed, and even where they are applicable, operate only where housing costs are uniform. In brief, commuting patterns are superimposed upon a pre-existing, uniquely-determined urban spatial structure. Further research should indicate the extent to which this is true for other cities.

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CHAPTER I

THE RELATIONSHIP BETWEEN PLACE OF WORK AND RESIDENCE

The long journey to work is an unpleasant fact of life for many modern urbanites. Each day large numbers of people travel ever increasing distances between homes and work. It has been suggested by many writers that the costs incurred in work-travel are a major determinant of residential location and that ceteris paribus most workers attempt to minimize the length of the journey to work. Yet the distance from work is but one of several factors which conditions the individual's choice of where he will live. The journey to shop, or to school, or to the park and theatre are all important in his weekly schedule and will all presumably be considered in the choice of residential location. Why people live where they live in cities is a question which has not been satisfactorily answered.

It is recognized that work and residence are areally segregated in cities.

In the contemporary large American city, writes Foley, a mosaic of functional areas has evolved seemingly as an inevitable counterpart of the broad fact of economic specialization. Ecologists term this process segregation. So long as the city is characterized by specialization, and specifically, by segregation, we can expect that movement among divergent functional areas will be necessary if that city is to function as an integrated community.

Thus the journey to work in aggregation may be considered as the movement of people from residential areas to those in which economic activity is dominant.

¹D. L. Foley, "Urban Daytime Populations--A Field for Demographic-Ecological Research", Social Forces, 32 (May, 1954) pp. 323-330.

It is often assumed that these movements are analogous to a tidal ebb and flow about a central node. Although the movement from outlying suburbs to the central area is certainly dominant in many cities, import cross- and counter-currents add to the complexity of rush-hour traffic patterns.

The movements from home to work have been described by Dickinson² and others as movements of conflux and dispersion.

These movements, when considered from the viewpoint of the dwelling place and the work-place respectively, may be regarded as movements of dispersion from the former--inhabitants of a neighbourhood leaving each morning on journeys of very different lengths--and as movements of conflux to the latter.³

Are the journeys to work generated by a given neighbourhood in fact of "very different lengths"? It would seem equally likely that a specific residential neighbourhood will be linked by the daily journey to work of large numbers of its inhabitants to a specific centre of employment. If the minimization of the journey to work is important, this centre of employment must be the closest. If it is not the closest, then other factors must be involved. These would include the other determinants of residential location mentioned above, and the ability of one group of workers to assume priority over another by residing in an area where these determinants are best fulfilled.

Residential areas are themselves segregated and each major occupational group concentrated in specific neighbourhoods. The question arises--are these concentrations functionally related

²R. E. Dickinson, City Region and Regionalism (London: Routledge and Kegan Paul, 1946), p. 124.

³Ibid.

to the place of work for each group, or to some other factor or group of factors.

This study will attempt to identify the linkages between specific places of employment and specific residential neighbourhoods. The exercise of relating areas of supply to areas of demand is familiar to geographers, but is seldom applied to the question of labour. Yet it is apparent that some parts of the city have more jobs than homes, and others more homes than jobs. It is equally obvious, even from a perfunctory analysis, that some areas have a preponderance of certain kinds of jobs, and others a preponderance of certain kinds of homes. It will be the purpose of this study to identify the relationships linking such areas.

Some Working Hypotheses

Industrial plants require a specific range of commodities derived from fairly discrete areas--this source of raw materials and energy. The areas from which labour is drawn may be of more limited extent, but will nonetheless have discrete spatial co-ordinates.

Whether or not a specific plant draws labour from a specific residential area will be dependent upon two principal factors. First, the distance of the residential neighbourhood from the plant will not be further than a reasonable daily journey to work of the plant's worker. Second, the residential neighbourhood must of course contain workers who may be employed in the plant's operations.

A major difference arises between the distances from which labour will be drawn, and the distance from which raw materials and energy will be drawn. The cost of transporting the latter commodities is borne by the plant, while the cost of transporting labour is borne by the workers themselves. It is moreover, a cost which is repeated from day to day and one which must be measured in social as well as financial terms.

As an initial hypothesis then it may be stated that other things being equal the worker will attempt to minimize the costs of work-travel. This is an hypothesis which has been framed by several workers, notably Carrol,⁴ Schnore,⁵ and (implicitly) Vance.⁶ However, the costs of the journey to work may be minimized not only by minimizing the separation between home and work, as Carrol at least has assumed, but by varying the mode of transportation. One may question that for workers who drive their own cars to work in a city as small as Vancouver, the length of the journey to work is accorded much importance in any case. For those who use their cars to get to and from work, what then are likely to be the major determinants of residential location?

A major factor would seem to be the costs of housing. It may then be hypothesized that the length of the journey to

⁴J. Douglas Carrol, "The Relationships of Home to Work and the Spatial Pattern of Cities", Social Forces, 30 (March, 1952), pp. 271-282.

⁵Leo F. Schnore, "The Separation of Home from Work: A problem for Human Ecology", Social Forces, 32 (May, 1954), pp. 336-343.

⁶James Vance, "Labour-Shed, Employment Field, and Dynamic Analysis in Urban Geography", Economic Geography, 36 (July, 1960), pp. 189-220.

work is for most workers a less important determinant of residential location than the cost of housing.

This hypothesis does not contradict that framed initially. The initial hypothesis assumes that workers will attempt to minimize work-travel other things being equal. Clearly, other things will not be equal in many cases. Certainly in a uniformly low-cost residential area a clustering of the labour force about a place employing low-income workers will be expected. Where, however, the structure of residence is not homogeneous, the varying costs of housing may be expected to come into play. Specifically, workers of high income will be drawn from areas of high cost housing, and workers of low income from areas of low cost housing, irrespective of the distance of these areas from the place of work.

There is a mutual interaction between certain types of economic activity and the cost of housing prevailing in adjacent areas which it would be unwise to ignore. The noxious smells attending certain kinds of industrial plants result in a lessening of the amenity value of adjacent residential areas which is reflected in lower housing costs. In addition, these residential areas often contain older homes which have declined in value over the years. It is thus difficult to determine whether low-income industrial workers are attracted to such areas by their proximity to suitable employment per se or by the fact that, by virtue of their proximity to industrial plants, they provide less expensive accommodation.

This would seem to be a case in which it would be dif-

difficult to identify the major determinant of residential location --costs of the journey to work or costs of housing.

The two hypotheses framed to this point suggest certain corollaries through which, in fact, they will be tested.

It has been suggested by several writers, notably Carroll,⁷ Burt, ⁸ Reinemann,⁹ and Taaffe, Garner and Yeates,¹⁰ that the central area draws its labour from a city-wide distribution compared with the more clustered labour catchment areas of peripherally located workplaces. However, if the hypotheses framed above are valid, then it will follow that although the central area draws labour from throughout the city, 1) its labour force is residentially clustered towards the centre, and 2) low income workers are drawn from low-cost residential areas while high income workers are drawn from high-cost residential areas.

A major generic difference between the central area and peripheral work concentrations is that while the former has a varied labour force the latter employ predominantly industrial workers.¹¹ Thus, clustering of the labour force about peripheral workplaces will be expected where the costs of housing in adjacent areas are low.

⁷J. Douglas Carroll, op. cit.

⁸Martin Reinemann, The Localization and the Relocation of Manufacturing Within the Chicago Metropolitan Area (unpublished Ph.D. dissertation, Dept. of Geog., Northwestern University, 1955), cited by E. J. Taaffe, B. J. Garner and M. H. Yeates, The Peripheral Journey to Work (Evanston, Ill.: Northwestern University Press, 1963).

⁹Everett J. Burt, Jr., Labour Supply Characteristics of Route 12 Firms, Research Report No. 1 (Boston: Federal Reserve Bank of Boston, 1958).

¹⁰E. J. Taaffe et al., op. cit.

¹¹Ibid., p. 14.

Obviously, some further corollaries may be framed which will concern the length of the journey to work. Except for the observation stated above that the housing close to industrial plants may be of low cost because of the artificial site factors induced by contiguity with noisy or smelly economic activities, there is no reason why industrial workers are more likely to seek residential locations closer to work than white-collar workers. Duncan¹² has suggested that the degree of work-residence separation varies with the worker's socioeconomic standing. It is suggested here that the length of the journey to work varies not necessarily with the workers socioeconomic status but with the degree of centralization of his workplace. Thus central area workers of all kinds are expected to have a greater degree of work-residence separation than those employed in peripheral workplaces, irrespective of the socioeconomic standing of the worker.

These views may then be summarized as follows. Urban spatial structure is uniquely determined for each city. It is the result of the characteristics of the site which the city occupies and its sequence of growth. The result is a mosaic of discrete areas with varying social and economic attributes. Patterns of commuting are superimposed upon this spatial structure. This is not to say that there is no possibility of a "theory of the journey to work", but rather that what theories exist must be applied to each generic class of cities in a different manner. This present study will attempt to identify patterns of commuting

¹²Beverly Duncan, "Factors in Work-Residence Separation: Wage and Salary Workers, Chicago, 1951", American Sociological Review (February, 1956), pp. 48-56.

in Vancouver and to show that they are determined not by the aggregated processes of cost-minimization, but by the existing spatial structure. To this major hypothesis the following may be suggested as corollaries.

A Workers attempt to minimize the costs of work travel only where other things are equal. This will be indicated by

- 1) A clustering of the labour force about the place of work where suitable housing is available close to the workplace.
- 2) Where suitable housing is not available close to the workplace workers will be drawn from the nearest residential neighbourhood where it is available.

B The length of the journey to work is a less important determinant of residential location than the costs of housing.

Thus for both central and peripheral workplaces

- 1) Low income workers will be drawn from low-cost housing areas, and,
- 2) High-income workers will be drawn from high-cost housing areas, irrespective of the distance of these areas from the place of work.

C The central area draws its labour force from a city-wide distribution but

- 1) Central area employees are residentially clustered about the centre, and,
- 2) Different components of the labour force are drawn from distinct sectors of the city.

D Since peripheral workplaces have a predominantly industrial labour force, workers will be residentially clustered about the place of work where adjacent low-cost housing is available.

E The length of the journey to work does not vary with the workers' socioeconomic standing, but with the location of his workplace within the city. Workers employed in the central area will travel further to work on the average than those employed elsewhere, irrespective of socioeconomic standing.

The Area of Study

Metropolitan Vancouver is an urban area of some three-quarters of a million people. Its role is increasingly that of a regional capital. Generically, it falls into the same class as the other cities of the Pacific Coast. Its origins, like those of Seattle or Los Angeles, are in the streetcar era and, unlike the cities in the east, Vancouver has never really experienced a time when the journey to work had to be made by foot. The first streetcar lines struck out into the bush in the 1890's and were followed by workingmen's homes. The location of the latter, it would seem, was never determined by distance from zones of economic activity. The same fare brought the worker from forty blocks as from four.

Vancouver thus forms an appropriate vehicle for the present argument. Within a generation it has passed from village status to that of a major metropolis. There has been little time for the slow processes of succession and decay which have given the older eastern cities their apparently more ordered structure. As in the wider region of which Vancouver is the focus, land-use has changed through a rapid sequence of trial and error. The results of some of yesterday's errors remain as small incongruities

in the urban landscape. A few decaying mansions remind us that the West End has not long been Vancouver's "Gold Coast" of high-rise apartments. They have relevance no longer in the context of geography, but of history.

This apparent lack of structure is as noticeable in the built up areas of the city as in its recent suburbs. It is upon the former area that the present study focusses. The immediate area of study comprises the city of Vancouver, Burnaby, North and West Vancouver, New Westminster, and the areas of Richmond, Delta, Surrey, Coquitlam, and Port Moody which have experienced the most recent effects of urban sprawl are excluded. The choice of this area has been determined by two principal factors.

- 1) This is the area included within the Vancouver City Directory, one of the primary sources of data. Where other sources will be referred to, some attention will be given to those areas lying outside the immediate area of study.
- 2) Apart from this practical consideration, the area may be justified on methodological grounds. Its boundaries, except in the east, are well defined by natural features. To the north, the mountains of the North Shore limit residential growth, as does, of course, the coastline to the west. The southern boundary is the North Arm of the Fraser River. Although there is interaction across this boundary, it may conveniently be isolated at the crossing points. In addition, residential growth to the south is largely in the form of urban sprawl to which it may not be methodologically sound to apply the same considerations as to the comparatively intensively built

up area of study. To the east, the influence of New Westminster as a place of employment is increasingly felt, the labour shed between Vancouver and New Westminster lying somewhere in Burnaby.

The study is thus set in the fairly limited context of an intraurban situation. The intraurban scale has largely been ignored in the past by those writers who have relied on official statistics. The reasons undoubtedly lie in the unsuitability of this source of data for comparatively fine-grained studies. Census data is not provided on commuting in Canada and even in those centers where it is (Sweden, the U.K., and since 1960, the U.S.A.) the areal units for which data are given are of a coarser grain than would be required for an intraurban study.

Origin-destination studies, of which every large American city has a plethora, since they are carried out with the pragmatic purposes of the traffic engineer in mind, have reference to commuters using a specified single mode of transportation.

Sources of Data

In this study, three primary sources of data have been used in addition to those available from published census materials.

1) The Vancouver City Directory for 1963

A systematic sample was taken from the Vancouver City Directory for 1963 of 1775 persons, representing 0.78 percent of the residential labour force of Vancouver, Burnaby, North Vancouver and West Vancouver. The occupation, sex, marital status,

employer, zone of residence, and zone of employment were recorded for each person in the sample. For a partial sample of 825 persons, the air-line distance between work and residence was measured and information pertaining to the employer interpolated from the Dun and Bradstreet directory and from Contacts Influential.¹³ This information was coded on IBM cards and sorted mechanically.

The use of this data source was of value for the following tasks:

- (a) The identification of major linkages between specific residential areas and areas of economic activity.
- (b) The analysis of the mean length of the journey to work for specific categories of worker and of workplace.
- (c) The identification of labour catchment areas of specific zones of economic activity, especially the downtown area.

Since the sample is relatively small, only one dimension of disaggregation was possible, except in the case of downtown workers who are sufficiently numerous to permit further disaggregation without serious loss of validity.

2) The 1962 Downtown Parking Survey¹⁴

This survey was carried out in May and June of 1962 by the Vancouver City Engineering Department. Its primary purpose was to determine parking needs in downtown Vancouver, and its findings are presented in Vancouver Downtown Parking.¹⁵ In all

¹³ See Appendix A.

¹⁴ See Appendix C.

¹⁵ Transportation Engineering Branch, Vancouver Downtown Parking (Vancouver: City Engineering Department, 1962).

some 60,000 interviews were carried out, representing the total number of vehicles entering the downtown area in working hours on an average working day. The information recorded during these interviews had been coded on IBM cards and it was possible to isolate those pertaining to work-trips downtown.

3) Personnel Files of Select Firms

A large sample was selected from the personnel files of five selected employers and the residences of workers plotted.

The literature on the journey to work is not abundant. Attempts have only recently been made to treat this topic on a theoretical basis. In the following chapter, a review of the literature will suggest that among these attempts, those with an ecological perspective have been most influential. In many ways, this perspective has enhanced the theoretical basis of urban geography and has led to the formulation of "laws" of spatial structure. The major inadequacy of the writings of ecologists has been in their attempt to frame a theory of urban spatial structure in terms of the journey to work. This present study will present the alternative view that commuting patterns are conditioned by an existing urban spatial structure. In the following chapter, the major themes of the literature will be traced and a proposal suggested for the departure of the present study from these themes.

CHAPTER II

A CRITICAL REVIEW OF THE LITERATURE ON THE JOURNEY TO WORK

The Journey to Work as a Feature of Urbanization

The long journey to work is of recent origin. According to such writers as Pirenne,¹ Weber,² and Sjoberg³ a characteristic feature of the preindustrial town was the close contiguity of work and residence. Economic activity and domesticity often in fact shared the same building. "Except where the industry was small and noisy . . . this intimate connection of industrial and domestic life long remained normal."⁴ Even in the early industrial period, economic activity was carried on in the cottages of the workers--which together formed a kind of dispersed factory. Thus, industry and residence were interwoven into the fabric of the preindustrial and early industrial town alike.

New forms of energy and industrial technology required the concentration of workers in one location, and greater industrial specialization led to the areal segregation of industrial activities. The individual craftsman working in his own home became increasingly dependent upon the larger organization in most industries.

¹Henri Pirenne, Medieval Cities (Garden City, N.Y.: Anchor Books, 1962).

²Max Weber, The City trans. D. Martindale and G. Newirth (New York: Collins Books, 1962).

³Gideon Sjoberg, The Preindustrial City (Glencoe, Ill.: The Free Press, 1960).

⁴Lewis Mumford, The City in History (New York: Harcourt, Brace and World, 1961), p.284.

Weavers who worked in their own cottages found themselves dependent upon supplies of raw materials: as new technology was introduced, they were forced to rent the new equipment, thereby relinquishing ownership of the means of production. Ultimately the technical advantages of the eighteenth century made the factory system dominant.⁵

The site characteristics of particular zones of the city gave them advantages for particular types of industrial activity, and the morphology of the city as a whole became a mosaic of zones each of which associated with a particular industrial enterprise or group of related enterprises.

Even the dominant commercial areas began increasingly to require special situational characteristics, those with greatest accessibility to the mass of the urban population being especially favoured.

The areas which were not required either for industrial or commercial uses were left to residential uses and the locally oriented services which residential areas support. Thus, the city in its segregated aspects came to reflect the pluralistic nature of evolving industrial society.

Distinctions could even be made between one residential area and another. The concentration of economic activities resulting in economies of scale for the entrepreneur: these were compensated for by diseconomies borne by the worker.

"External" as well as "internal" economies accrued to the firm, writes Lampard, but not the diseconomies created by the firm's own operations. Some of the latter no doubt fell on other firms . . . others were transferred to the household which was now separated institutionally as well as spatially from the place

⁵James Beshers, Urban Social Structure (Glencoe, Ill.: Free Press, 1962), p. 72.

of work.⁶

The ability to bear these diseconomies varied with the income of the worker, a fact which has affected considerations of the theoretical basis of the journey to work in current writings. In the early industrial era, when the millhand's home was still adjacent to his place of work, his long working day was not unnecessarily attenuated by time spent in the journey to work, nor his low wage effectively diminished by the cost of travelling to work. In fact, the transportation technology of the time precluded the location of residence beyond a reasonable walking distance from work. His employer on the other hand was able to avoid the unpleasant environment created by his own industrial activity by residing at some distance away and travelling each day to work by carriage.

The introduction of modes of mass transportation (the railroad and the streetcar) extended the advantage of residing at some distance from work down through the social spectrum. However, it was not until later that increased personal prosperity and a reduction of the working day extended this advantage to all workers, and decreased the validity of the purely economic determinant of the length of the journey to work. The widespread use of the automobile in more recent times has rendered even greater freedom to the worker in the location of residence with respect to his workplace.

⁶Eric E. Lampard, "Urbanization and Social Change", in Oscar Handlin and John Burchard (eds.), The Historian and the City (Boston: M.I.T. and Harvard University, 1963), pp. 225-247.

The Journey to Work as a Social Problem

In the modern metropolis, the costs of the journey to work are social as much as economic. "Estimates made for both the London central area and lower Manhattan indicate that the time spent in the journey to work lengthens the workday by a gross amount of almost 20 percent."⁷ Time spent in the journey to work does not produce economic gain and, moreover detracts from the time spent in leisure activities. It thus represents a social deficit which must be borne by society at large . . . and of which society is becoming increasingly aware. The President of the United States, in a list of domestic problems under consideration by his administration, gives high priority to that of cutting the commuter's travel time in the nation's congested urban centres.⁸

It is not surprising then that within this context, pioneer studies of the journey to work were concerned primarily with its costs to society.

One of the most influential studies which has considered the journey to work as a social problem is that of Liepman.⁹ The major contribution of this work is its analysis of the social and economic functions of the journey to work. Although alarmed by the increasing time spent in commuting in pre-war Britain and the consequent burdens placed upon an already overloaded public transportation system, Liepman was also aware of the benefits to society

⁷Howard S. Lapin, Structuring the Journey to Work, (Philadelphia: University of Pennsylvania Press, 1964), p. 14.

⁸Time (Canadian Edition), December 25, 1964, p.11.

⁹Kate Liepman, The Journey to Work, (London: Routledge and Kegan Paul, 1944).

implied by a highly mobile labour market.

She suggests that the causes of the journey to work are twofold. First, there are the topographic causes resulting from the spatial segregation of industrial, commercial, and residential areas in a burgeoning and relatively unplanned industrial society. Second, there are the social and economic causes which carry with them important benefits to employer and employee alike.

1. The economies of scale effected by modern industry require a large and varied labour force, which may be supplied, she maintains, only from an extensive labour catchment area. "Daily travelling by the workers has . . . become necessary to secure the concentration of labour in plants of the size demanded by technical and economic considerations."¹⁰
2. A highly mobile labour force requires that each worker should have access to alternative work places at which he may find employment.

The advantages accruing to the employer are that he may expand, reorganize, or relocate his plant without serious disruptions of his labour supply. The employee on the other hand has a greater choice of employment within the extended range of the daily journey to work brought about by public transport facilities of the ownership of a car.

However, it does not follow that large scale commuting is desirable in itself. The advantages for both employer and employee would still exist, maintains Liepman, were alternative work places brought within closer reach of each employed person in a

¹⁰Ibid., p.11.

regional pattern of distinct small towns about a central nucleus. This scheme, which recalls Ebenezer Howard's Welwyn Garden City and Letchworth, was influential in Britain's post-war New Towns Policy.

Although Liepman's study represented an important step towards the consideration of the pattern of work-trips as an important component of the structure of urban areas, her lack of regard for what she herself called topographic causes of the journey to work contributes little towards the viewpoint which will be taken in this study.

Later British writers added force to Liepman's argument by postulating the existence of labour-deficient and labour-surplus areas and by commenting on the power of certain areas to attract labour from very extensive catchment areas. Westergaard's¹¹ report of a study on commuting in the Greater London area suggested, for example, that "only the Central Area, and to a lesser extent the subsidiary centre depend for their labour supply on a widespread catchment area."¹² Unfortunately, the nature of the data used by Westergaard did not permit him to comment on the occupational groups which would be drawn long distances to the central areas, or to identify the residential zones from which they come. The existence of a complex system of surface and underground railways permits workers to commute to central London from as far away as fifty miles with comparative ease and speed. However, the prohibitive costs in travelling such distances would suggest that only higher

¹¹ John Westergaard, "Journeys to Work in the London Region", Town Planning Review, 28 (April, 1957), pp. 37-62.

¹² Ibid.

income workers are able to avail themselves of these services. In support of this view, Chaline¹³ has shown the existence of a belt of higher income workers on the outer fringes of the conurbation in what is often called the "stockbroker belt", taking advantage of the pleasant site characteristics of the dip-slope of the North Downs and the Chilterns.

Similarly, Westergaard's finding that those who live in the main and subsidiary centres of employment more often work near their homes than those who live elsewhere may provoke little surprise, but certainly leads one to question the occupation of those about whom this observation is made. The finding that the status of the County of London's day population is higher than that of its night population suggests that they may indeed be employed in the low income occupations.

The question which remains unanswered in the works of both Liepman and Westergaard is the nature of the equation between the social and economic, and the topographic determinants of the journey to work. Do those who both live and work in the London central area do so because they cannot afford a long journey to work or because the quality of residential accommodation available there is more appropriate to their earnings than that found in the outer suburbs?

However, both studies obliquely suggest a chorological division of urban areas which may contribute towards a potential geographical viewpoint. Westergaard's in particular would suggest the existence of four distinct types of urban area on the basis of

¹³C. Chaline, "Nouveaux Aspects de la Cité de Londres", Annales de Géographie, 70e. Année (1961), pp. 273-286.

their labour deficiency or abundance.

1. Self-sufficient labour markets in which the local residents are employed exclusively, there being no inflow from other areas.
2. Areas where the daily inflow and outflow of workers is in a state of balance. In this case, the number of residents who must find employment elsewhere is the same as the number of in-commuters.
3. Areas where the residential population is much greater than the available employment and therefore, the inflow greater than the outflow.
4. Areas where the available employment is much greater than the residential population and therefore the inflow greater than the outflow.

The Journey to Work as a Problem of Demography

What we have here then is evidently a problem of demography. Some parts of the city have a larger working population than a residential population, others a larger residential population than a working population. The journey to work is the link between such areas. Several writers have focussed on the areas themselves rather than on the links between them. Such a focus has been in large part determined by the nature of official statistics. For example, several studies originating from Sweden have attacked the problem through a chorological distinction between areas of labour abundance and of labour deficiency as a key to inter-city commuting.

Kant¹⁴ has suggested two different indices which may be employed to make such a distinction in quantitative terms, but in the last analysis such a distinction is after all between areas of economic activity and residential areas, and may thus be made on an intraurban scale, on a simple morphological basis. If a regionalization is to be of value at this scale, it must surely be based upon the identification of the labour catchment areas of particular workplaces or groups of workplaces.

Both Kant and Forbat have stressed in Migration in Sweden¹⁵ that more meaningful studies of work-residence relations would be forthcoming were information on the catchment areas of specific work places available from official statistics. The coarse-scale regionalization attempted by these writers leaves two questions unanswered. First, what is the importance of commuting within the areas considered? This is termed "pseudocommuting" according to Kant, but the distinction between this kind of commuting and commuting across administrative boundaries is not generically different. Second, the gross figures give no indication of the direction of commuting. Do for example the residents of a particular administrative division who find employment outside converge on a particular work zone or are they distributed throughout all the work zones in a random fashion?

The same criticism as may be levelled against Kant's

¹⁴ Edgar Kant, Suburbanization, Urban Sprawl and Commutation, "Migration in Sweden" (Lund: The Royal University, 1957), pp. 244-309 and: Edgar Kant, "Zur Frage der Inneren Gliederung der Stadt", I.G.U. Symposium in Urban Geography (Lund: The Royal University, 1962), pp. 321-383.

¹⁵ Op. cit.

work applies also to the various studies of day and night populations of American cities.¹⁶ In all the functional aspects are not apparent except by inference, and the picture presented is a static one. This is a criticism which may be levelled against all work in which the plotting of populations per se is dominant. The inadequacies of static cartography have been pointed out by Hagerstrand.

As the human geographer produces his dot maps of population distribution he is fully aware that this method, however useful, gives an inadequate impression of the population in geographical space. The dot maps give a static picture, as if each individual has his given place. In reality, the reverse is the most obvious feature of the population--fluidity. Each individual has a moving pattern of his own, with turning points at his home, his place of work and his shopping centre during the week, and his recreation grounds on a holiday or Sunday.¹⁷

This is a problem which is at the root of much geographical methodology, not least that of regional subdivision. Geographers have traditionally distinguished between two different kinds of region:

1. The region which has homogeneous characteristics among certain specified components. These may include its geology, natural vegetation, soils--or in the case of the present study, the nature of its residential labour force or the fact of its hav-

¹⁶For example, see G. W. Breese, The Daytime Population of the Central Business District of Chicago (Chicago: University of Chicago Press, 1949); F. S. Chapin and P. H. Stewart, "Population Densities Around the Clock", The American City (October, 1963); D. L. Foley, "Urban Daytime Populations--A Field for Demographic-Ecological Research", Social Forces 32 (May, 1954), pp. 323-330; R. C. Schmitt, "Estimating Daytime Populations", Journal of the A.I.P., 22 (Spring, 1956), pp. 83-85.

¹⁷Torsten Hagerstrand, "Migration and Area", Migration in Sweden (Lund: The Royal University, 1957), pp. 27-159.

ing a labour deficiency or surplus.

2. The region which is given unity by virtue of the fact that it is functionally linked to a particular node--the hinterland, umland, or in this present case, the labour catchment area.

The analysis of this latter type of region is more demanding, but in the end is likely to be more fruitful for the type of study in hand. Even here, however, there is a problem since regions of this kind may either be distinguished on the basis of desire-lines which encompass the entire area of study, or points which have some functional relationship to a specified node. Into the former category would fall the flow-lines of commodities to a port or industrial city, the bus-routes beloved of a generation of British urban geographers, or origin-destination lines of commuters. The latter would include the sources of the commodities used in an industrial centre, or the origins of commuters for a specified destination.

Conflux and Dispersion as Concepts

The terms conflux and dispersion occur fairly frequently in the literature and may have a potential as tools which has not been fully realized. In particular they would seem to provide the link which is missing from purely demographic studies. The terms were coined by Liepman¹⁸ who used them as capsule descriptions of the gross movements of commuters in an urbanized area. Residential areas are areas from which people disperse on journeys of different lengths towards workplaces of different types and

¹⁸Op. cit.

locations. In the simplest terms, they may be regarded as zones of dispersion, a term coined by Vance.¹⁹ But the term implies something more than a simple description of the fact that there is net outflow, it implies also a sense of direction. One may speak of a particular residential area being a zone of dispersion towards one, two, three or more places of work. The daily movements of population described by the term, when viewed from the place of work itself are movements of conflux and the latter may be regarded as a zone of conflux.²⁰ Here too is the implication of direction since a particular place of work may be seen as a zone of conflux from one, two, three or more residential areas.

If it could be ascertained that a particular residential area supplied workers to several distinct places of work this might be found to be due to; 1) the differing nature of these places of work, and 2) the differing nature of the residents themselves.

These differences could then be related to the occupational category, sex, mode of transportation used, etc. for the residents involved. A more meaningful understanding of the theoretical basis of commuting patterns might in fact arise from the disaggregation of movements of dispersion.

Similarly, if it were found that a specific place of work drew its labour force from several residential areas association might be found between the intervening distance, the qualitative differences between the residential areas and the occupational

¹⁹James E. Vance, "Labor-Shed, Employment Field, and Dynamic Analysis in Urban Geography", Economic Geography 36. (July, 1960), pp. 189-220.

²⁰Ibid.

category, sex, mode of transportation, etc. of the workers.

Using the concept it is possible to bridge the gap between the demographic approach which distinguishes areas by virtue of their homogeneity and an approach which recognizes areas which are functionally linked to a specific node. Such an approach has recently been adopted by Vance²¹ in the work referred to above. The major value of this work lies in its development of a theoretical description of labour catchment areas based on an evolutionary process through changes in transportation technology.

To summarize this sequence, Vance stresses that the relationship between work and residence may be explained only in terms of its historical development. He postulates an original zone of conflux as the initial site of an urban area. It is a site above all which contains certain economic advantages--because of the location of a resource, a source of energy, or facilities which encourage the gathering together of resources for processing and exchange. As the economic activity in question increases so also does the labour force until it can no longer be accommodated at the initial site. At this stage the community divides into two distinct zones, a zone in which work is performed (the zone of conflux) and another in which those who perform the work reside (the zones of dispersion). The presence of a growing population itself attracts further industry and commerce, which unable now to locate at the initial zone of conflux, locates at the periphery. The effect is to increase to total employment of the area and to provide for secondary zones of conflux at the periphery. The expansion of employment, Vance points out, in fact takes place in

²¹Ibid.

two ways: the expansion of the CBD through the accretion of adjoining areas, and the external reproduction of manufacturing and transportation facilities at the periphery. Improvements in transportation technology themselves have the effect of widening potential labour catchment areas and maintaining the dominance of the CBD when transportation focusses upon this zone.

The changing interaction between the zones of conflux and of dispersion, Vance proposes, may be understood in terms of a simple spatial model which describes changes in labour sheds and employment fields through changes in the transportation technology. These two terms require some definition:

1. Labour shed is defined by Vance as the area from which a particular place of work derives its labour force. The obvious analogy with watersheds may be felt to lead to some confusion and the term "labour catchment area" is felt by the present writer to express this idea more exactly.
2. Employment field is a term coined by Vance to define the work zone to which workers come from a specific residential zone.

Vance's model of urban growth consists of an hexagonal grid of zones, the dimensions of which are those of a reasonable daily journey to work on foot or on horseback. Each is thus a potential labour-shed or employment field in the initial stages of transportation technology.

The coming of the railway and the street railway results in an expansion of both labour shed and employment field through the linking of contiguous zones in a linear fashion. The most recent phase of transportation technology, that characterized by widespread use of the automobile, sees a return to the initial

situation, modified only by an extended range to the daily journey to work. "By breaking down the compartmentalized organization within the complex", writes Vance, "automobile transportation has made the geographical city an intimately tied economic and functional agglomeration".²²

However, this view assumed that all members of the population and of the labour force take maximum advantage of each successive stage of transportation technology upon its introduction. In the present city it may well be that all three stages, foot, streetcar and railroad, and automobile, are represented by different sectors of the work force, and that consequently different residential areas have different connotations for workers of different socio-economic status. In this respect, Vance's study may be criticized for placing undue emphasis upon distance as a variable and less upon the evolving structure of the city itself.

For this reason, Vance's study may perhaps be most appropriately placed within the context of the work of those sociologists who were influenced by the ecological school of the University of Chicago, and for whom too distance was the dominant variable. Vance's statement that, "the areal structure of economic activity along with the dependent urban areal structure would result from two irreducible variables, 1) absolute distance from an initial or satellitic zone of conflux, and 2) transportation technology",²³ may be compared with a view expressed by Amos Hawley,²⁴ one of the chief spokesmen of this school. The latter sug-

²² Ibid.

²³ Ibid.

²⁴ Amos Hawley, Human Ecology (New York: Ronald Press, 1950), especially Chapter 13.

gested that the distributional patterns are the result of the interdependence of man's activities within the limitations set by the varying character of space and the friction of distance. If anything, Vance places more stress upon the latter than upon the former.

The Journey to Work as a Problem of Human Ecology

The ecological approach towards the journey to work is in many ways the most promising for a possible geographical point of view.

This school, which had its origins in the Chicago school of sociology in the 1930's had as its aim, "to discover the principles and factors involved in the changing patterns of spatial arrangement of population and institutions resulting from the interplay of living beings in a continuously changing culture."²⁵ The major principle of the ecologists is that man exists in a competitive environment (the analogy with Darwinism is apparent) in which adjustments are made between individuals and institutions such that the city represents a closely inter-related functional whole. "In spite of its errors, ecology still is the closest we have come to a systematic theory of the city."²⁶ Studies of the journey to work which may be placed in the ecological context have generally, like that of Vance, assumed the pervading influence of the length of the journey to work.

²⁵ R. D. McKenzie, "Human Ecology", Encyclopaedia of the Social Sciences (New York: Macmillan, 1931). Quoted by Leonard Reissman, The Urban Process (Glencoe, Ill.: The Free Press, 1964), p.93.

²⁶ Leonard Reissman, loc cit.

An early study by Carrol²⁷ employed hypotheses largely based upon Zipf's principle of least effort.²⁸ These hypotheses suggested that:

1. "Forces are in operation tending to minimize distances between home and place of work", and
2. "the concentrative effect of these forces is an important factor conditioning total residential arrangement of urban populations.

The findings of a previous study had indicated that, "the bulk of factory workers live close to work, and beyond two or three miles the proportion of factory workers decrease as distance from the factory increases".²⁹ The findings of both studies were summarized into three broad generalizations:

1. "total urban area population is residentially distributed about the central business district of the principal city",
2. "residential distribution of persons employed in central districts tends to approximate that of the entire urban population", and
3. "residences of persons employed in off-center work-places are concentrated most heavily in the immediate vicinity of the place of work."³⁰

²⁷J. Douglas Carrol, "The Relations of Homes to Workplaces and the Spatial Pattern of Cities", Social Forces 30 (March, 1952), pp. 271-282.

²⁸G. K. Zipf, Human Behaviour and the Principle of Least Effort (Cambridge, Mass.: Edison Wesley Press, 1949).

²⁹John Douglas Carrol, "Some Aspects of the Home-Work Relationships of Industrial Workers", Land Economics, 25 (November, 1949), pp. 414-422.

³⁰John Douglas Carrol, op. cit. (1952).

The resulting pattern of urban spatial structure is one that occurs frequently in the ecological literature--that of dominance and sub-dominance. The pattern is one in which, ". . . population and the residences of central district employees are arranged about the core areas in a constantly declining density (and) off-center work concentrations, on the other hand, have residences grouped about them so that they seem to resemble nucleated sub-clusters within the larger whole."³¹

Schnore³² has pointed out with some justification that the ability to minimize effort varies among the population: it has been suggested earlier that the ability to meet the diseconomies transferred from the plant to the worker by the necessity of a journey to work are borne with varying ease by different sectors of the labour force. While the lower income manual worker might find it necessary to minimize the journey to work, the higher income white-collar worker has presumably greater ability to meet the costs of commuting from further afield.

This returns of course to the problem stressed earlier of disentangling the costs of the journey to work per se from the structural features of the city which would encourage the settlement of low income workers close to zones of employment.

Beverly Duncan³³ has shown in Chicago that work-residence separation is higher for "white-collar" than for manual workers

³¹ Ibid.

³² Leo Schnore, "The Separation of Home from Work: A Problem for Human Ecology", Social Forces 32 (May, 1954), pp. 336-343.

³³ Beverly Duncan, "Factors in Work-Residence Separation: Wage and Salary Workers, Chicago, 1951", American Sociological Review (February, 1956), pp. 48-56.

and that:

1. the degree of work-residence separation varies directly with the socioeconomic level of the worker,
2. the degree of work-residence separation is directly related to the centralization of workplaces, and consequently,
3. work-residence separation is greatest for workers of high socioeconomic status with centralized workplaces.

However, the question remains unanswered as to whether this is the result of those in low wage occupations being unable to meet the higher costs of the journey to work, especially if employed in off-center workplaces with difficult public transport connections, or of urban structure itself.

Whiting³⁴ has shown that, following the relocation of Chicago families from the central area (actually the so-called "black belt") to scattered public housing, the affinity for workplaces within or near the loop remained. This was particularly apparent at one public housing project located some distance from downtown, to which more than 80 percent of the tenants had to move ten miles or more, but in which the change of jobs was slight.

What is in operation in this case is evidently a set of locational "preferences" which are independent of the distance from the place of work. The case of the public housing tenants in Chicago may be explained by their apparent failure to find employment close to their new homes--a fact that is not surprising when the random processes which led to the location of public hous-

³⁴R. F. Whiting, "Home-to-Work Relationships of Workers Living in Public Housing Projects in Chicago", Land Economics 28 (August, 1952), pp. 283-290.

ing in that city are considered.³⁵ But it does bring the analysis of the journey to work solely in terms of cost and distance into question.

Workers locational preferences are not a unique and interdependent portion of the totality of the workers' labour-market preferences. A related set of propensities are those involving worker's choices between labour and leisure.³⁶

Proximity to shopping facilities, to parks and other recreational facilities, and the operation of traditional patterns of residential occupance must all be taken into question. Even in the USSR, where the possibilities of the relocation of population according to rational ideas of space economy would be expected to be at a maximum, Lyubovnyy³⁷ reports that in the industrial city of Kolomna, different factories, and even different departments within the same factory, may be staffed with workers from completely different residential villages, some of which are traditional sources of labour for a particular industrial operation.

It would thus seem that in addition to the consideration of distance as a variable other factors are involved including: 1) the positive or negative effects of planning, 2) the operation of bases of preference other than proximity to work, and 3) what might be termed "traditional" patterns of work and residence. In this latter case, by a process similar to that of industrial iner-

³⁵ Martin Mayerson and Edward C. Banfield, Politics, Planning and the Public Interest (Glencoe, Ill.: The Free Press, 1955).

³⁶ William Goldner, "Spatial and Locational Aspects of Metropolitan Labour Markets", American Economic Review 45 (1955), pp. 113-128.

³⁷ V. Ya. Lyubovnyy, "Some Questions Relating to the Formation of Urban Populations", Soviet Geography 11 (December, 1960), pp. 51-57.

tia, the linkages between certain residential areas and workplaces persist, even though the causal factors have ceased to have relevance.

Towards a Theory of the Journey to Work

From the above discussion, it seems clear that the research methods used depend upon the researcher's a priori conceptualization of urban structure. It may be asked with some justification whether the process of conceptualization is invalidated by the very complexity of the variables involved.

Liepman,³⁸ Westergaard,³⁹ and Thompson⁴⁰ in Britain were absolved from the responsibility of describing a general theory of commuting. Their task at that time was after all simply to draw attention to the need for planning in order to minimize the journey to work in a burgeoning urban-industrial society. Perhaps closer to the geographer's concern were the attempts of sociologists, particularly those with an ecological cast, to formulate a view of urban spatial structure in terms of the journey to work. Forces which tend to minimize and maximize the journey to work have been dealt with by Carrol⁴¹ and Schnore⁴² respectively, while among geographers, an ecological perspective has been adopted by Vance⁴³

³⁸ Kate Liepman, op. cit.

³⁹ John Westergaard, op. cit.

⁴⁰ Jean Thompson, "The Journey to Work--Some Social Implications", Town and Country Planning (November, 1950), pp. 441-446.

⁴¹ J. Douglas Carrol, op. cit.

⁴² Leo F. Schnore, op. cit.

⁴³ James E. Vance, op. cit.

in a sequential model of the changing pattern of labour shed and employment field through changes in transportations technology.

These latter studies, although intellectually more satisfying than the descriptive demographies of Kant,⁴⁴ Breese,⁴⁵ and Foley⁴⁶, take little or no account of the discrete variable of particular site characteristics which may be the result of planning, of certain amenity factors, or of established preferences. Yet such factors are the traditional concern of geographers and may be ignored only at the peril of formulating a theory of urban structure that has no relation to reality--a mathematical abstraction which is never expressed in bricks and mortar.

The attributes of a unit of residential space are determined not only by its physical site (its aspect, view, etc.) but by the succession of uses to which it has been put. These factors may be conveniently aggregated in to price it commands upon the open market. Involved in this also however are its situational characteristics, its linkages with certain amenities and with employment. These are essentially an aggregation of the moving pattern of its occupants, occurring in different forms, frequencies, and functions. The journey to work is a necessary, frequent, and recurrent movement, more necessary than the journey to the park, more frequent than the journey to the store, and recurrent where the journey to the hospital is not. If distance is important at all in determining residential preferences proximity

⁴⁴Edgar Kant, op. cit.

⁴⁵G. W. Breese, op. cit.

⁴⁶D. L. Foley, op. cit.

to work will surely be a prime situational determinant of residential location.

In essence, this present study attempts to assess the relative importance of a site factor (the cost of housing) and a situational factor (the cost of the journey to work). This is a task which has not been attempted to date.

1. The Causes of the Journey to Work

Liepman⁴⁷ and other British sociologists were concerned with the social and economic costs of work-travel for the individual and the ways in which work-travel itself could be minimized by planning. Although Liepman refers to the topographic causes of the journey to work, she makes no attempt either to define them in detail or to examine their effects. She recognizes, as do other British writers, that the journey to work is an inevitable concomitant of large concentrations of economic activity making use of economies of scale, and by a dispersed labour force with diverse occupational skills. From this early emphasis upon the causes of the journey to work, research diverged along two channels.

2. The Demographic Consequences of the Journey to Work

It was possible in the first case to distinguish between areas of labour supply and of labour demand in fairly gross terms. The availability of suitable census data encouraged research in these directions in Britain, Sweden, and some other European countries. This in turn led to the notion that some areas (those with very great labour needs) must draw labour from widespread catchment areas.

⁴⁷Kate Liepman, *op. cit.*

3. The Ecological Approach

This view fell on fruitful ground in Chicago where it was adapted by the human ecologists into a useful theory of urban spatial structure. Westergaard's⁴⁸ conclusion that the central area of London draws its labour supply from throughout the metropolitan area was formalized into Carrol's⁴⁹ views of urban spatial structure. According to this view, cities are eco-systems of functionally related parts. Within this system, central work concentrations and peripheral work concentrations assume a dominance and sub-dominance according to their respective abilities to draw labour from long distances. The causal mechanism for such a structure is seen as the desire to minimize the journey to work leading to a clustering of the labour force about workplaces. Further refinement was added by Schnore⁵⁰ and Duncan⁵¹ who suggested that the desire to minimize the journey to work is tempered by the workers' ability to meet the costs of work travel. Although this approach even now would appear to be the most fruitful, its deficiencies lie mainly in the limited number of variables it includes.

Descriptive and Explanatory Models

Recently, some approaches have been followed which would appear to give greater mathematical refinement than has been achieved

⁴⁸John Westergaard, op. cit.

⁴⁹J. Douglas Carrol, op. cit.

⁵⁰Leo F. Schnore, op. cit.

⁵¹Beverly Duncan, op. cit.

to date. These attempt to construct models which take account of several variables, both continuous and discrete.

1. Gravity and Potential Models

In the concepts of gravity and potential, a full account of which are given by Isard,⁵² the interaction between two zones is seen as varying directly with some function of their populations and inversely with some function of the intervening distance. Implied in this model is the frictional effect of distance which may only be accepted with some reservations in a limited intraurban context. Even if distance were found to exercise such an effect, the most proper question might then be not "how?" but "why?".

2. Probability Models

A recent modification of a basic gravity model has been developed by Taafe, Garner, and Yeates.⁵³ This model has been used with notable success to predict the spatial distribution of workers from a peripheral workplace in Chicago. In a static version of the Monte Carlo simulation of diffusion used by Hagerstrand,⁵⁴ these writers modify the initial P/d model by assigning a range of low or high probability factors to each residential zone on the basis of their location relative to that of the workplace in question. This procedure may be summed up in the statement that "the relation between distance and the probability of commuter origination

⁵²Walter Isard, Methods of Regional Analysis (Cambridge, Mass.: M.I.T., 1960), especially pp. 493-566.

⁵³Edward J. Taafe, Barry J. Garner, and Maurice H. Yeates, The Peripheral Journey to Work--A Geographic Consideration (Chicago: Northwestern University Press, 1963).

⁵⁴Torsten Hagerstrand, "On the Monte Carlo Simulation of Diffusion", Mimeo.

is not a continuous one".⁵⁵ This model has the advantage that, while predicting the distribution of workers with satisfying accuracy, it yet enables statements to be made about the effect of such factors as the race, occupation, and income of workers and the proximity to alternative sources of employment on the residential patterns, through a comparison of the model and reality.

3. Systems of Work-Trips

Howard Lapin⁵⁶ has suggested an empirical method which may be of some value in that it enables areas of residential segregation to be identified. Systems of trips may be described in the method suggested by this writer in terms of an origin-destination matrix from which a single algebraic expression may be derived to describe the relationship between the length of trip and deviations from the average proportion of trips to the destination. In a pilot study made in Philadelphia, "it was inferred that points located above the curve (describing this algebraic expression) corresponded with a close matching of the work capabilities of the resident workers with job opportunities in the destination zone, together with at least adequate transportation service".⁵⁷

In the two works mentioned above it is felt that methods have been achieved which enable generalizations to be made about both work-residence relations and urban structure without the necessity of an a priori conceptualization of the latter. Essentially empirical methods such as these are thought to accord more

⁵⁵Edward J. Taaffe et al., op. cit.

⁵⁶Howard S. Lapin, op. cit.

⁵⁷Ibid., p.136.

with the traditional methods of geographers than methods placed in an ecological frame.

The Approach of the Present Study Towards the Problem

In the present study, the journey to work is not seen as a prime cause of urban spatial structure. Patterns of commuting are rather superimposed upon an existing suburban structure, the determinant of which lies in the city's growth sequence over a unique site. The first task then will be to identify the present patterns of work and residence in terms of both functional segregation, and the linkages between functionally segregated zones. This will be done through:

1. A consideration of the distribution of employment and residence in the city in gross terms.
2. A consideration of the variation in the length of the journey to work.
3. The development of a descriptive model of commuting patterns for Vancouver for each major occupational group.

The second task will then be the evaluation of the views put forward by other writers on the journey to work in the light of the findings for Vancouver. In particular, the costs of work-travel as a factor tending to minimize the journey to work will be weighed against the varying costs of residential space in the city.

Finally, some attempt will be made to plot the co-ordinates of the labour catchment areas of both central and peripheral workplaces and to ascertain from these which of the two above-

mentioned cost factors is a stronger determinant of residential location.

CHAPTER III

PATTERNS OF WORK AND RESIDENCE IN VANCOUVER

In this chapter, consideration will be given to the distributional patterns of employment and of residence in Vancouver and the linkages between them. The latter will be considered through a discussion of the variation observed in the mean length of the journey to work, and the development of a model of commuting patterns for Vancouver.

Residential Distribution of the Labour Force

Fig. 1 indicates that the residential labour force is fairly evenly distributed throughout the area of study. There is a slightly marked local clustering in the areas of greatest employment opportunities (especially the Central Area and to a lesser extent the North Arm of the Fraser) which would perhaps indicate greater pressures on residential land in these areas.

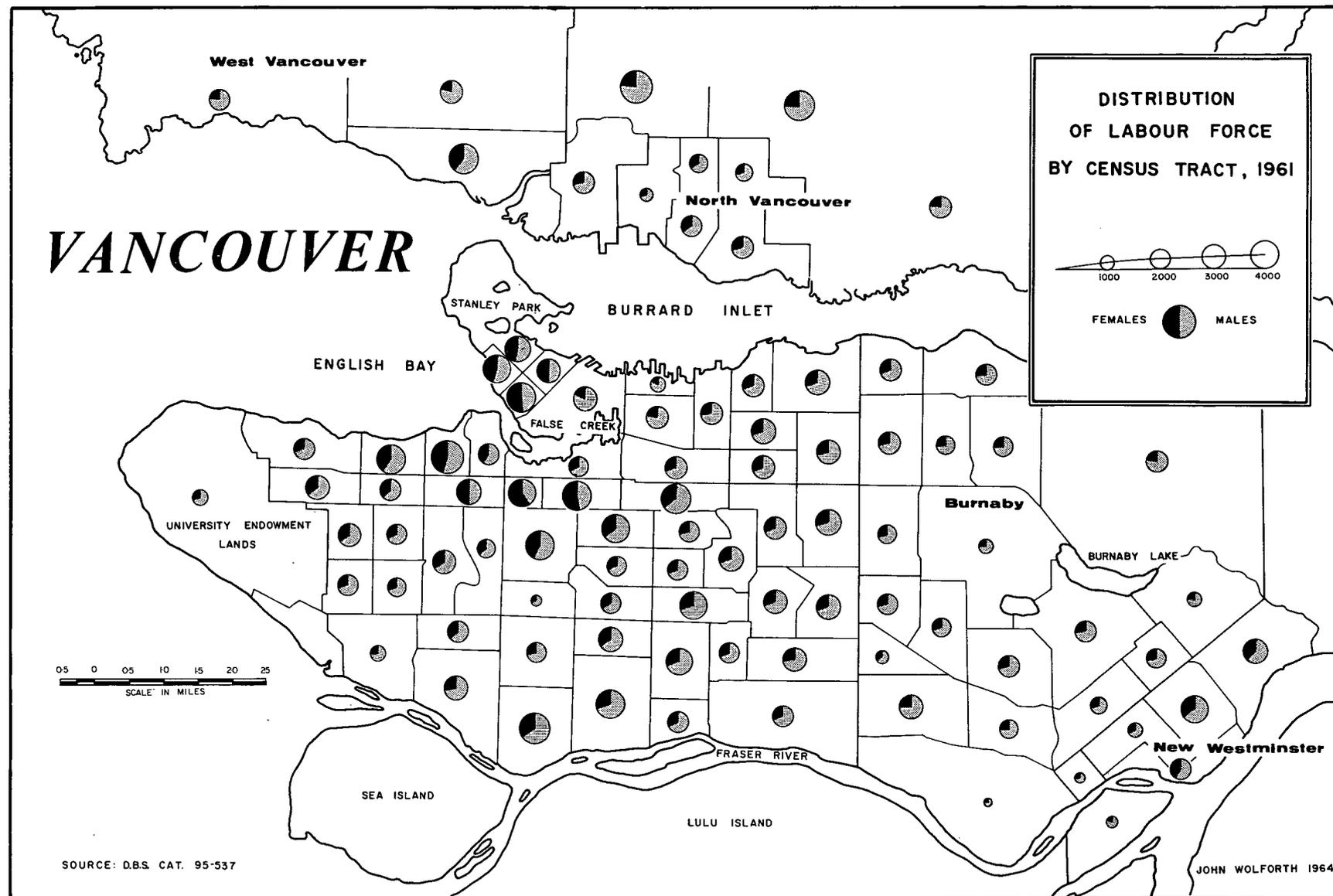
Of greater significance however, is the larger proportion of females in the labour force in the areas adjacent to the Central Area, although not in the Central Area itself. This raises questions concerning the occupations of females residing in these areas, and their mode of transportation in getting to work.

Residential Segregation of Occupational Groups

In Fig. 2, it is apparent that of these areas, the West End¹ has a predominant proportion of clerical workers. Another

¹The West End in the area between the downtown and Stanley Park.

FIGURE 1**RESIDENTIAL DISTRIBUTION OF THE LABOUR FORCE, VANCOUVER, 1961**



study² has indicated that this is not an accidental correspondence: the West End is indeed an area favoured by usually single girls employed in clerical occupations. Since this is a class of worker which rarely has access to automobiles, the contiguity of work and residence is preferred. This does not apply to other classes of worker shown in Fig. 2. The concentration of managers on Point Grey and especially towards Southwest Marine Drive would seem to be related more to the greater amenities offered by these areas, while the concentration of industrial workers in the eastern parts of the City of Vancouver may perhaps be related either to the cheaper housing available in these areas, or to the proximity to employment.

The above account raises more questions than it answers. Subsequent paragraphs will attempt to provide some of the answers to these questions.

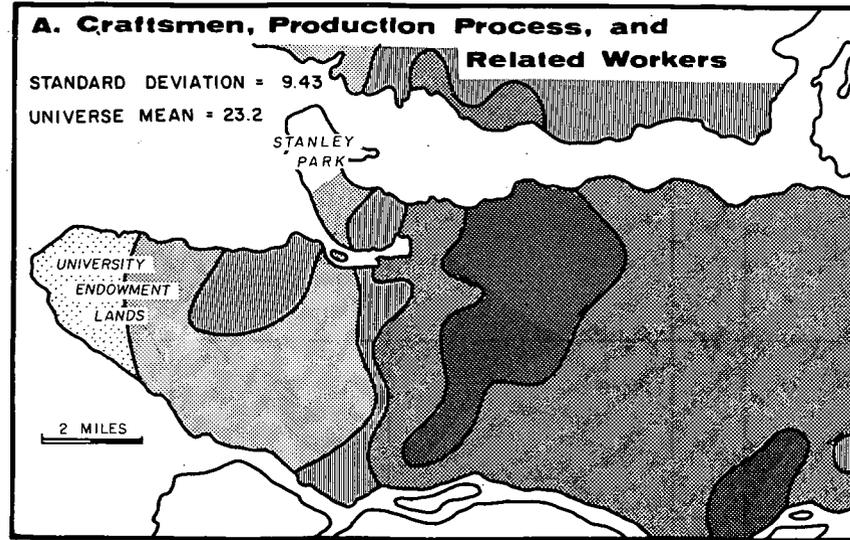
Variation in the Length of the Journey to Work

The problems concerning the linkages between residential areas and places of work may be approached through an analysis of variation in the mean length of the journey to work. Variation may be ascribed to the attributes of the worker, or to the attributes of his workplace. The attributes of the worker which may be isolated are 1) the location of residence, 2) the occupation, and 3) the sex and marital status of the worker.

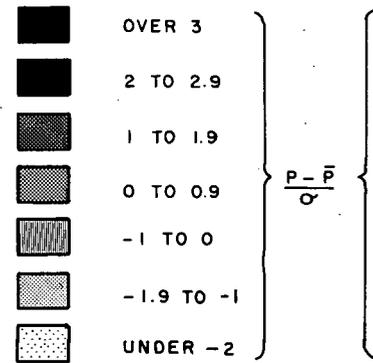
²Ann McAfee, Residences on the Margins of the Urban Core: A Case Study of the West End, Vancouver, B.C. (Unpublished M.A. thesis, Department of Geography, University of B.C., 1965).

FIGURE 2

**RESIDENTIAL SEGREGATION OF THREE MAJOR OCCUPATIONAL GROUPS, VAN-
COUVER, 1961**



DISTRIBUTION OF THREE CATEGORIES OF THE VANCOUVER LABOUR FORCE (NORMALIZED DATA)

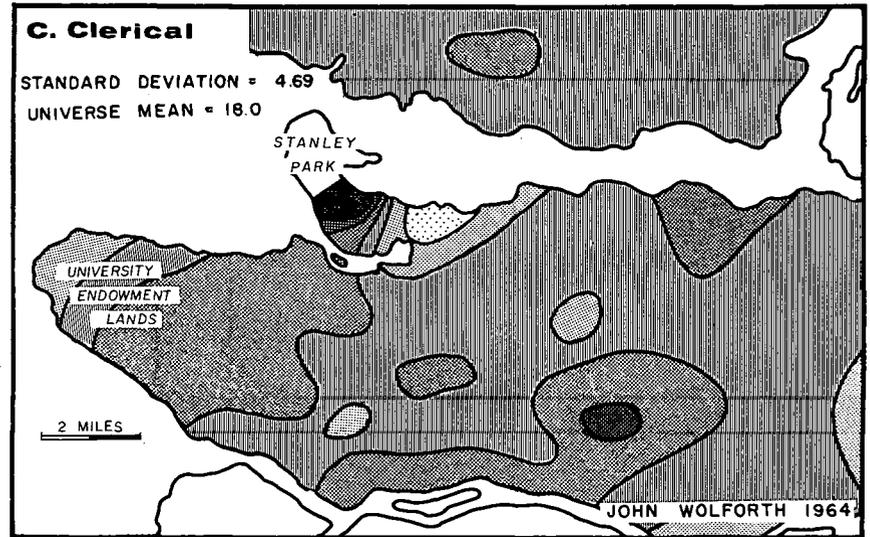
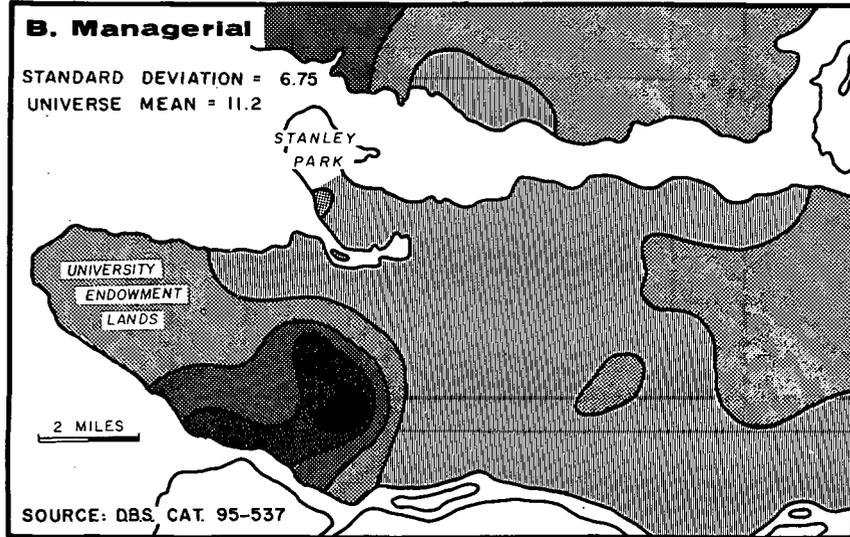


WHERE:

P = % OF WORKFORCE IN GIVEN CATEGORY IN CENSUS TRACT

\bar{P} = UNIVERSE MEAN FOR GIVEN CATEGORY

σ = STANDARD DEVIATION



The attributes of the workplace are 1) its location, 2) the type of economic activity carried on, and 3) the number of employees on the payroll.³

Variation According to Location of Residence

It is observed that variation occurs in the mean length of the journey to work for workers residing in different parts of the city. This areal variation does not correspond to areal differences in socioeconomic status. Neither does it increase with the distance from the central area, as would be expected if all workers were employed downtown. It does, however, seem to be affected by proximity to other sources of employment.

It was hypothesized then that the mean length of the journey to work varies areally with the proximity to employment opportunities.

An index is now required which will express the proximity to jobs in gross terms. Although the central area undoubtedly forms a major node of employment, a measure of distance (air-line, time taken to travel by car, etc.) from the central area will fail to take into account the pull of other employment nodes. For this purpose, two indices were considered.

³The source of data used in this chapter has been the Vancouver City Directory for 1963 from which a systematic sample of 1775 persons was taken, representing 0.78 percent of the residential labour force of Vancouver, Burnaby, North and West Vancouver, the area covered by the directory. The occupation, sex, marital status, employer, zone of residence and zone of employment were recorded for each person in the sample. For a partial sample of 825 persons, the air-line distance between work and residence was measured and information pertaining to the employer interpolated from Dun and Bradstreet and Contacts Influential. See Appendix A.

- 1) Hansen⁴ has suggested a measure of accessibility to employment which would seem to be of value. It has been found by Lakshmanan⁵ for example to correlate highly with residential growth rates in Baltimore. Hansen's measure of accessibility is given by:

$$A_1 = \frac{S_2}{T_{1-2}^x} + \frac{S_3}{T_{1-3}^x} + \frac{S_4}{T_{1-4}^x} \dots \dots \dots + \frac{S_n}{T_{1-n}^x}$$

- Where: A_1 = the accessibility of zone (1) to employment
 S_2 = the number of jobs in zone (2)
 T_{1-2} = the travel time between zones (1) and (2)
 x = an empirically derived exponent which describes the effect of travel time between zones

Since we are concerned primarily with the accessibility to work in general rather than by some specified mode of transportation, implied in the Hansen model by the term T^x , the similar but more "neutral" potential model will be used.

- 2) In the potential model, a full account of which are given by Isard,⁶ accessibility to employment of each residential zone is given by:

⁴W. G. Hansen, "How Accessibility Shapes Land Use", Special Issue of the Journal of the American Institute of Planners (May, 1959), pp. 73-76.

⁵T. R. Lakshmanan, "An Approach to the Analysis of Intraurban Location Applied to the Baltimore Region", Economic Geography, 40 (October, 1964), pp. 348-370.

⁶Walter Isard, Methods of Regional Analysis (Cambridge, Mass.: M.I.T., 1960), pp. 493-566.

$$A_1 = \frac{S_1}{1} + \frac{S_2}{D_{1-2}} + \frac{S_3}{D_{1-3}} + \dots + \frac{S_n}{D_{1-n}}$$

Where, A_1 = the accessibility of zone (1) to employment

S_1 = the number of jobs on zone (1)

D_{1-2} = the straight line distance between zones (1)
and (2)

In practice, employment within the 87 traffic zones⁷ was grouped at fifteen control points, each at the approximate centre of gravity of employment in each aggregated group of zones. The potential was computed for each of these control points: distances were measured along straight lines between the points except where a journey would involve crossing a body of water, in which case the distance was measured across the nearest bridge. Isolines in equi-potential in jobs per mile were now constructed upon the fifteen control points (fig. 3). It will be seen in this that the accessibility gradient is steep close to the Central Area, becomes more shallow towards the periphery and especially where there are areas of alternative employment (the North Arm of the Fraser, and New Westminster).

It could now be hypothesized that the mean work-residence separation of workers in each residential zone varies inversely with the accessibility to employment of that zone. The regression line (fig. 4) indicates that this hypothesis holds although the correlation is far from close. This indicates the following tendencies:

⁷See Appendix B.

FIGURE 3

EMPLOYMENT IN VANCOUVER BY TRAFFIC ZONE, 1963, WITH ISOLINES OF
EQUIPOTENTIAL IN JOBS PER MILE

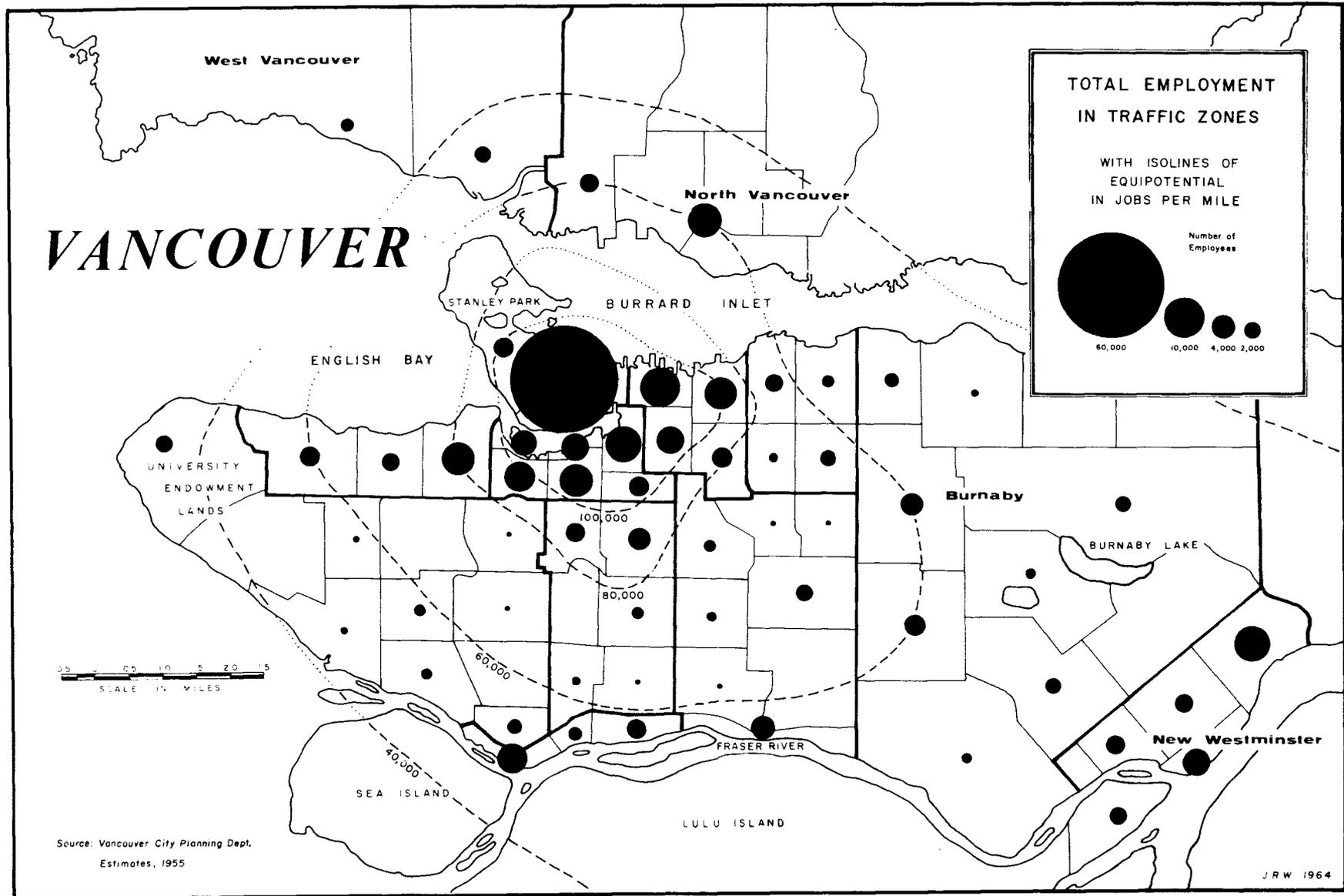
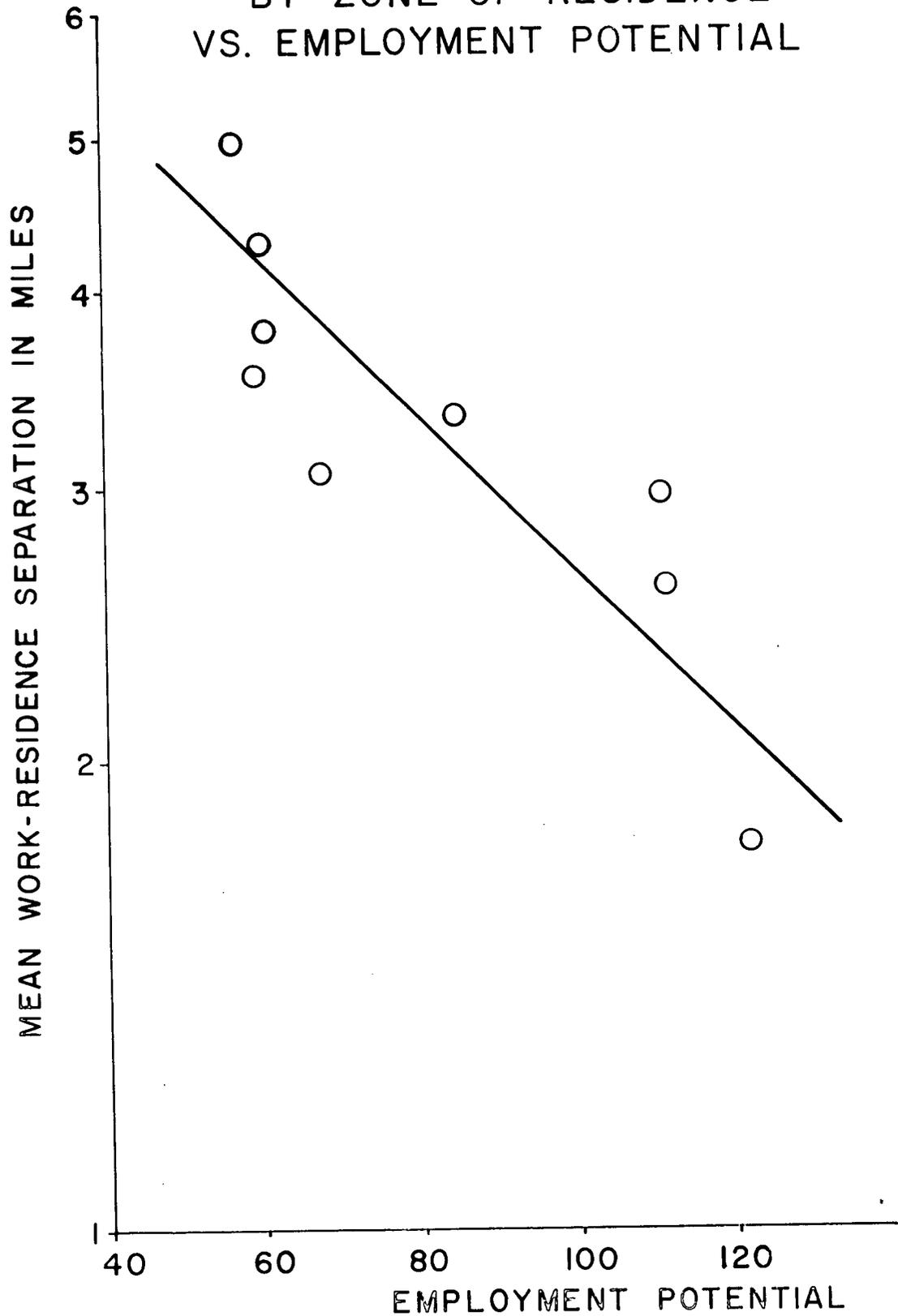


FIGURE 4

**RELATIONSHIP BETWEEN MEAN DISTANCE TRAVELLED TO WORK AND EMPLOY-
MENT POTENTIAL, VANCOUVER, 1963**

MEAN WORK-RESIDENCE SEPARATION
BY ZONE OF RESIDENCE
VS. EMPLOYMENT POTENTIAL



- 1) Since the labour force is residentially dispersed the distance travelled to work is a function of the concentration of employment opportunities. Zoning policies in Vancouver have tended to further the concentration of employment. If a short journey to work were seen as a benefit, it could be achieved by dispersing the employment opportunities. Despite the views of Liepman⁸ and others, it is doubtful whether this is in fact a benefit which should be brought about by planning in a city the size of Vancouver and with a large proportion of car owners.
- 2) No zone of the city is completely self-sufficient in labour. In each there is a proportion of workers who find employment elsewhere, although the mean distance travelled to work by all employed residents decreases toward employment concentrations.

Variation According to Location of Workplace

The most highly concentrated employment is of course in the Central Area and thus workers are drawn here, it would seem, from a city-wide distribution. This will be examined in more detail at a later stage, but it is possible to point out at least that Central Area workers on the average travel further to work than those employed in other parts of the city (Table I). These results support those of Beverly Duncan⁹ for Chicago, which are presented for purposes of comparison. The Vancouver results would of course be increased somewhat were values for workers

⁸Kate Liepman, The Journey to Work (London: Routledge and Kegan Paul, 1944).

⁹Beverly Duncan, op.cit.

from outside the immediate area of study included.

Table I Mean Work-Residence Separation by Place of Employment

City	Central Area	Outside Central Area
Vancouver, 1963 ^a	4.0 miles	3.4 miles
Chicago, 1951 ^b	6.6 miles	4.0 miles

^aVancouver City Directory Sample.

^bBeverly Duncan, op. cit.

It has also been suggested by Beverly Duncan¹⁰ that there is variation in mean work-residence separation by socioeconomic status. This however was not found to be the case in Vancouver, when tested at the same level of aggregation.

Variation by Socioeconomic Status

In Chicago, the city upon which Duncan based her research, variation in the mean length of the journey to work with socioeconomic status may be the result of Chicago's urban structure. This city is after all the home of the famous "concentric zone theory" of urban structure. White-collar workers may be expected to travel long distances to work since the white collar residential areas are largely outlying suburbs. It is significant that in Vancouver both white-collar and manual workers on the average travel the same distance to work (Table II).

Table II Mean Work-Residence Separation by Occupational Group

City	Manual Workers	"White-Collar"
Vancouver, 1963 ^a	3.9 miles	3.9 miles
Chicago, 1951 ^b	3.9 miles	5.7 miles

^aVancouver City Directory Sample.

^bBeverly Duncan, op. cit.

¹⁰Ibid.

It may be of course that in a period of twelve years an increase in automobile ownership has reduced the "economic" limitations placed upon the length of the journey to work. Research carried out in Chicago at the present time might indeed show less variation than was shown in 1951. As Reeder points out, "the rather widespread ownership of the automobile, and its use as the major vehicle of transportation in the daily journey to work appears to render greater flexibility to the breadwinner with regard to the location of residence in terms of his place of work."¹¹

A more detailed analysis suggests, however, that variation not revealed in the gross means does in fact occur. It was hypothesized that work-residence separation does indeed (as suggested by Duncan¹²) vary directly with the socio-economic status of the worker, and (as has already been suggested) inversely with the employment potential of the zone in which he resides. This hypothesis was now tested by standard correlation and regression procedures, for both "white-collar" and manual workers, with the results shown in Table III.2.

Variation in the length of the journey to work is greater among manual than among white-collar workers; most white collar workers travel about 4 miles to work while, although for manual workers the mean is the same, some have much shorter distances to go to work and others much longer. For manual workers, there is no correlation between the length of the journey to work and

¹¹L. G. Reeder, "Social Differentials in Modes of Travel, Time and Costs in the Journey to Work", American Sociological Review, 21 (February, 1956), pp. 56-63.

¹²Beverly Duncan, op. cit.

Table III Correlation Coefficients; Work-Residence Separation, Socioeconomic Index and Employment Potential, White-Collar and Manual Workers, Vancouver, 1963^a

Occupational Group	W-R ^b	σ^c	r_{xy}^d	F ^e	r_{xz}^f	F ^e
White-Collar ^g	3.9	2.5	-0.35	43.34	0.23	14.61
Manual	3.9	4.5	-0.31	35.71	-	-

^aThe index of socioeconomic status used was that suggested in A. J. Reiss, Occupations and Social Status (Glencoe, Ill.: The Free Press, 1961). The scale of indices presented here represents an extension of the much-used North-Hatt Prestige Scale. It would have, of course, been preferable to use a Canadian scale for the present study, but the only one known to the writer (Bernard Blisshen, "The Construction and Use of an Occupational Class Scale", in Canadian Society (Glencoe, Ill.: The Free Press, 1961) contains only a partial list of occupations and is therefore less suitable for present purposes. However, as might be expected, the correlation between the Canadian and American scales is high.

^bW-R is the mean work residence separation obtained from analysis of the Vancouver City Directory sample.

^c σ is the standard deviation.

^d r_{xy} is the correlation coefficient between the log of work-residence separation and employment potential (i.e. accessibility to employment in labour market).

^eF shows F-ratios. Values do not differ significantly from 0 at the 0.01 level: degrees of freedom are 1 and 359, and 1 and 229 for white-collar and manual workers respectively.

^f r_{xz} is the correlation coefficient between the log of work-residence separation and socioeconomic index of the worker.

^gthe regression line for white-collar workers is:

$$\text{Log (W-R)} = -0.0136y + 0.0105z + 3.669$$

the worker's socioeconomic level, although there is between the length of his journey to work and the employment potential of his residential zone. For white-collar workers, the correlation between the length of the journey to work and the worker's socioeconomic level is low, but statistically significant; in effect this represents the tendency for workers in this occupational group to minimize the length of the journey to work with increasing em-

ployment potential and with decreasing socioeconomic level.

Even were a labour force of diverse occupations residentially distributed in a random fashion, and employment opportunities similarly distributed, there would be variation in the length of the journey to work by virtue of the number of opportunities in each occupational category. When the labourer changes jobs, he is likely to be able to find suitable employment close to home, a skilled operative less so, the professional worker least of all. As Goldner¹³ points out, nuclear physicists do not keep cyclotrons in their basements! There is in fact a hierarchy of job opportunities which has strong spatial connotations: even in a residentially homogeneous situation, a longer journey to work is to be expected from those whose skills are specialized. Add the fact of the concentration of economic activities, and the journey to work will be yet further extended. There is certainly no clear indication of variation in the length of the journey to work with socioeconomic status.

Variation According to Type of Workplace

Some economic activities are more concentrated than others, particularly those which are oriented towards specific site advantages or reap the benefits of areal association with similar or related activities. Typically, industrial activities are concentrated, not only because of their demand for transportation facilities, but because of zoning policies. Retail trade activities, on the other hand, are relatively dispersed in order

¹³William Goldner, "Spatial and Locational Aspects of Metropolitan Labour Markets", American Economic Review, 45 (1955), pp. 113-128.

to serve a dispersed residential population.

The mean work-residence separation for employees of industrial plants is consequently greater than that for employees of retail stores. Wholesale trade establishments fall between these two extremes, but the fact that the number of workers in wholesale trade is comparatively small reduced the validity of this result (Table IV).

Table IV Mean Work-Residence Separation by Type of Industry^a

Industry	Work-Residence Separation
MANUFACTURING	
Food Industries	4.1 miles
Forest Industries	4.1 miles
Metal Industries	4.2 miles
TRANSPORT AND COMMUNICATIONS	4.7 miles
WHOLESALE TRADE	3.6 miles
RETAIL TRADE	3.4 miles

^aVancouver City Directory sample.

The fact that workers in three different manufacturing industries have essentially the same mean work-residence separation indicates that this is not a function of the different wage structure applying to each.

One of the central arguments of this thesis is that the economic determinants of the length of the journey to work has a fairly minor role. This has been indicated by:

1. The mean work residence separation of urban residents varies inversely with their distance from employment concentrations, but not with the socioeconomic status of the zones in which they reside.
2. For individuals there appears to be little or no variation in

the length of the journey to work with socioeconomic status. White-collar and manual workers travel the same order of distances to work. Among the white-collar group, there is some little variation with socioeconomic status but it is equally possible this is related to other differences (e.g. of sex, concentration of workplaces).

3. Variation in the mean length of the journey to work occurs from workplace to workplace, but according to the concentration of the workplace itself rather than the presumed socioeconomic status of its employees. Thus workers in industrial establishments travel further to work than those in retail stores.

One case will now be considered where the economic determinant of the length of the journey to work would seem to be of importance.

Variation by Sex and Marital Status

Women would seem to be more dependent on public transportation than men. For single women, lower wages and a different style of life preclude the use of a car. For married couples in which both husband and wife are employed, the family car will of course only be used by one partner to get to work. The other will rely on public transit facilities, or will find work within walking distance.

A comparison of mean work-residence separation according to sex and marital status (Table V) indicates that; 1) On the average men travel further to work than women, and 2) Married men whose wives are working travel over twice as far as employed mar-

ried women.

Table V Mean Work-Residence Separation by Sex and Marital Status

Sex and Marital Status	Work-Residence Separation ^a
All men	4.2 miles
Men with working wives	5.7 miles
All women	3.0 miles
Women with working husbands	2.5 miles

^aVancouver City Directory sample.

In summary, it may be said that the length of the journey to work is in general a function of the relative concentration of employment opportunities and the residences of workers. There seems in Vancouver to be little variation according to socio-economic status--except among "white-collar" workers, and even this is not clearly marked. For the labour force in toto no part of the city would appear to be a self-contained labour market since those living furthest from concentrations of employment not unexpectedly have to travel further to their own particular job. In order to determine the labour self-sufficiency of each part of the city in terms of the major occupational categories however, a different kind of research tool is required. This is found in the concepts of conflux and dispersion.

A Model of Commuting Patterns in Vancouver

Development of the Model

If the structure of residence and employment is reduced to its simplest components, it will be seen that both may hypothetically display a scattered or a concentrated pattern, existing

in the following possible combinations:

1. Residence and employment scattered;
2. Residence and employment concentrated;
3. Residence scattered and employment concentrated;
4. Residence concentrated and employment scattered.

These combinations may be described by a simple model, which may then be applied to the major occupational groups in order to describe deviations in the pattern of commuting for each from the four ideal types. The model which will be used is in the form of a simple rectangular matrix in which the origins of commuters appear in a row at the top of the table, and the destinations in a column at the left of the table. In each cell, a figure may be entered which indicates the number of trips from a particular origin to a particular destination.

Let an urbanized area be assumed, in which both residences and employment have an even distribution, and in which there is no occupational differentiation among workers. If it is further assumed that workers have no locational preferences as to their place of work, the origin-destination matrix $M (=m_{ij})$ in which (i) is a residential zone containing 10 percent of the labour force and (j) is a workzone in which 10 percent are employed, is given by:

$$M_1 = \begin{vmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{vmatrix}$$

If the distortion is now introduced that workers by pre-

ference work close to home, the origin-destination matrix becomes:

$$M_2 = \begin{pmatrix} 10 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 10 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 10 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 10 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 10 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 10 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 10 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 10 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 10 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 10 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 10 \end{pmatrix}$$

This situation may be described in a spatial model (Fig. 5a). In this case the area becomes a mosaic of labour catchment areas of limited dimensions and which do not overlap.

If residence and employment are concentrated, but not necessarily in the same zone, the origin-destination matrix now becomes:

$$M_3 = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 100 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}$$

In this case 100 percent of the labour force resides in zone (i) and finds employment in zone (j). In this case the residences of workers are clustered about the place of work, the remainder of the area not being occupied by workers.

A more usual situation is that in which residence is scattered and employment concentrated. In this case the origin-destination matrix becomes:

$$M_4 = \begin{vmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 10 & 10 & 10 & 10 & 10 & 10 & 10 & 10 & 10 & 10 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{vmatrix}$$

To use Liepman's terminology once more, it could be said that this represents strong conflux at zone (j) from a region-wide zone of dispersion (Fig. 5b). The converse of this case is found when employment is scattered and residence concentrated: here zone (i) represents a sole zone of dispersion sending workers throughout the entire region. The origin-destination matrix is differentiated from that shown above in that the values are arranged vertically rather than horizontally.

These ideal situations will not obtain in reality. It may be expected however, that the pattern of work-residence for each major occupational group will approximate to one or other of the ideal cases. In toto, the patterns of work-residence will represent a complex aggregation of the patterns for each occupational group (Fig. 5c).

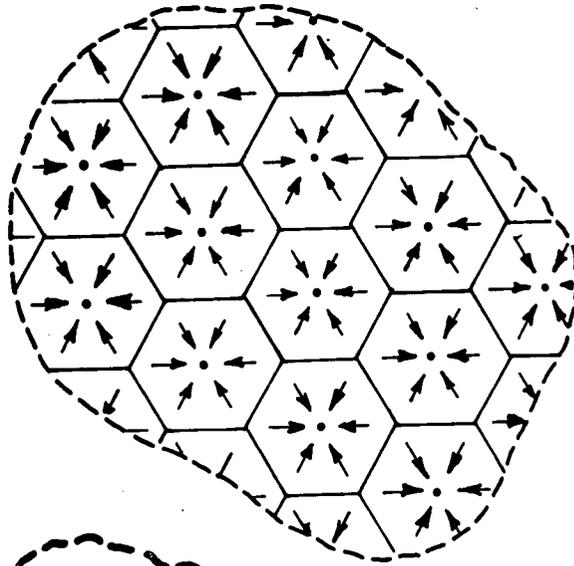
There are also implications here for the length of the journey to work. Mean work-residence separation will be least when residence and employment are both evenly distributed with workers' locational preferences operating as indicated (i.e. workers seeking employment at the place of work closest to home). On the other hand, the mean length of the journey to work is at a maximum both when the residences of workers are concentrated and employment dispersed, and when employment is concentrated and the

FIGURE 5

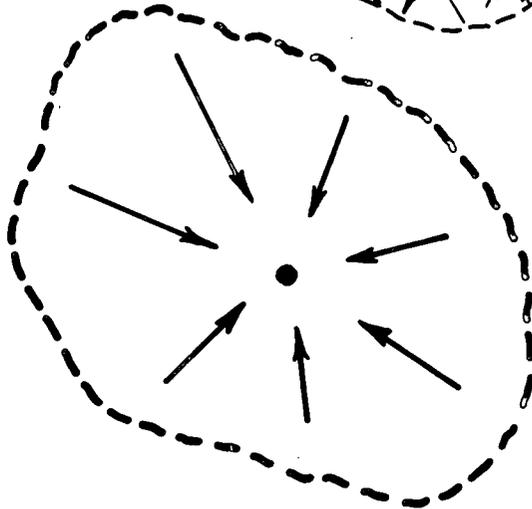
A SPATIAL MODEL OF LABOUR CATCHMENT AREAS

IDEALIZED LABOUR
CATCHMENT AREAS

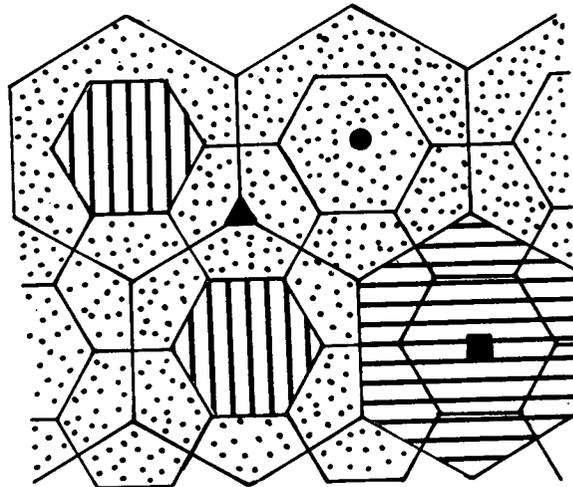
a) Employment and the residences of workers evenly distributed



b) Employment concentrated and the residences of workers dispersed.



c) Several different occupational categories with overlaid patterns of commuting.



-  Occupation 1
-  Occupation 2
-  Occupation 3
- Work Places
-  Occupation 1
-  Occupation 2
-  Occupation 3

residences of workers dispersed. When employment and the residences of workers are both dispersed, and where there is no preference for the work place closest to home, the mean work-residence of all workers falls between the maximum and minimum values. Where employment and the residences of workers are both concentrated, mean work-residence separation varies between the maximum and minimum theoretical values, depending upon the distance between the areas of concentration for each.

Application of the Model

In Fig. 6 a through g, origin-destination matrices have been constructed for each of the major occupational categories. Rather than entering values, percentages have been computed and the cells choroplethed using fixed class intervals. It is thus possible to compare the patterns of commuting in one occupation with those in another with greater ease. Since the concern here is for gross movements of commuters from one major part of the city to another in each occupational category, the variation in size of the zones does not matter. The zones were selected on the basis of their overall homogeneity as follows:

- A The Central Area, grouped for convenience with the West End.
- B The generally working class residential area along the south
- C } shore of Burrard Inlet.
- D Burnaby.
- E The eastern part of the City of Vancouver.
- F The "transitional" section straddling Main Street.
- G The Point Grey Peninsula in the western part of the City of Vancouver.

H Kitsilano.

I The False Creek industrial area, but including also the hospital complex on 12th Avenue.

J The North Arm of the Fraser industrial area.

K North Vancouver.

L West Vancouver.

The boundaries of these areas are shown in Appendix A.

1. Professional, Technical, and Kindred Workers

Both employment and residences of professional and technical workers tend to be concentrated. The Central Area would seem to be the principal node towards which workers in this category are drawn--especially from the West End, the Point Grey Peninsula, and the North Shore. Apart from these major movement of conflux, workers in this category tend to find employment in the zone in which they reside. This is especially true of the Point Grey peninsula considered as a whole, and in North Vancouver.

2. Managers, Officials, and Proprietors

For managers, officials, and proprietors, the patterns of commuting are somewhat different. Although there is conflux at the Central Area, it is from a city wide distribution, the Point Grey peninsula only providing a slightly higher proportion of workers in this category than other parts of the city. However, as indicated by the census also (see Fig. 2) the Point Grey peninsula is a favoured area of residence for workers in this category--they are however dispersed fairly widely for the purposes of employment. False Creek draws fairly widely in this category of employment--except from the areas to the north and east along the

FIGURE 6

ORIGIN-DESTINATION MATRICES VANCOUVER, 1963

KEY TO ORIGIN-DESTINATION MATRICES

Professional, Technical, & Kindred Workers

		ORIGIN											
		Central Area	Burrard Inlet	Burnaby	City East of Main	City West of Main	Kitsilano	False Creek	Fraser River	North Vancouver	West Vancouver		
		A	B	C	D	E	F	G	H	I	J	K	L
DESTINATION	Central Area	A		C	D		F	G	H	I		K	L
	Burrard Inlet						F						
	Burnaby												
	City East of Main				D	E							
	City West of Main							G	H	I			
	Kitsilano												
	False Creek				D		F	G	H	I			L
	Fraser River												
	North Vancouver											K	
	West Vancouver												

Percentage of Labour Force in
Given Category

- 1 to 3
- 4 to 9
- Over 10

south shore of Burrard Inlet.

3. Clerical and Kindred Workers

A somewhat similar pattern is found for clerical workers, both the Central Area and False Creek forming major areas of conflux. Although the Point Grey peninsula is still an important zone of dispersion for this category, commuting is more local--to the Central Area, the Burrard Inlet industrial zone, and the North Arm of the Fraser. Burnaby, North Vancouver, and West Vancouver find their workers in this category from the local area.

4. Sales Workers

As would be expected, sales workers are drawn to the Central Area, especially from the Point Grey peninsula, North Vancouver, and Burnaby. The latter is a favoured residential area for this category, and workers commute from here not only to the Central Area, but to the City east of Main Street.

5. Industrial Workers

Craftsmen and foremen are distinguished from other operatives in order to show similarities rather than differences in their commuting patterns. For both, the major zones of conflux are in the Central Area, the Burrard Inlet industrial area, False Creek, and to a lesser extent the North Arm of the Fraser industrial area. For industrial workers residing in the city, there seems to be a tendency to work within the broadly-defined zone of residence, although this is not strongly marked. Largely, the most favoured residential areas are east of Main Street (cp. Fig. 2) and in Burnaby.

6. Service Workers

The final category to be considered, that of service workers, shows strongly marked conflux upon the Central Area, especially from east of Main Street, and also of False Creek. It must be remembered that this latter zone includes also the hospital complex on 12th Avenue, and that ward attendants, etc. will be drawn here from a fairly wide area.

Summary and Conclusions

The following conclusions may be drawn from the present chapter:

1. The Vancouver metropolitan area contains two principal nodes of commuting--Vancouver City and New Westminster. Settlement of the North Shore and the Fraser Delta is "suburban" in the sense that it is largely residential settlement supplying labour to these two areas. Burnaby, halfway between the two, also falls into this category since it has a larger residential labour force than employment.
2. In the more limited area of study the residential segregation of the major occupational categories is marked--in general manual workers residing largely east of Main Street and white-collar workers on the Point Grey peninsula and the North Shore. Within this category, clerical workers are highly concentrated towards the Central Area.
3. The length of the journey to work is more a function of the relative concentration of employment opportunities and the residences of workers than of any economic determinants. On the average workers in all categories in Vancouver travel about

four miles to work.

4. Commuting to the central area is strongly marked in all categories of employment and from all parts of the city. Even so, currents cut across and run counter to the dominant centripetal and centrifugal movements, depending upon occupational categories.

CHAPTER IV

CONFLUX AT THE CENTRAL AREA

This chapter will attempt to plot the labour catchment area of Vancouver's Central Area. This area is the main focus of commuting in Vancouver and employs a numerically greater and more varied labour force than any other concentration of employment in the city.

The Growing Dominance of the Central Area as a Centre of Employment

The Central Area accounts for a growing proportion of the employment offered in the city. In 1955, some 28 percent of the working population of the City of Vancouver, Burnaby, North and West Vancouver were employed here.¹ In 1963, this had risen to 35 percent,² the increase being largely due to the addition of a considerable number of jobs in the clerical categories. This eight year period has seen the construction of several multi-storey office buildings in the Central Area, especially along Georgia Street West and Pender Street West. The growing dominance of the Central Area as a zone of employment reflects slight changes in the total employment structure of the city at large. As Vancouver expands its functions as a regional centre, the percentage of workers employed in administrative enterprises increases. Thus from 1951 to 1961 the proportion of professional, technical, service, and clerical workers has increased (Table VI).

¹Estimates made by Vancouver City Planning Department.

²City Directory sample.

Table VI Percentage of Workers in Major Occupational Categories, Vancouver (1951 and 1961)^a

Employment Category	1951	1961
Managerial	11.2	11.4
Professional and Technical	8.9	11.8
Clerical	16.3	18.2
Sales	10.5	9.4
Service and Recreational	12.6	14.0
Industrial Workers ^b	35.4	31.4
Labourers	6.2	3.7

^aVancouver, Burnaby, North and West Vancouver. From Dominion Bureau of Statistics, Census of Canada, 1951 and 1961: Population and Housing Characteristics, Vancouver (Bull. CT-22).

^bTransport and Communications, Primary, Craftsmen, etc.

It is largely the workers in these expanding categories who find employment in Vancouver's Central Area.

Thus the Central Area represents a zone in which not only are employment opportunities greater than the residential population, but also in which the difference is likely to increase as the employment structure of the city at large changes. Moreover, the opportunities for employment are largely in those categories of employment not occupied by those who reside here.

The Components of the Central Area

The Central Area of Vancouver has boundaries which are capable of fairly exact geographical definition. Both to the north and to the south it is bounded by bodies of water (Burrard Inlet and False Creek respectively) which, even if they have not limited growth, have controlled its orientation. In some cases, growth has taken place parallel to the boundary where access to the waterfront has been desired; in others, it has occurred perpendicular to the boundary and towards the rather limited crossing points

which give access to the city's main residential areas. The core-frame concept of Horwood and Boyce³ would seem to have relevance to Vancouver's Central Area. According to these writers, "the primary feature of the core-frame concept is not so much that activities in the core and frame are distinct from each other, but rather that different functional, geographical, and historical attributes are ascribed to the core and the frame respectively". Thus, in Vancouver, the Central Area (core-frame) comprises a varied mix of economic activities. In the core itself are found the departmental and other retail stores, the financial establishments, the main entertainment centres, and the head offices of major companies. The frame contains some residences, often in a poor state of repair, vacant lots used for parking, warehouses, and some industrial uses. Considerable interdigitation occurs, however, and makes the drawing of precise chorological boundaries somewhat fruitless. In particular, the uses generally ascribed to the core have extended into the frame in a linear fashion either in a north-south or east-west orientation depending upon the importance accorded to waterfront accessibility and accessibility to crossing points respectively. Linear growth has been particularly marked in recent years to the west, where these two considerations are complementary rather than in opposition, although for the office buildings along West Pender and West Georgia, accessibility to the waterfront is an aesthetic rather than economic consideration.

Since the distinction between these zones is made on functional rather than geographical grounds, the areal units upon

³E. M. Horwood and R. Boyce, Studies of the Central Business District and Urban Freeway Development (Seattle: University of Washington Press, 1959).

which this study will be based are defined arbitrarily upon the sources of data available. In general this chapter will focus upon successively smaller scales. The spatial distribution of the work force of the following areas will be considered.

1. The Central Area

The Central Area is defined as traffic zone 900.⁴ It is bounded on the north by Burrard Inlet and on the south by False Creek and comprises the greater part of the Burrard Peninsula excluding the West End.

2. The Core

Within the Central Area is a core of more intensive use which may be equated with the CBD defined by Murphey and Vance.⁵ "Here one finds the greatest concentration of offices and retail stores, reflected in the city's highest land values and its tallest buildings. Here pedestrian travel on the streets reaches its maximum proportions. And, in one way or another too, the transportation net of the city, and that of a considerable area around the city, is oriented towards the CBD."⁶ Typically also, it may be added, the CBD provides the dominant workplace in terms of the number employed here. It will be one of the purposes of this chapter to determine whether in this sense also "the CBD assemblage serves the entire city rather than any section of it".⁷ However,

⁴See Appendix A.

⁵Raymond E. Murphey and James E. Vance, "Delimiting the CBD", Economic Geography 30 (July, 1954), pp. 189-222.

⁶Raymond E. Murphey, "Central Business District Research", IGU Symposium in Urban Geography (Lund: The Royal University, 1962), pp. 473-483.

⁷Ibid.

it is not a part of this study to attempt a precise definition of this zone and in this case again the arbitrary definition based upon traffic zones will be used.

3. Sample Studies

The distribution of the work force of two typical places of work within the core will be examined in the following chapter.

Conflux at the Central Area

The resulting dominance of the Central Area as a zone of conflux is accentuated by the fact that, contiguous with it are areas which provide employment for a further one-third of the labour force⁸ in manufacturing establishments grouped around False Creek and the south shore of Burrard Inlet. These areas together with the Central Area form what might be termed an "Inner City" providing employment for about two-thirds of the labour force of Vancouver, Burnaby, North and West Vancouver. Their location with respect to the Central Area is a response to unique site conditions. At both False Creek and Burrard Inlet, access to tidewater and to rail facilities encouraged the location of industrial enterprises here at an early stage of Vancouver's history, and before the development of the Central Area in its functional role. Their presence may perhaps be regarded as a distortion of the concentric zone theory of urban structure advocated by the Chicago ecologists and once again point up the theme of uniquely applied site characteristics. Although these zones may be excluded from a consideration of the Central Area per se, it is clear that their presence augments centripetal traffic and potentially distorts the Central

⁸Labour force of Vancouver, Burnaby, North and West Vancouver.

Area labour shed.

The employment they provide is largely in the industrial category, and since the areas in question are bounded by the shore of False Creek and the Central Area itself to the west, and by the shore of Burrard Inlet to the north, labour in this category is most likely to be drawn from the south and east. There will thus be competition for residential space here between industrial workers employed at False Creek and Burrard Inlet, and (largely white-collar) workers employed in the Central Area.

The Spatial Distribution of Central Area Workers

It has been suggested by Carrol⁹ that persons employed in the Central Areas of cities have a distribution approximating that of the entire urban population--i.e. ". . . that the population and the residences of central district employees are arranged about the core area in a constantly declining density". Analysis of the City Directory sample indicates that this statement may be accepted only with reservation for Vancouver.

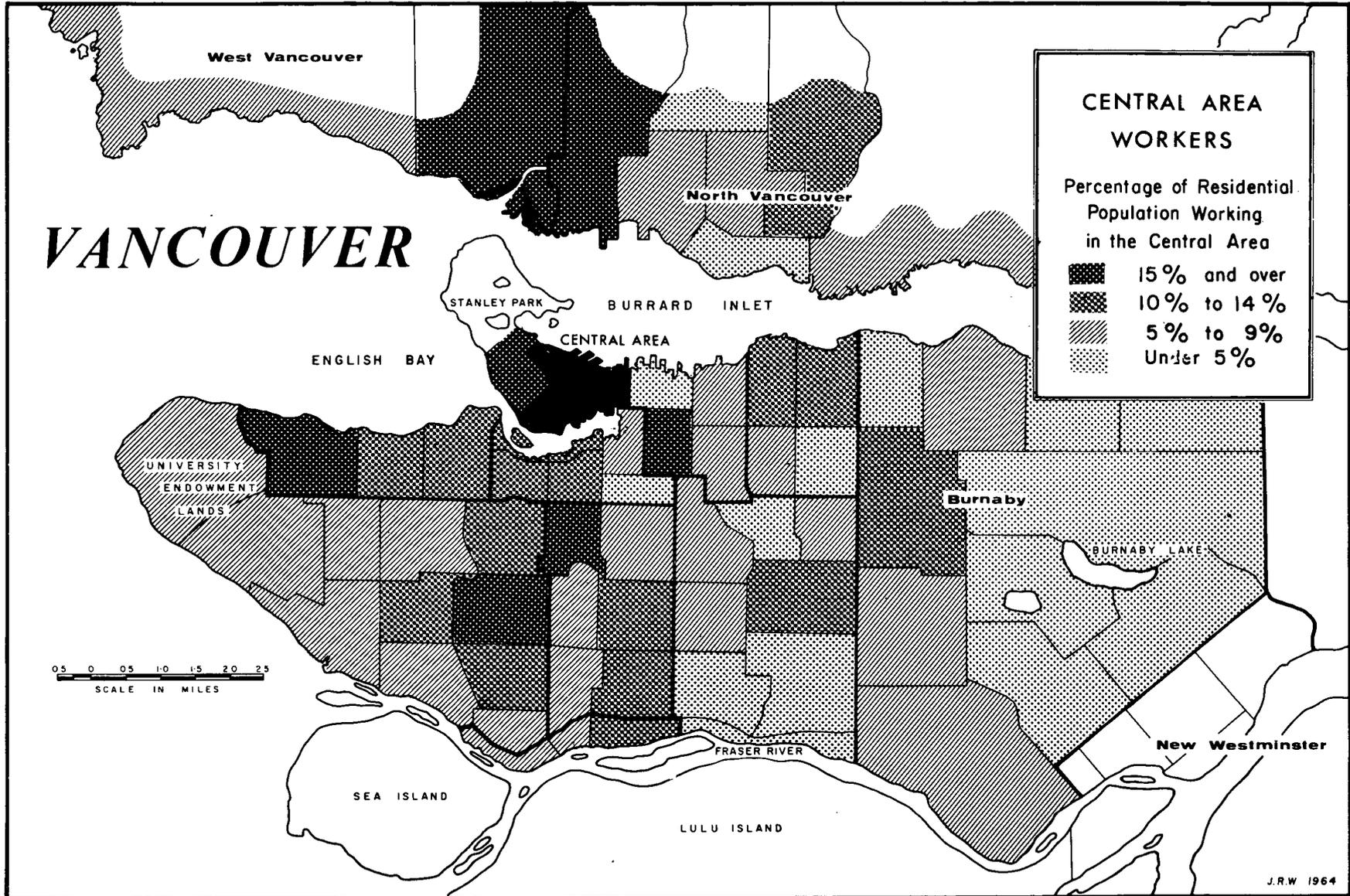
1. The proportion of Central Area employees to the total population varies areally (Fig. 7).
2. This variation may be explained in terms of the residential structure of the city as well as distance from the Central Area.

Some general features of the distribution of Central Area workers are immediately apparent. Workers from the West End and from West Vancouver are particularly drawn to the Central Area,

⁹John D. Carrol, "The Relations of Home to Workplaces and the Spatial Pattern of Cities", Social Forces 30 (March, 1952), pp. 271-282.

FIGURE 7

DISTRIBUTION OF CENTRAL AREA EMPLOYEES, VANCOUVER, 1963



there being no significant intervening opportunities for employment. The concentration of Central Area workers in these areas has been both cause and effect of residential growth--in particular in the West End, where the burgeoning high-rise apartments provide accommodation above all for the unmarried female office worker.

West Vancouver, and particularly British Properties, would seem to fulfill a somewhat different role--that of providing a prestigious location for the homes of Central Area executives. Old Shaughnessy and British Properties have at different times in Vancouver's history been developed specifically for this role, and in both areas, the factors of site and of commanding view would seem to be pre-eminent.

North Vancouver, on the other hand, is less influenced by the employment opportunities of the Central Area of Vancouver than is West Vancouver. It feels the attraction of the Central Area as a place of work not only towards the Lion's Gate Bridge, but also towards the Second Narrows Bridge, but the core of North Vancouver forms a fairly self-contained labour area, experiencing neither extensive outflow towards Vancouver's Central Area, nor inflow from residential areas other than those of North Vancouver itself.

Occupying a somewhat anomalous position are those areas immediately adjacent to the Central Area in the east. The proximity of manufacturing industry, of a railroad complex and of docks interact to produce site characteristics quite different from those of the West End. The poorer natural amenities of the eastern area diminish its appeal for Central Area workers and, conversely, the

proximity of other types of employment reduces the attraction of the Central Area as a place of work for those who live here. In both cases the effect of intervening opportunity¹⁰ would seem to be clear. For residents of the West End there are no opportunities for employment between home and the Central Area, for residents of the east end there are opportunities in abundance.

The Implications of Theories of Urban Structure

The residential growth and structure of cities have traditionally been described in terms of a concentric or a sectoral zonation. The concentric zone typology had its origins in the Chicago school of the 1920's, its most consistent advocates being those sociologists like Park, Burgess, and McKenzie¹¹ who saw the metropolitan community as an eco-system of functionally interdependent parts. Essentially, the "concentric zone city" was seen to consist of:

1. The Central Business District in which the highest land values became manifest in high density construction of those activities (department stores, office buildings, financial institutions, etc.) whose revenues would be sufficiently high to pay high rents.
2. A "zone in transition" in which once well-kept residences had deteriorated as their prosperous owners had moved outwards, to

¹⁰ Samuel Stouffer, "Intervening Opportunities: A Theory Relating Mobility and Distance", American Journal of Sociology 14 (August, 1949), pp. 845-852.

¹¹ These views are presented in Robert E. Park and Ernest W. Burgess (eds.) The City (Chicago: University of Chicago Press, 1925). This contains a group of essays which in general support the ecological perspective.

be replaced by new immigrant areas and the city's skid road.

3. A "zone of workingmen's homes" containing industrial uses which had lined the periphery of the city before being engulfed by later residential accretions, and the homes of the workers employed in industrial activities.
4. A "zone of middle-class residences" containing the residences of white-collar workers and the satellite business districts which provided shopping facilities locally.
5. The so-called "commuters' zone" occupied by the higher incomes groups who travel daily to business in the downtown area.¹²

It was rarely suggested, even by the strongest advocates of the concentric zone typology, that every city conformed to this description. Even in Chicago, its city of origin, the ideal concentric zonation is truncated by the shore of Lake Michigan. It was, however, suggested as a description to which many, if not most, cities in very general terms conformed.

The validity of this view was challenged in the 1930's by Hoyt,¹³ who suggested as an alternative interpretation that residential growth in cities takes place in sectors which straddle the major lines of communication. Specifically, Hoyt's criticisms of the concentric zone description were that:

1. The retail shopping area, and not the financial area, forms the focal point of most cities, and "where the financial and

¹²The above summary is adapted from Leonard Reissman, The Urban Process (Glencoe, Ill.: The Free Press, 1964), pp. 105-107.

¹³Homer Hoyt, Structure and Growth of Residential Neighbourhoods in American Cities (Washington, D.C.: Federal Housing Commission, 1939).

retail shopping areas are separated, it is the retail shopping center that lies nearest the converging lines of transportation that bring people from all points on the periphery of the city to the center".¹⁴

2. Although contiguous with it, the light manufacturing and wholesaling area described as the "zone of workingmen's homes" does not necessarily surround it in a continuous zone.
3. Heavy industry tends to follow major transportation lines and for both of these activities, the use of the automobile no longer necessitates the close proximity of workingmen's homes to industrial workplaces.
4. Many high rent areas have arisen close to the CBD (e.g. the Gold Coast of Chicago and Vancouver's West End) which have changed the nature of the "zone of transition", and tended to stabilize residence.

In reality, then, cities would seem to lie along a continuum, of which the concentric zone and the sectoral zone types are the poles.

Residential Structure in Vancouver

In Vancouver, the site factor tends to distort the residential structure from either of these two extreme positions.

In the Point Grey peninsula and on the North Shore, certain areas, usually with a high elevation or some other natural amenity, are highly valued residential locations. Since the advantages of view and aspect they offer are seldom duplicated elsewhere they have been favoured by high income residents.

¹⁴Ibid, p. 19.

The low-lying lands of the Fraser delta in which some of Vancouver's most recent residential growth is taking place cannot offer the same advantages, and thus have been developed largely for residences priced to suit the medium or low income worker. This area is generally lacking in many of the amenities (both natural and planned) which are found in many other residential areas closer to downtown. In this sense then, Vancouver is not typical of the concentric zone type of city in which the outer periphery is the "commuters' zone" of relatively high value suburban homes.

The peninsular nature of Vancouver's site has resulted in certain areas becoming accessible for residential development at specific times in the city's history. Thus, in many instances, the direction of residential growth has been dependent upon the construction of appropriate crossing points from the North Shore to the Burrard peninsula, from the Burrard peninsula to the Point Grey peninsula, and from the Point Grey peninsula to the Fraser delta. Growth has then taken place in a sporadic manner in some residential areas. The best example of this is the high prestige residential development of the British Properties area which had to await the construction of the Lion's Gate Bridge in the 1930's. In this area the advantage of a commanding view was exploited specifically for high cost residential growth.

At the present time, Vancouver's residential areas consist of a patchwork of varying qualities which conform neither to the concentric, nor the sectoral pattern. Although they might seem at first sight to conform to the latter more closely than to the former, this is related to the varying natural site conditions rather than to a sequence of growth along major arteries.

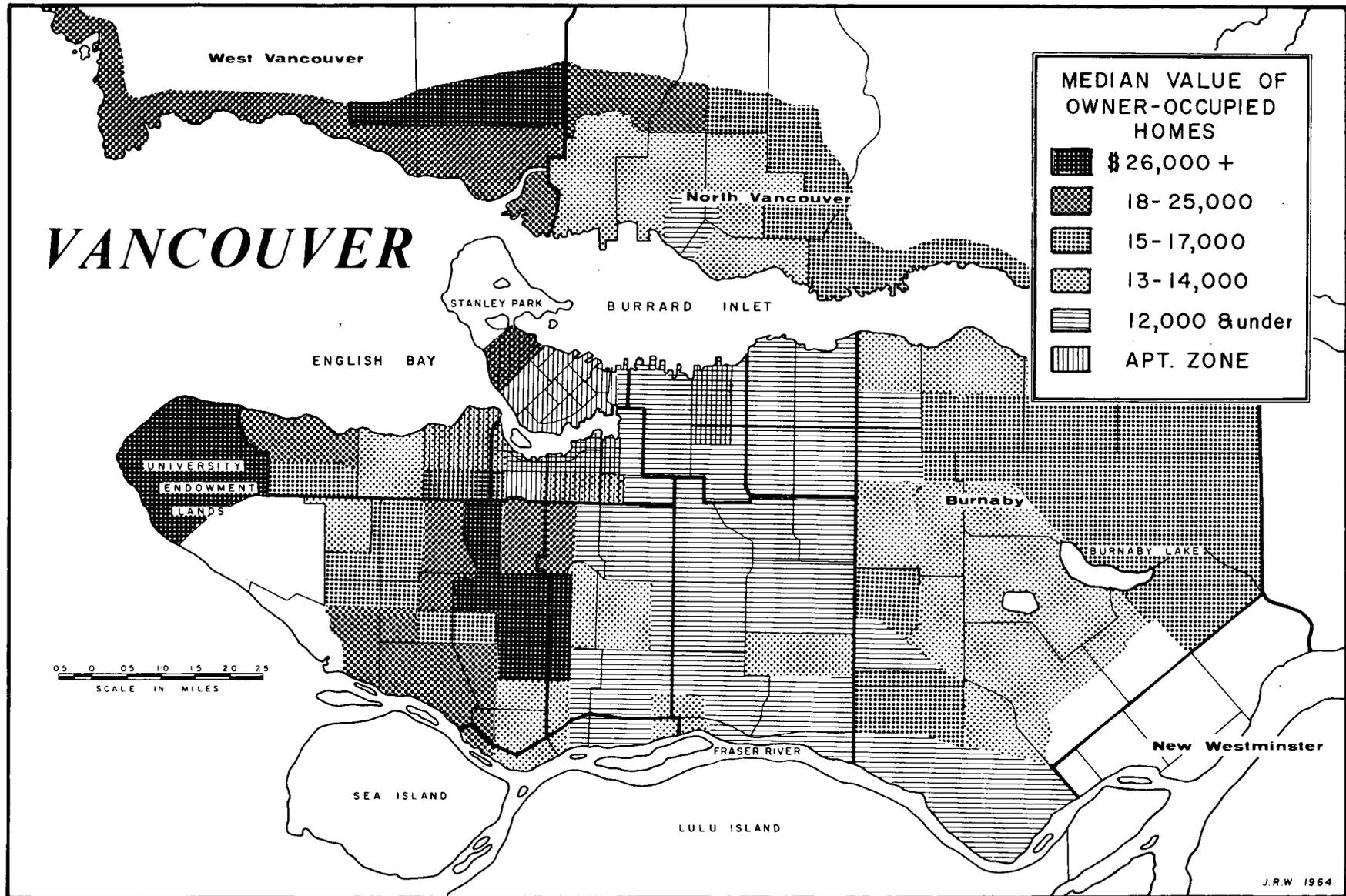
If the median value of owner-occupied homes may be taken as a measure of the prevailing costs of accommodation in each census tract, then Main Street appears as a sharp division between areas of low- and high-cost housing. The census tracts in which the median value of owner-occupied homes is less than 13,000 dollars lie almost without exception between Main Street and Boundary Road (Fig. 8). On the other hand, the median value of owner-occupied homes on the Point Grey peninsula west of Main Street and on the North Shore is generally much higher, while Burnaby falls somewhere between the two extremes.

It is not part of this study to describe in detail the reasons for this marked separation at Main Street between low- and high-cost housing. It would appear however, that it is certainly related to; 1) the varying site characteristics of the respective areas, and 2) the sequence of residential growth.

On the Point Grey peninsula, the better residential areas (i.e. those census tracts in which the median value of owner occupied homes is high) lie generally above the 200-foot contour and command a view either of Burrard Inlet and the North Shore mountains, or of the Fraser delta and Georgia Strait. The importance accorded to view is well illustrated along Southwest Marine Drive where the homes on the south (view) side are among the best in Vancouver, while those of the north (non-view) side are of medium quality. Old Shaughnessy is the earliest of these high prestige areas and still in many ways the most prestigious. It combines easy access with downtown along Granville Street (which it straddles) with a sequestered suburban atmosphere. The generous planting of trees has to some extent reduced the early advantage

FIGURE 8

MEDIAN VALUE OF OWNER-OCCUPIED HOMES, VANCOUVER, 1961



of a commanding view for many parts of the area, but this is a small matter in comparison with the aura of prosperity which has been built up over the years. Even in other parts of the Point Grey peninsula, the streets are generally tree-lined and the homes substantial. Some outliers of early Vancouver (including parts of Kitsilano and of Marpole which originated as street car suburbs) exist today as islands of older frame houses in a state of comparative disrepair, but these are exceptions.

The area between Main Street and Boundary Road presents a different complexion. Residential growth here began as discrete villages clustered about the stations of the B.C. Electric Railway to New Westminster. These may be distinguished even on the street map by the orientation of streets at right angles to the railway line, rather than in an east west direction. The subsequent sprawl of speculative building which took place from 1910 onwards is generally of poorer quality than that found in the western parts of the city. The entire area suffers from not having the advantages of site offered west of Main Street. First, its access to the waterfront is restricted by the main railway line following the shore of Burrard Inlet and the industrial and warehouse complex which straddles it. Second, it is to the leeward side of the major industrial area of False Creek and experiences a greater degree of air pollution than areas to the west or with high elevation. Third, since it is generally low-lying, few parts of it command a view.

The Components of the Downtown Labour Catchment Area

A Variation in the Distributions of Downtown Worked by Income

It is hypothesized here that although the downtown area draws workers from all parts of the city, the high income component of its labour force comes from the high-cost residential sector to the west and on the North Shore, and its low-income component from the low-cost residential sector to the east.

It will be noted that this hypothesis is in contradiction with views put forward elsewhere on the distribution of downtown workers. For example, it has been suggested by Carrol that, ". . . population and the residences of central district employees are arranged about the core areas in a constantly declining density".¹⁵ However, the concentric zone view of urban spatial structure posits a commuters zone on the outer fringes of the city from which higher income workers are drawn to downtown. In conformity with this view, Beverly Duncan has suggested that the distance travelled to work varies with the workers socioeconomic standing.¹⁶ It will be remembered that this has not been found to apply to Vancouver where both white collar and manual workers have the same work-residence separation. This is not surprising in a city where, as it has been shown, the most expensive residential areas are not on the periphery of the metropolitan area, nor are the least expensive clustered around the core area. Even if the city's residential structure were arranged in a concentric manner, it is unlikely that,

¹⁵J. Douglas Carrol, op. cit.

¹⁶Beverly Duncan, "Factors in Work-Residence Separation: Wage and Salary Workers, Chicago, 1951", American Sociological Review (February, 1956), pp. 48-56.

given the greater dominance of white collar workers in the downtown labour force, the density of downtown workers would decrease in a constant manner as Carrol suggests. It seems rather that it would reach maximum proportions in the commuters' zone on the periphery.

In a recent study, Kain has in fact shown this to be the case for Detroit.¹⁷ This study has suggested that the choice of residential location in each major occupational group is related to the presumed ability of this group to meet the costs of work-travel. Thus, if the city is arbitrarily divided into concentric rings, each ring will be occupied by the major occupational groups in a sequence determined by the income of the worker and the distance from the ring in which he is employed. Low income workers employed in the core area will be more dominant in the residential rings closest to the core area, while high income workers will be more dominant in the residential rings furthest away.

The central hypothesis of Kain's study is that, "households substitute journey to work expenditures for site expenditures."¹⁸ This may be compared with the view expressed earlier by Schnore that, "the maximum distance from significant centers of economic activity at which a unit (i.e. a household) tends to locate is fixed at that point beyond which further savings in rent are insufficient to cover the added costs of transportation."¹⁹

¹⁷ John Kain, "The Journey to Work as a Determinant of Residential Location", Papers and Proceedings, Regional Science Association, 9 (1962), pp. 137-160.

¹⁸ Ibid.

¹⁹ Leo F. Schnore, "The Separation of Home From Work: A Problem for Human Ecology", Social Forces 32 (May, 1954), pp. 336-343.

What is being suggested here as an alternative hypothesis is that the expenditures involved in the journey to work are not sufficient to restrict the choice of residential location to the immediate neighbourhood of the place of work, even for low-income workers, and that there is really no question of compensating for high costs of residential space with low travel costs for most workers. Workers live in areas where they are able to find accommodation they can afford irrespective of the distance from their place of employment, and meet the costs of work travel as best they can.

Testing the Hypothesis

In order to test the hypothesis, the City Directory data were arranged in two different forms.

1. The first form is similar to that used by Kain in the work cited above.²⁰ The area of study was divided into concentric rings each one mile wide and centred on the intersection of Georgia and Granville Streets. The downtown labour force was disaggregated according to six major occupational groups of the census. The percentage of each occupational group residing in each ring was computed. The percentages for each ring were now ranked and this ranking compared with the ranking of the occupational groups according to their mean incomes by means of the Spearman Rank Correlation coefficient (Table VII). The coefficients were found to be significant and negative in the residential rings one to two, and two to three miles from the intersection of Georgia and Granville Streets, and significant and positive

²⁰John Kain, op. cit.

Table VII

Rate of Residential Selection and Distance from Downtown

Occupational Group	Man.		Prof.		Prod.		Sales		Cler.		Serv.		Coefft. ^a
Mean Income ^b	\$6203		\$4714		\$3812		\$3239		\$2766		\$2320		
Distance	A	B	A	B	A	B	A	B	A	B	A	B	
Ring 1	7.6	5	10.9	2	9.0	3	4.4	6	8.7	4	12.2	1	-0.31
Ring 2	10.1	5	10.9	3.5	7.7	6	10.9	3.5	15.1	1	14.6	2	-0.76*
Ring 3	11.4	6	16.4	5	20.5	3	26.1	2	19.8	4	26.8	1	-0.83*
Ring 4	22.8	3	16.4	6	26.9	2	21.7	4	27.8	1	19.5	5	-0.06
Ring 5	35.4	1	27.3	2	20.5	5	23.9	3	16.7	6	22.0	4	+0.77*
Ring 6	6.3	3	3.6	5	9.0	1	4.4	4	8.7	2	2.4	6	+0.26
Beyond	6.3	4	14.5	1	6.4	3	8.7	2	3.2	5	2.4	6	+0.80*

^aSpearman's rank correlation coefficient.

^bDominion Bureau of Statistics, Census of Canada, 1961, "Earnings . . . by Occupations, Metropolitan Areas", Catalogue 94-540 (Vol. III--Part 3).

A - Percentage of occupational group working in Central Area (Zone 900) and residing in specified ring.

B - Ranking of percentages.

*Statistically significant.

in the ring four to five miles from this point. These are similar but less satisfying results than those achieved by Kain. The implication is that lower income downtown workers are relatively more concentrated residentially between one and three miles from downtown, while higher income downtown workers are more concentrated residentially between four and five miles from downtown.

2. Much more satisfactory results were obtained when the same procedure was followed not for concentric rings centred upon downtown, but for areas in which the costs of housing were assumed to be generally uniform. The median value of owner-occupied homes in each census tract was taken to be a measure of the housing costs in that tract. Spearman Correlation coefficients were again computed comparing for each group of census tracts, (i) the major occupational groups ranked according to the percentage of each residing in the zone, and (ii) the major occupational groups ranked according to their mean incomes.

In this case, coefficients were found to be significant and positive for each group of census tracts in which the median value of owner occupied homes is greater than 15,000 dollars, and significant and negative for each group in which the median value of owner occupied homes is less than 13,000 dollars (Table VIII).

Seventy-nine percent of the downtown workers employed in occupational categories in which the mean annual income is less than 4000 dollars were found to live in the group of census tracts in which the median value of owner occupied homes is less than 14,000 dollars, compared with only twenty-nine percent of those employed in categories with a mean annual income of greater than

Table VIII

Rate of Residential Selection and Costs of Housing

Occupational Group	Man.		Prof.		Prod.		Sales		Cler.		Serv.		Coefft. ^a
Mean Income ^b	\$6203		\$4714		\$3812		\$3239		\$2766		\$2320		
<u>Housing Type</u>	A	B	A	B	A	B	A	B	A	B	A	B	
Apartments ^c	17.9	6	20.8	3	19.5	5	20.4	4	25.2	2	33.3	1	-0.83*
<u>Median Value^d</u>													
\$26,000 and over	15.4	1	11.3	3	2.6	5	12.2	2	8.9	4	0	6	+0.71*
\$18,000-\$25,999	29.5	1	20.8	2	7.8	4	6.1	5	12.2	3	2.4	6	+0.83*
\$15,000-\$17,999	12.8	3	22.6	1	11.7	4	16.3	2	10.6	5	4.8	6	+0.71*
\$13,000-\$14,999	16.7	3	9.4	6	24.7	2	32.6	1	13.0	4	9.5	5	0
\$12,999 and under	7.7	6	15.1	4	33.8	2	12.2	5	30.1	3	50.0	1	-0.71*

^aSpearman's rank correlation coefficient.

^bDominion Bureau of Statistics, Census of Canada, 1961, "Earnings . . . by Occupations, Metropolitan Areas", Catalogue 94-540 (Vol. III--Part 3).

^cAreas in which more than 50 percent of dwelling units are apartments.

^dMedian value of owner-occupied homes from Dominion Bureau of Statistics, Census of Canada, 1961, "Population and Housing Characteristics, by Census Tract: Vancouver", Catalogue 95-537.

A - Percentage of occupational group working in central area and residing in specified housing type.

B - Ranking of percentages.

*Statistically significant.

4000 dollars.

These findings may be summarized as follows:

1. The cost of housing is a stronger determinant of residential location for downtown workers than the distance from downtown.
2. There is some tendency for lower income workers to live closer to downtown than higher income workers, provided they are able to find residential accommodation of suitable costs.

Those census tracts in which residential accommodation is mainly in the form of apartments (i.e. in which more than fifty percent of the dwelling units are apartments) would seem to present a special case. With two exceptions, they are grouped around the downtown area. The correlation between the ranking of the percentages of each occupation living in this zone and the ranking of occupations according to their mean incomes is significant and negative. This indicates that the apartment areas are favoured by the lower income downtown workers. In particular, one quarter of the downtown clerical labour force, one fifth of the downtown sales labour force, and one third of the downtown service labour force lives in these areas. Of course, it can only be assumed that these workers actually live in apartments.

In this case above all, the substitution would seem to have been made between journey to work expenditures and site expenditures. High apartment rents may be compensated for by low travel costs since these areas are within walking distance, or a short bus ride from downtown. In addition, it should be noted that many of the workers in these occupations are young, single women who will be less likely to possess cars in any case than the family man.

The only occupational group which is ranked differently in this zone for income and for the percentage of the total group residing here is the professional and technical workers.

It is now possible to suggest the explanation for the westward bias of the total downtown labour catchment area.

1. The Point Grey peninsula west of Main Street and West Vancouver are areas in which the median value of owner occupied homes is high. The high income components of the downtown labour force come predominantly from these areas.
2. The low-income component of the downtown labour force is drawn both from the relatively few census tracts of the Point Grey peninsula (mainly in Kitsilano) in which the median value of owner occupied homes is relatively low, from the zones in which over one-half of the dwelling units are apartments, and from the area between Main Street and Boundary Road. The latter area provides only low-income workers to the downtown employment concentration and only a small proportion of the total low-income workers employed downtown. Low-income workers living in this area may, after all, find alternative employment in the industrial plants which are closer at hand.

B The Distribution of Work-Trips by Car to Downtown

The use of the automobile for journeys to work in downtown Vancouver is perhaps more important than in such other major Canadian cities as Montreal and Toronto. Although Vancouver as yet has no freeways providing access to downtown as in Toronto, access by car is still relatively easy especially from the south and from the Point Grey peninsula by way of multiple lane arterial

roads. Although False Creek does indeed present a barrier it is more adequately surmounted by bridges (relative to the amount of traffic that crosses it) than, say, the St. Lawrence River at Montreal. Even in rush periods, the Granville Street, Burrard Street, and Cambie Street Bridges seldom experience excessive traffic.

There is not in Vancouver, as in Toronto, a rapid transit system providing a suitable alternative to work-trips by private car. In addition, due to an over-optimistic evaluation of the growth potential of the Core area, an abundance of parking spaces is available in the form of lots which have not been taken up for other uses. All these factors then tend to maximize the use of the private car for work-trips to the downtown area.

The Parking Survey data²¹ may be referred to for information on downtown workers who commute by car. Strictly speaking, these data refer to the Core area²² rather than to downtown as a whole. Although the destination area is more limited in extent than that about which the discussion has already taken place it provides the greatest number of employment opportunities.

Generally speaking, a greater percentage of the residential population travels to the Core for work by car from the Point Grey peninsula and the North Shore than from the area between Boundary Road and Main Street (Fig. 9). This confirms the observations already made concerning the distribution of the total downtown labour force (i.e. the labour force of the "Central Area"). Particularly high percentages are found in Old Shaughnessy and the areas extending southwards to Marine Drive. Surely it is no coin-

²¹See Appendix B.

²²Traffic Zones 910, 920, 930, 940, 970, 980.

cidence that this area contains a high proportion of the city's managers and proprietors (Fig. 2b), who if working downtown may be expected to use their cars to get there. East of Main Street, on the other hand, are the main concentrations of industrial workers (Fig. 2a) who would be expected to find employment in areas other than downtown, and, as has been observed, of the lower income downtown workers. This latter group may be expected to rely more on the bus facilities provided. The relative absence of arterial roads providing quick access to downtown from this area provides a further discouragement to the use of the automobile for work-trips. It is significant that the number of work-trips generated per 1000 residents is somewhat higher along the Kingsway route than elsewhere in this area (Fig. 9). A slight rise in the number of work-trips generated per 1000 residents in Burnaby may also be observed.

An attempt to explain this variation has been framed in terms of a standard regression model in which it is hypothesized that the number of work-trips by car generated per 1000 residents from a given zone varies directly with the average per capita income of residents of that zone, directly with the ratio of the distance from nearest similar zone (North Vancouver, New Westminister) to the distance from the Core, and directly with the logarithm of the distance from the Core.

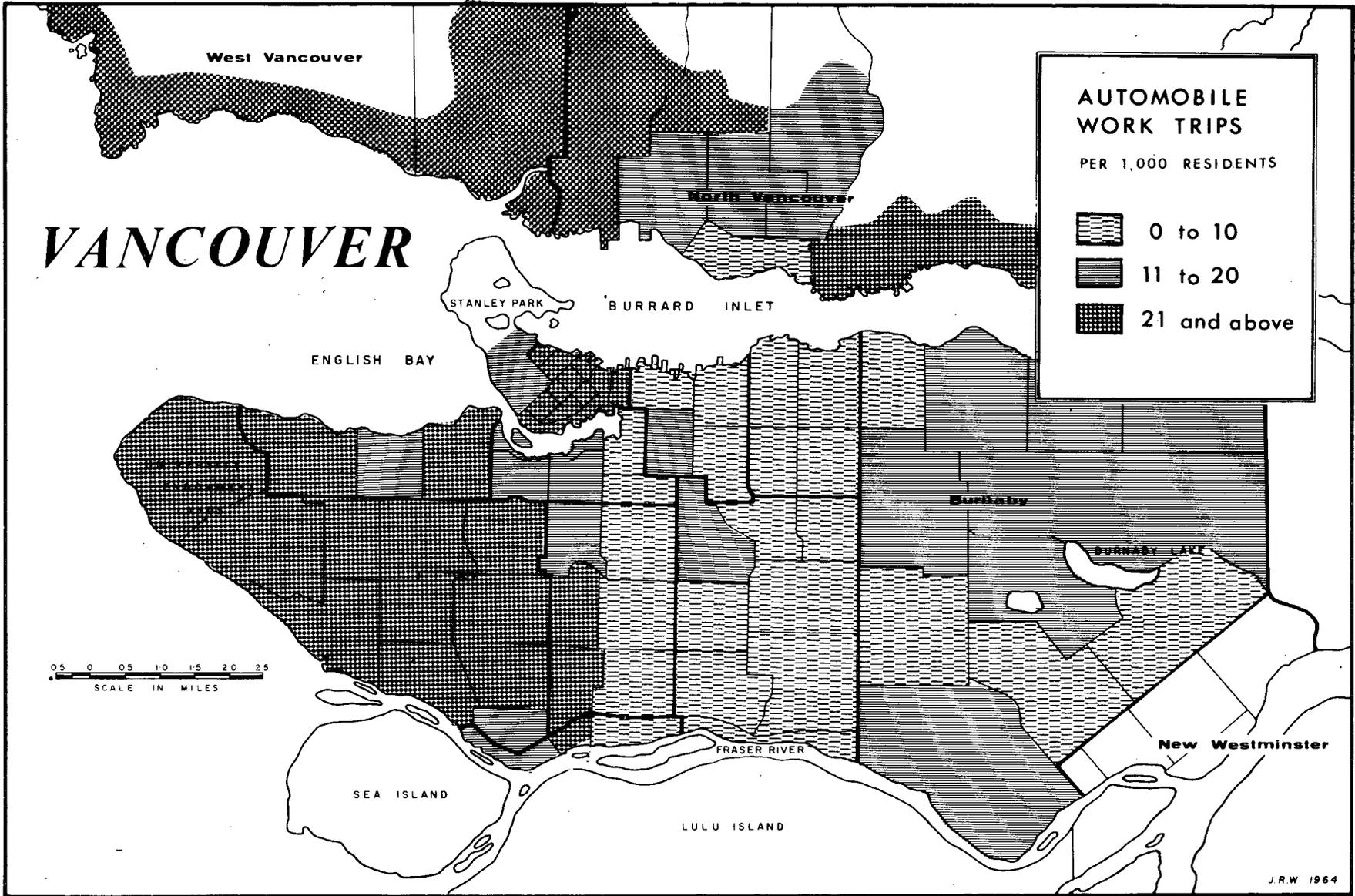
Standard correlation and regression procedure suggests the following equation:

$$T_j = 3.59X + 60.54 \frac{D_2}{D_2} + 98.50 \log D_2 - 177.15$$

Where T_j = Number of work-trips by car generated per 1000 residential population from zone (j) to the Core area;

FIGURE 9

DISTRIBUTION OF ORIGIN OF AUTOMOBILE WORK-TRIPS TO DOWNTOWN, 1962



X = Mean per capita income of that zone;

D_1 = Distance from zone (j) to the nearest zone similar to the Core (North Vancouver, New Westminster);

D_2 = Distance of zone (j) from the Core (i.e. the intersection of Georgia and Granville Streets).

In all, fifty-nine percent of the variation in the number of work-trips by car to the Core per 1000 residential population is "explained" by these variables. Partial correlation coefficients are low but statistically significant (Table IX).

Table IX Partial Correlation Coefficients: Number of Work-Trips per 1000 Residential Population from a Given Zone vs. Mean Per Capita Income of Residents Distance Ratio and Log Distance to Downtown

Variables	r^a	F-Ratios
Per Capita Income	0.225	4.21
Distance Ratio	0.690	71.84
Log. Distance	0.338	10.20

^aValues do not differ significantly from 0 at the 0.05 level. Degrees of freedom are 1 and 79.

The form of the equation is suggestive. Since it has already been shown that the proportion of downtown workers to the total residential population tends to decrease with distance from downtown (Fig. 8), the direct relationship between the number of automobile work-trips per 1000 residential population and the log. of the distance from the core suggests merely that increased distance from the core encourages the use of the automobile over other forms of transportation.

In more detail, it would appear that in fact the number of automobile work-trips generated per 1000 residential population increases to its maximum at 4 miles from the Core and then decreases

outwards (Table X).

Table X Number of Automobile Work-trips to the Core per 1000 Residential Population by Distance from Downtown

Distance from Georgia/Granville	Number of Work-Trips
Ring 1 (less than 1 mile)	11.3
Ring 2 (1.0 to 1.9 miles)	15.3
Ring 3 (2.0 to 2.9 miles)	16.4
Ring 4 (3.0 to 3.9 miles)	23.0
Ring 5 (4.0 to 4.9 miles)	18.3
Ring 6 (5.0 to 5.9 miles)	13.3
Ring 7 (6.0 to 6.9 miles)	21.2
Ring 8 (7.0 to 7.9 miles)	11.7
Ring 9 (8.0 to 8.9 miles)	11.6
Ring 10 (9.0 to 9.9 miles)	6.6
Ring 11 (10.0 to 10.0 miles)	3.1

The peak between six and seven miles from the Core may be ascribed to the greater number of work-trips generated from the North Shore.

When the destinations within the Core are differentiated (Fig. 10) it may be seen that a smaller proportion of work-trips are generated to the eastern zones (970, 980) and the southern zone (940) than to those in the centre and on the west. The central and western zones (910, 920, 930) are those in which the financial and business institutions are largely concentrated and so may be expected to draw greater proportions of those in managerial and executive occupations. For these three zones, not only are the proportions of work-trips generated greater, but the variation with distance in the proportions of work-trips is more marked.

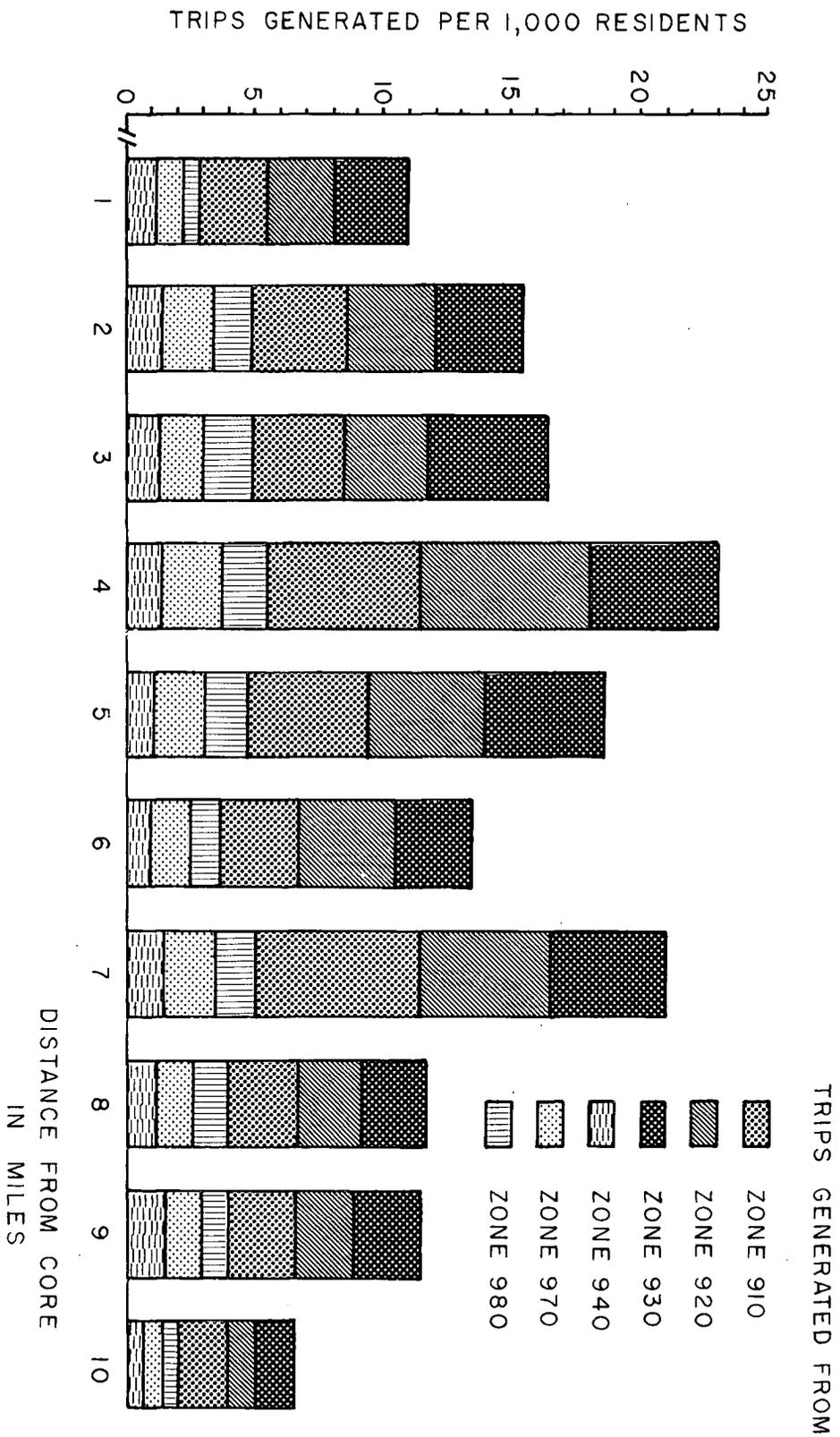
To summarize, the equation of the regression line suggests:

1. The significantly high r-value between the proportion of work-trips generated from each zone and the ratio of the distance of that zone from an alternative similar zone of employment to

FIGURE 10

AUTOMOBILE WORK-TRIPS TO DOWNTOWN, BY DISTANCE, VANCOUVER, 1962

TRIPS GENERATED TO CORE BY DISTANCE



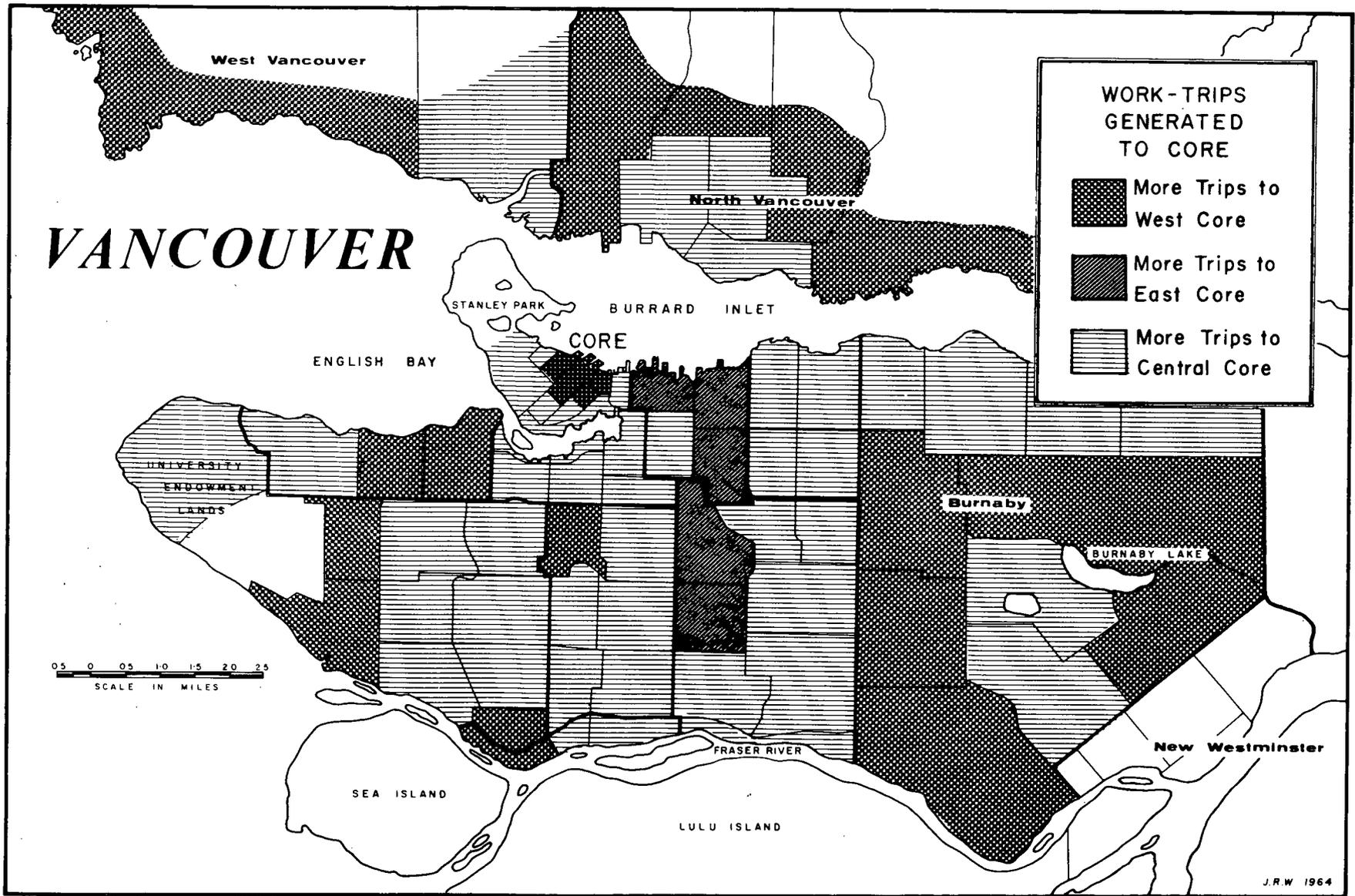
the distance from the Core suggests that if similar employment is available closer to home, then the Core loses much of its attractive force.

2. Work-trips by car to downtown in general increase with increasing distance but more detailed analysis suggests that they in fact increase up to four miles and then decrease with a local peak at seven miles.
3. That the proportion of work-trips generated is directly related to the ability of the residents of each residential zone to operate an automobile as measured by the mean per capita income of the zone.

The Parking Survey data, unlike those derived from the City Directory permit analysis by destinations within the Core. The central part of the Core (zone 920 and 930) draws from a generally city-wide distribution. Each of the two traffic zones which comprise this central part are the destinations for a greater number of work-trips than any other downtown zone in widely dispersed zones of origin (Fig. 11). Not only are these zones at the point of maximum accessibility by public transport, but they contain the main retail establishments which, with their varied labour forces, may be expected to draw from a city wide distribution. The residential zones which generate greater proportions of work-trips to the eastern zones of the Core than to any other are entirely in the east between Main Street and Boundary Road. On the other hand, the residential zones which generate greater proportions of work-trips to the western part of the Core are found in the higher cost residential areas of the Point Grey peninsula west of Main Street, the North Shore and Burnaby.

FIGURE 11

AUTOMOBILE WORK-TRIPS TO DOWNTOWN BY DESTINATION, VANCOUVER, 1962



1. The labour force of downtown is residentially distributed throughout the city, but is more strongly represented on the Point Grey peninsula west of Main Street and on the North Shore than elsewhere.
2. The area between Main Street and boundary road has relatively small proportions of its total residential population working downtown, even in those parts which are immediately adjacent to downtown.
3. Workers employed in occupational categories in which the mean annual income is greater than 4000 dollars are drawn to the downtown area predominantly from the Point Grey peninsula west of Main Street and the North Shore. Downtown workers employed in occupational categories with a mean annual income of less than 4000 dollars are drawn predominantly from the Area between Main Street and Boundary Road.
4. Since the higher income workers are more dominant in the downtown labour force than in that of other work concentrations, this fact may be invoked to explain the general orientation of the total downtown labour shed towards the better residential areas of the Point Grey peninsula and the North Shore.
5. As would be expected from the above, the proportions of the total residential population making work-trips to downtown by car are greater in the Point Grey peninsula and on the North Shore than elsewhere. This is because downtown workers are more numerous here anyway, and also, being employed in higher income occupational categories are more likely to get to work by car than workers from the eastern part of the city.
6. The proportion of work-trips by car to downtown generated from

each residential zone is a function of that mean per capita income of the residents of that zone, the distance of the zone from downtown up to four miles, and the ratio of the distance to an alternative zone of employment to the distance from downtown.

7. Beyond four miles the average proportion of worktrips by car to downtown decreases, if the North Shore is excluded.
8. The western parts of the Core area of downtown have a labour catchment area oriented towards the west, while the eastern parts have a labour catchment area oriented towards the east.
9. Much the greater proportion of work-trips by car to the downtown area terminate in the western parts of the Core.
10. Residential zones are occupied by downtown workers of varying incomes in a sequence determined by the proximity of these zones to downtown, and more clearly, by the prevailing costs of housing in the zone.

The relationship between the downtown labour catchment area and that of peripherally located work concentrations will be considered in the following chapter.

CHAPTER V

A COMPARISON OF THE DISTRIBUTION OF WORKERS OF CENTRAL AND PERIPHERAL WORKPLACES

Generic Differences in Labour Catchment Areas

Recent studies have recognized generic differences between the residential distribution of the labour forces of centrally and peripherally located work-places. It is generally agreed that, while central workplaces draw from a city wide distribution, the labour force of peripheral workplaces is residentially clustered about the place of work. The earliest concise statement of this view has been put by Carrol. ". . . Population and the residences of central district employees", he suggests, "are arranged about the core areas in a constantly declining density (and) off-center work concentrations, on the other hand, have residences grouped about them so that they seem to resemble nucleated sub-clusters in the larger whole."¹

The dominance of the central area Carrol suggests may be due to the greater volume and variety of employment found there, or to the nodal position the central area has with respect to transportation facilities. The central area of Vancouver has been dealt with in some detail already. The major focus of this chapter will be upon peripherally located workplaces, in which there is neither the volume nor the variety of employment offered by the central area, nor the convergence of public transit facilities.

¹J. Douglas Carrol, "The Relationship of Home to Workplaces and the Spatial Pattern of Cities", Social Forces 30 (March, 1952), pp. 271-282.

Some recent studies have confirmed the residential clustering of the labour force of such workplaces. In particular the study of Boston's Route 128 by Burke,² and that of Chicago's west suburban industrial area by Taafe, Garmer, and Yeates,³ may be cited. The latter study in particular suggests that the workers of peripheral workplaces are clustered residentially but about a radial axis. As the writers of this study remark, "the journey-to-work to peripheral employment centers would not be worth studying as a separate component of the aggregated pattern of metropolitan traffic flow, if it did not differ in several significant respects from the journey-to-work to places of employment in the central business district."⁴ The major difference found by these writers were that the use of the automobile is greater among commuters to peripheral workplaces, the labour force of peripheral workplaces is predominantly industrial and that the distance travelled to work is less than that for central area employees.

It has already been shown in Vancouver that the central area employee on the average travels further to work than those employed elsewhere. It has been shown also that the central area does indeed draw from a city-wide residential distribution, albeit with a westward bias. It now remains to determine whether the residential distribution of the labour force of peripherally lo-

² Everett J. Burke, Jr., Labour Supply Characteristics of Route 128 Firms, Research Report No. 1 (Boston: Federal Reserve Bank of Boston, 1958).

³ E. J. Taafe, B. J. Garmer, and M. H. Yeates, The Peripheral Journey to Work: A Geographic Consideration (Evanston, Ill.: Northwestern University Press, 1963).

⁴ Ibid.

cated workplaces shows a similar bias towards distinct residential areas.

The westward bias of the downtown labour force, it has been observed, is a function of; 1) the greater numbers of higher income workers in the downtown labour force, and 2) the better quality and higher cost of the residential accommodation in the Point Grey peninsula and the North Shore.

Higher income workers seek accommodation in these areas, and since they are more numerous in the total downtown labour force than in that of peripheral workplaces, their presence tends to distort the downtown labour shed towards the west.

It is hypothesized in this chapter that since peripherally located workplaces are largely industrial in type, they will have a predominance of lower income workers in their labour force and that, consequently, the residential distribution of the labour force will be biased towards the areas of low cost residential accommodation (i.e. the area between Main Street and Boundary Road).

Since the sample from the City Directory is too small numerically to permit disaggregation according to the place of work, apart from the central area, it will be referred to only in a very general way. The major sources of data for this chapter have been the personnel files of five major employers, two with a downtown and three with an eccentric location. These are:

1. MacMillan, Bloedel, and Powell River Ltd. (Head Office).
2. Hudson's Bay Company Ltd. (Department Store).
3. B.C. Sugar Refineries Ltd. (Sugar Refinery).
4. Dominion Bridge Ltd. (Metal Fabricating Plant).
5. Canadian White Pine Ltd. (Sawmill).

The first two cited are typical of downtown activities --business and retail activities. The last three are chosen in that they represent three different types of industrial activity and occupy three different but typical locations for industrial activity in Vancouver.

The Distribution of Work Concentrations in Vancouver

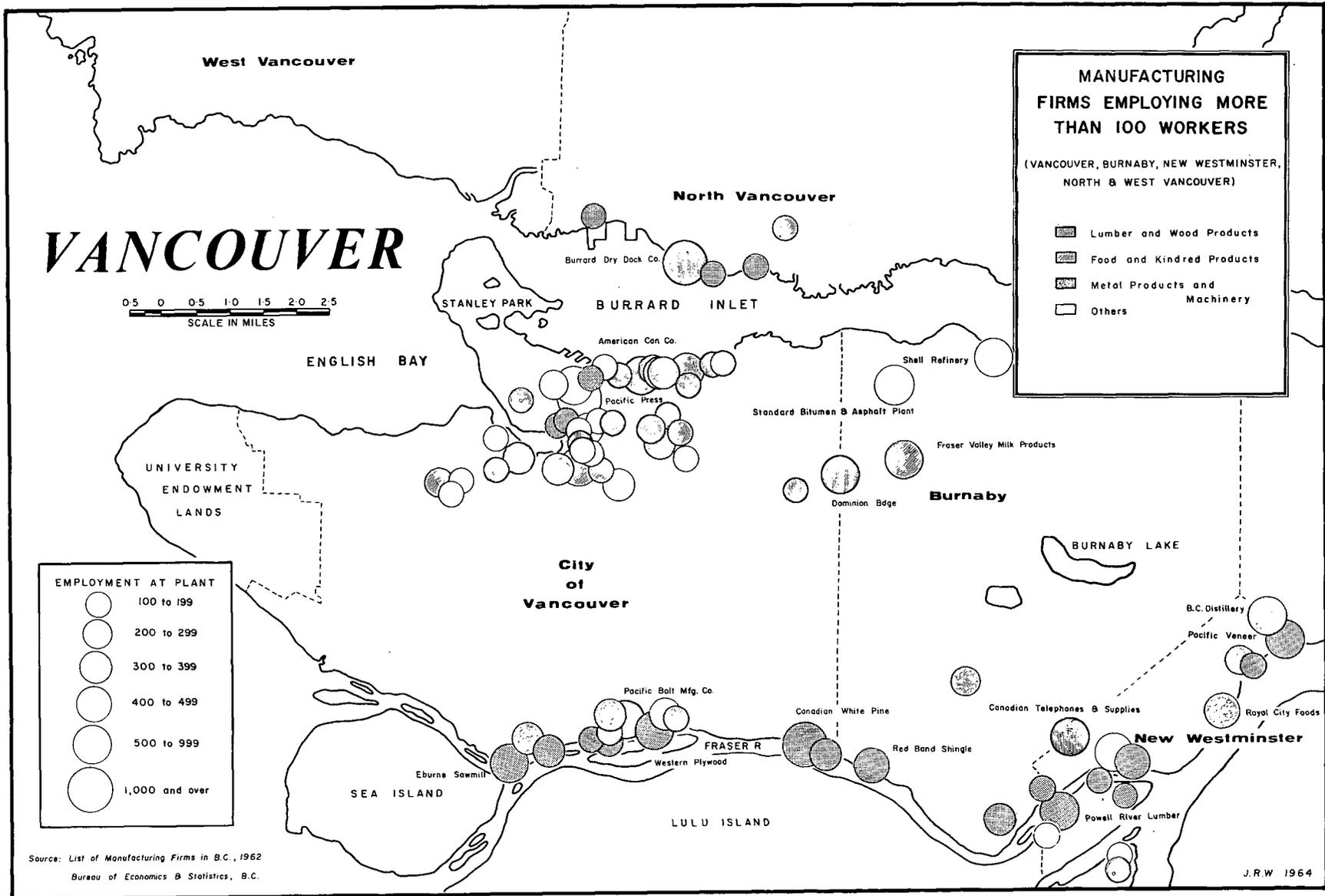
Work concentrations in Vancouver are in fairly distinct locations. The downtown area, which employs about one-third of the city's labour force, has already been described in some detail. The industrial establishments grouped around False Creek and the south shore of Burrard Inlet developed in its industrial role in response to the access to tidewater and to rail facilities. The earliest industries there were those which processed imported raw materials or those from the B.C. coast. The forest industry in particular was concentrated here at an early time, but is relatively less important today. Its persistence is still evident if only from the constant traffic of scows removing chips and hog fuel from the False Creek sawmills. The major employers today, however, are the food processing and metal and machinery industries (Fig. 12).

In North Vancouver, old established forest products industries and marine engineering works are found along the waterfront. The biggest industrial employer in the area is the Burrard Dry Dock Company.

A newer industrial area lines the North Arm of the Fraser River. Tidewater location is obviously of advantage to some of

FIGURE 12

INDUSTRIAL WORKPLACES IN VANCOUVER WITH MORE THAN 100 EMPLOYEES



VANCOUVER

0.5 0 0.5 1.0 1.5 2.0 2.5
SCALE IN MILES

MANUFACTURING FIRMS EMPLOYING MORE THAN 100 WORKERS
(VANCOUVER, BURNABY, NEW WESTMINSTER, NORTH & WEST VANCOUVER)

-  Lumber and Wood Products
-  Food and Kindred Products
-  Metal Products and Machinery
-  Others

EMPLOYMENT AT PLANT

-  100 to 199
-  200 to 299
-  300 to 399
-  400 to 499
-  500 to 999
-  1,000 and over

Source: List of Manufacturing Firms in B.C., 1962
Bureau of Economics & Statistics, B.C.

the plants here, while for others the rail facilities of the B.C. Electric Railway may have been of importance. This is the major present day concentration of the forest products industry, including the Eburne sawmills, Western Plywood, Canadian White Pine (both divisions of MacMillan, Bloedel and Powell River), and Red Band Shingle to name the largest employers. Other industries, including some food processing plants and the Pacific Bolt Manufacturing Company have also located here.

New Westminster has rather the same industrial mix, although the plants here are usually of older establishment. Here again, the major employers tend to be located close to the waterfront.

In North Burnaby are several fairly scattered plants. The largest employers here are Shell Oil at its refinery on Burrard Inlet, Standard Oil at its Bitumen and Asphalt Plant, Dominion Bridge, and Fraser Valley Milk Products.

In addition to these major concentrations are scattered retail and service activities generally distributed in a linear fashion along the major arteries.

Generalized Labour Catchment Patterns in Vancouver

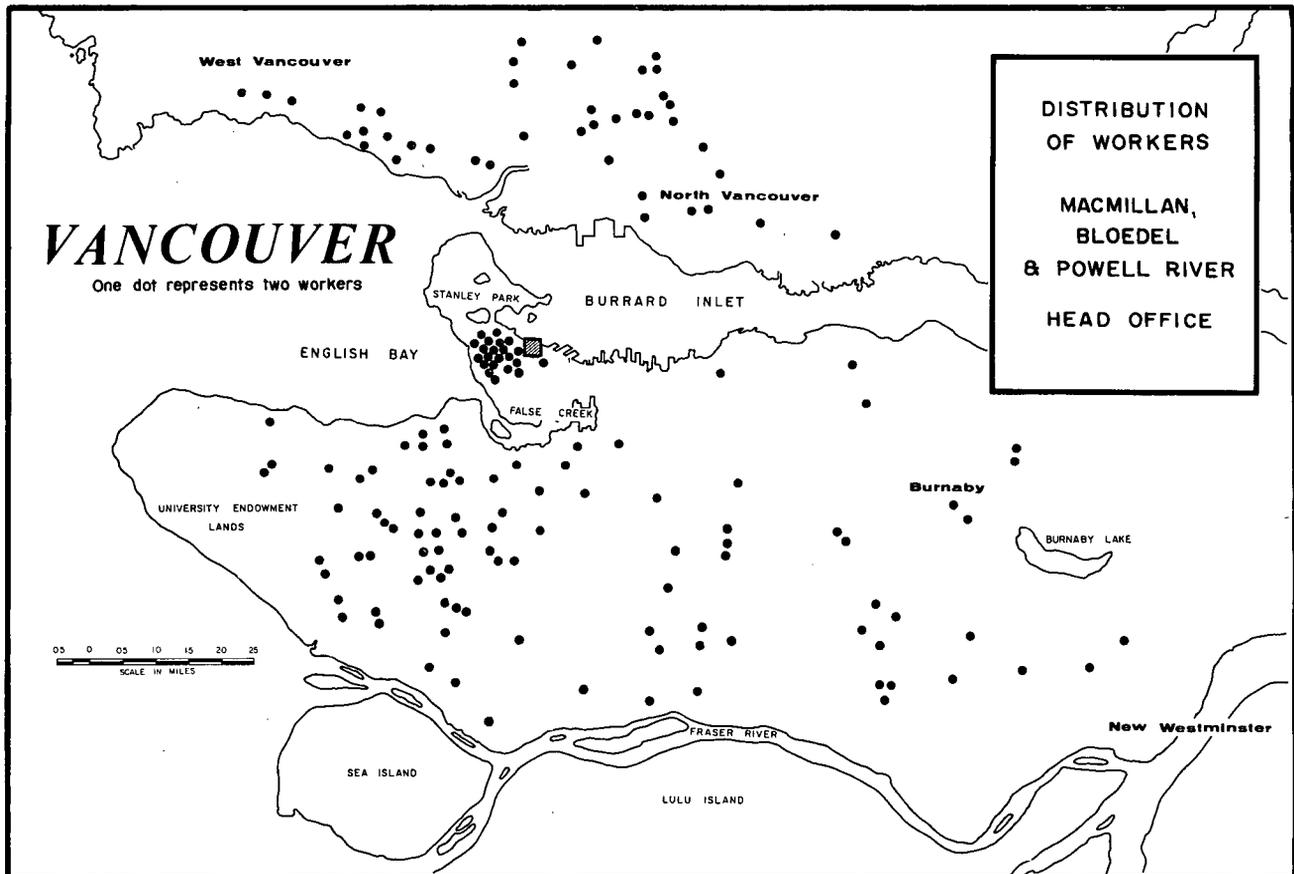
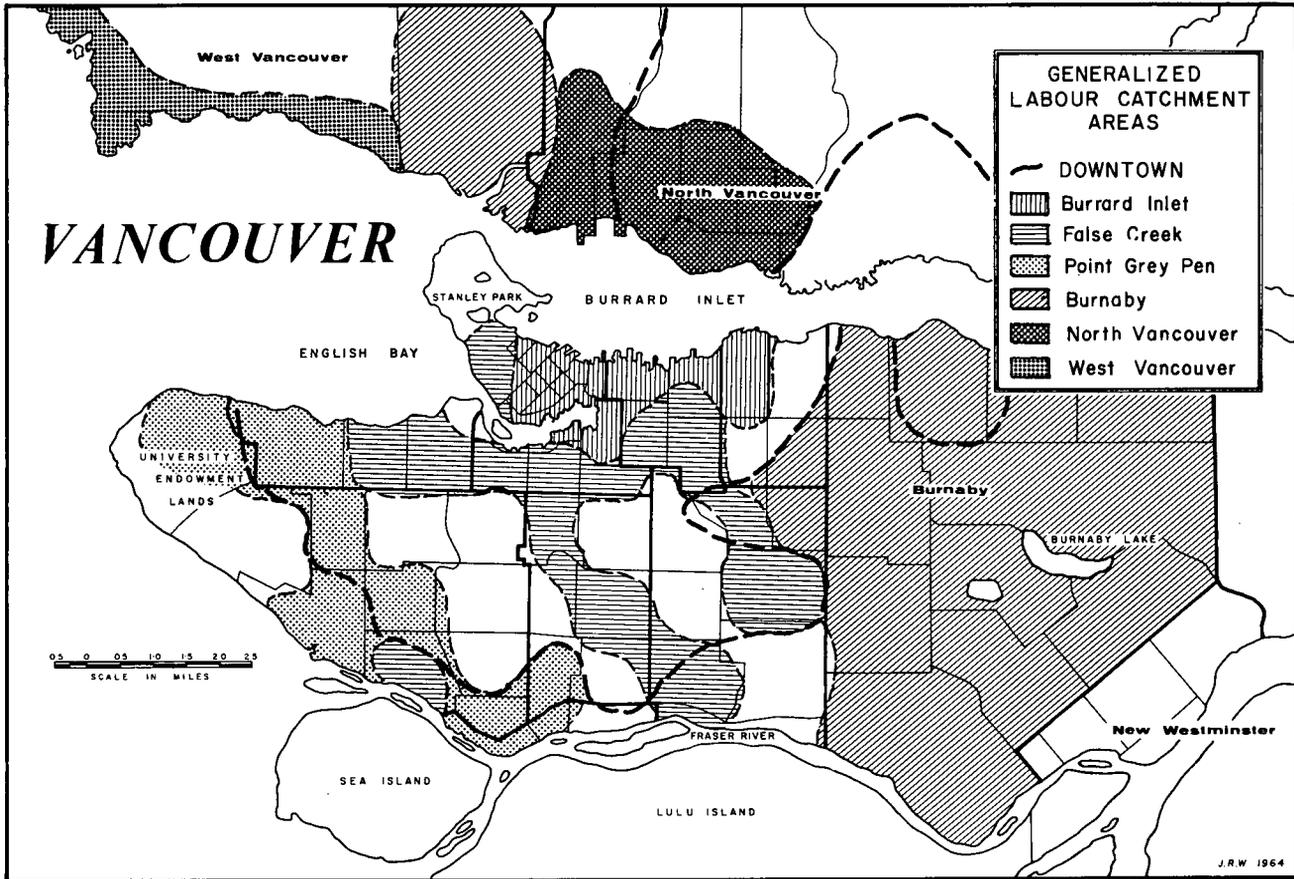
The City Directory sample was used in a general way to show crude labour shed patterns. Each residential zone was assigned to the work zone to which it contributes the greatest number of workers, excluding the central area and the resulting patterns generalized (Fig. 13). For this purpose the work zones are defined as; 1) West Vancouver, 2) North Vancouver, 3) False Creek, 4) South

FIGURE 13

GENERALIZED LABOUR CATCHMENT AREA, VANCOUVER, 1963

FIGURE 14

RESIDENTIAL DISTRIBUTION OF EMPLOYEES, MacMILLAN, BLOEDEL AND POW-
ELL RIVER CO., HEAD OFFICE, MAY, 1965



Shore of Burrard Inlet, 5) Point Grey Peninsula, and 6) Burnaby.

Surprisingly, no residential area was found to generate more work-trips to the North Arm of the Fraser River than to any other zone so this zone was not included. This is no doubt due to the smallness of the sample. The zones in which there was no clear majority were not assigned (Fig. 13).

1. The area of Point Grey west of Main Street largely forms a self-contained labour market, if those residents who are employed in the central area are ignored. Workers who are employed here also reside here, especially in the better quality residential areas to the south and west.
2. Similarly, those residing in Burnaby largely find employment there, the area even assuming precedence over downtown Vancouver as the most important destination for most residential zones in Burnaby.
3. West Vancouver residents find employment in West Vancouver itself (in the western section) and in Burnaby (in the eastern section) as a poor second to downtown Vancouver.
4. North Vancouver city is a self-contained labour market on the whole in that the majority of workers residing there find employment locally. In the municipality of North Vancouver, the Vancouver central area again assumes dominance with North Vancouver itself second.
5. The south shore of Burrard Inlet draws workers from a fairly local catchment area. After downtown employees are excluded, this area draws workers from downtown and from zones adjacent to Burrard Inlet.
6. The False Creek industrial concentration draws workers from a

labour catchment area which extends along three axes. One of these extends westward into the poorer residential areas of Kitsilano, the second southeastwards along Kingsway, and the third southward along Cambie Street and then southeastwards. Once again it should be emphasized that in most of these residential zones, the downtown area is the largest employer and the False Creek area the second largest.

Since these data are of doubtful reliability, reference is made here to the addresses of employees gathered from the personnel files of the employers listed above.

Labour Force Distribution of Sample Workplaces

The distribution of workers for both the MacMillan, Bloedel and Powell River head office and the Hudson's Bay Company department store confirm some of the observations made with respect to the residential distribution of the downtown labour force as a whole. Workers are drawn to these workplaces from a city-wide distribution, but with a westward bias (Figs. 14 and 15).

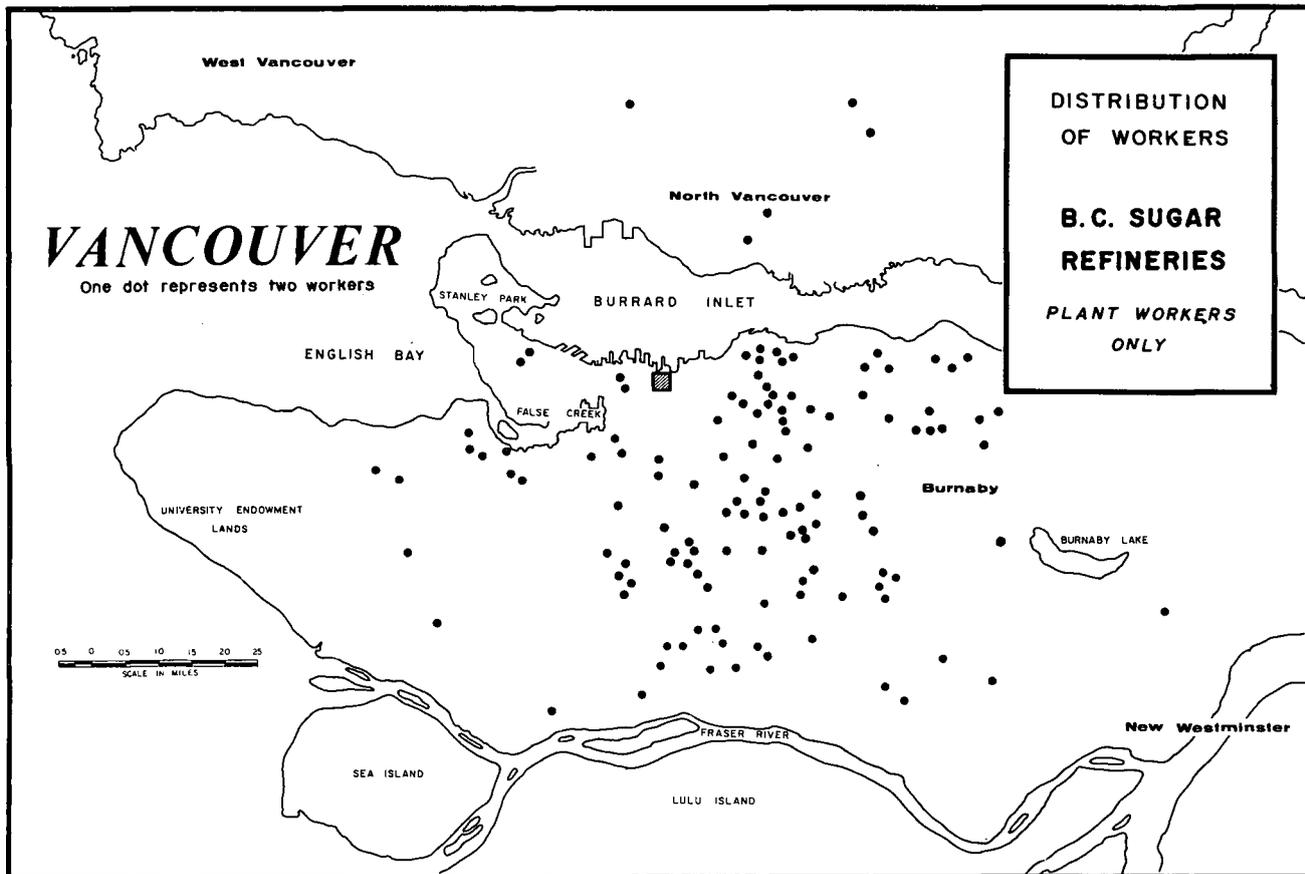
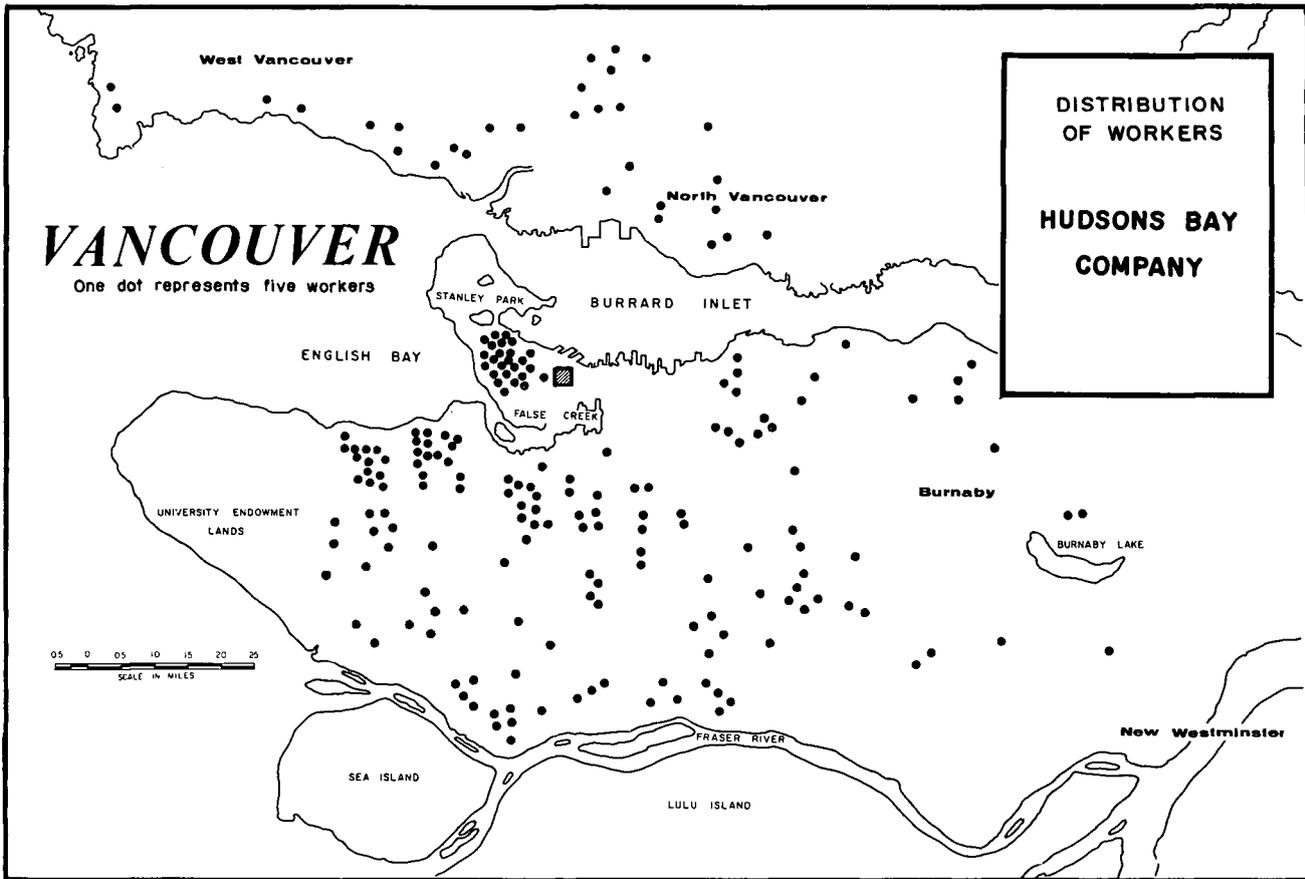
The relative paucity of workers between Main Street and Boundary Road is more marked in the case of the MacMillan, Bloedel and Powell River head office than for the Hudson's Bay Company store. In all, some twenty percent of the store employees are drawn from this area, compared with nine percent for the head office employees. This may be ascribed to the fact that the head office labour force consists essentially of two classes of worker--secretarial staff largely concentrated in the West End, and executive officers of the company distributed throughout the high prestige areas of the Point Grey peninsula and the North Shore. In contrast,

FIGURE 15

RESIDENTIAL DISTRIBUTION OF EMPLOYEES, HUDSON'S BAY COMPANY DOWN-
TOWN STORE, MAY, 1965

FIGURE 16

RESIDENTIAL DISTRIBUTION OF EMPLOYEES, B.C. SUGAR REFINERIES, MAY,
1965



the Hudson's Bay Company labour force is more diverse, at least with respect to the incomes drawn by its members, and consequently has a less restricted residential distribution. There seems to be a greater tendency in this case, however, for workers to cluster residentially close to the place of work. This may perhaps be ascribed to the large proportion of female employees who may be expected to rely on public transport facilities. It may be significant also that the employer provides no employee parking space at the place of work.

A quite dissimilar pattern is presented by the residential distribution of the employees of workplaces with an eccentric location. From the three cases considered here (Figs. 16, 17, and 18), two generalizations would seem to be immediately forthcoming.

1. The industrial workers of these three plants are rarely found to live outside the area bounded on the west by Main Street, excluding for the moment those who reside outside the main built-up area in Richmond, Surrey, and Delta.
2. There is a fairly marked tendency for workers to cluster around the place of work in the case of the two workplaces (Dominion Bridge and Canadian White Pine) furthest from downtown.

A British Columbia Sugar Refineries

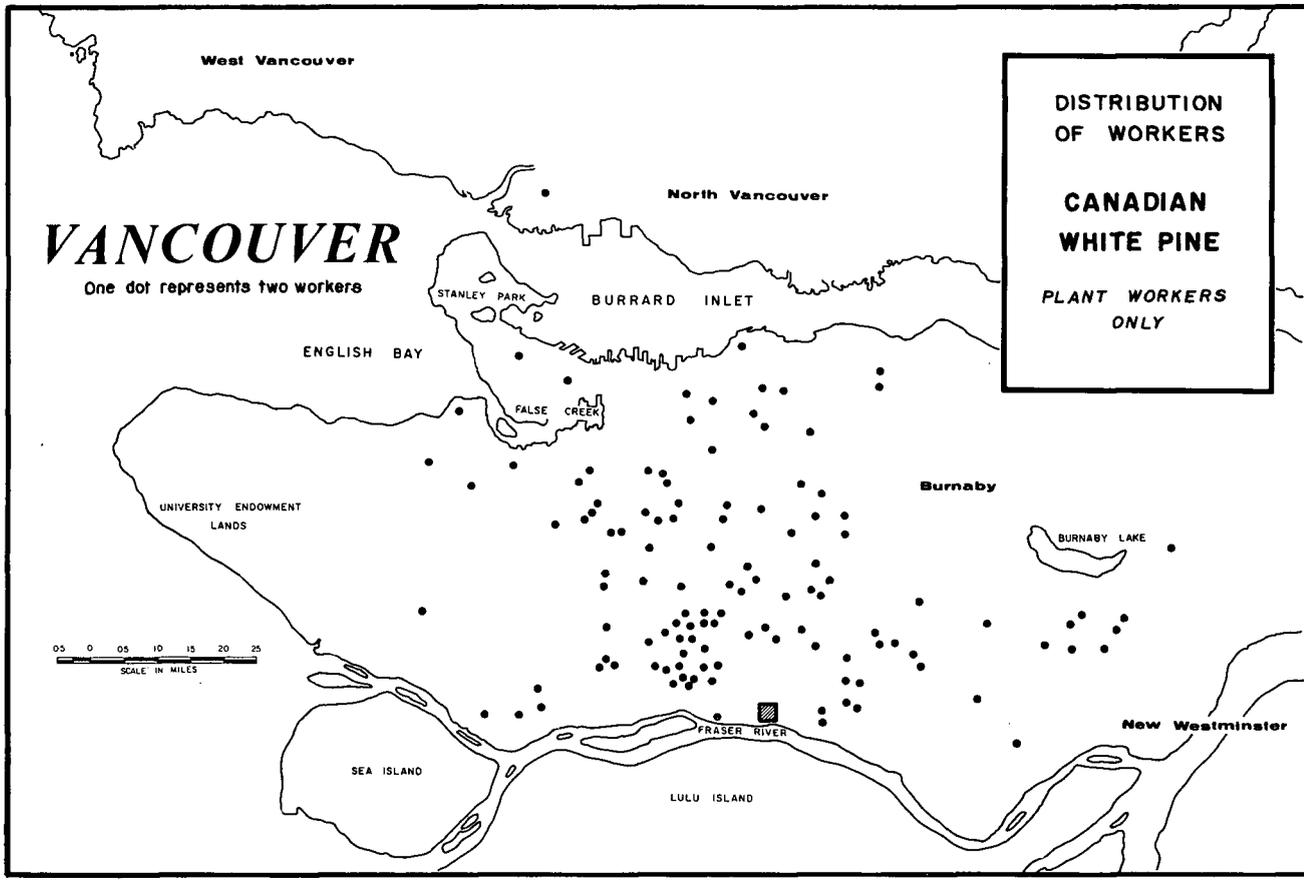
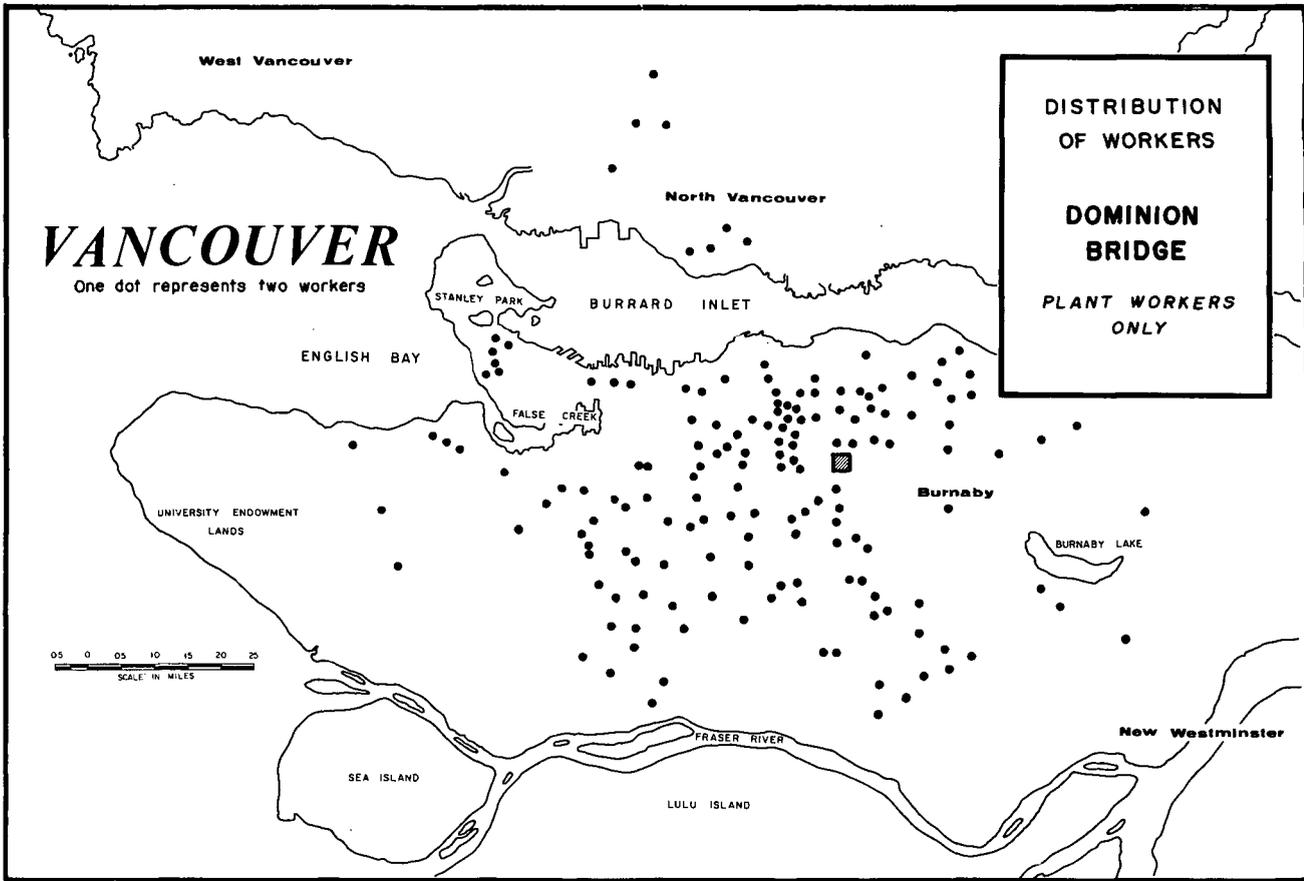
B.C. Sugar Refineries is an old-established plant founded on this site in the 1890's with the obvious orientation towards the waterfront demanded by the nature and source of its raw materials at that time. The industrial labour force is fairly widely scattered in the area between Main Street and Boundary Road. About sixty percent of the workers live here and a further twenty percent

FIGURE 17

RESIDENTIAL DISTRIBUTION OF EMPLOYEES, DOMINION BRIDGE, LTD., MAY,
1965

FIGURE 18

RESIDENTIAL DISTRIBUTION OF EMPLOYEES, CANADIAN WHITE PINE, MAY,
1965



in Burnaby. As recently as fifteen years ago the labour force was clustered more tightly about the plant than at present and the reliance on public transport was such that a bus strike necessitated the organization of special services to bring workers to the plant by truck.⁵ Today the great majority of the workers use cars to get to work, and in this connection it is significant that twenty-two percent of the plant workers are females. The relatively few office workers (not shown in Fig. 16) are distributed fairly evenly both east and west of Main Street.

B Dominion Bridge

Dominion Bridge Ltd. is a steel construction firm located in North Burnaby. Its plant personnel number about 400 and its office personnel 220. The residential distribution of the plant workers once again is fairly well scattered east of Main Street. Over one-third live between Main Street and Boundary Road and one-quarter live in Burnaby.

There is a tendency to cluster residentially towards the plant, over one-third of the industrial workers living within a distance of two miles. Significantly, the office workers (not shown in Fig. 17) like those of the B.C. Sugar Refineries plant, have a less restricted residential distribution. A greater percentage (thirty percent) are drawn from Burnaby than from the area between Main Street and Boundary Road (fifteen percent) in contrast with the industrial workers. It will be recalled that the median value of owner-occupied homes is generally higher in Burnaby than in the latter area. In addition, significant percentages are drawn

⁵Personnel Manager, B.C. Sugar Refineries Ltd., personal communication.

from the city west of Main Street (nine percent), from North Vancouver (ten percent), from West Vancouver (nine percent) and from Surrey, Richmond, and Delta (eleven percent).

C Canadian White Pine

Canadian White Pine is one of the two large plants operated on the North Arm of the Fraser River by MacMillan, Bloedel and Powell River Ltd. Once again, the industrial workers live east of Main Street. Between Main Street and Boundary Road are found thirty-seven percent, and a further fourteen percent live in Burnaby. Twenty percent of the workers live within two miles of the plant, excluding those on the south side of the river. As would be expected from the location of the plant, a significant proportion (nineteen percent) in fact, commute from suburban Richmond, Delta, and Surrey. These results are summarized in Table XII.

Table XII Distribution of Workers of Five Selected Workplaces^a

Area of Residence	Dom. Bdg.	B.C. Sug.	C.W.P.	H.B.C.	M.B.P.R.
Downtown and W.E.	3.5%	1.6%	11.0%	11.1%	12.4%
City East of Main	36.6	59.5	36.7	20.0	9.1
City West of Main	6.9	6.4	9.7	38.2	31.2
North Vancouver	5.0	4.0	0.5	9.8	11.8
West Vancouver	-	-	-	4.9	9.6
Burnaby	25.2	21.4	13.8	7.1	10.8
New Westminster	4.5	-	13.8	0.4	4.3
Surrey, Richmond, and Delta	8.9	2.4	19.4	6.6	7.0
Coquitlam, Port M.	2.5	2.4	1.0	1.3	1.1
Other Areas	6.9	2.4	5.1	0.4	2.7

^a Personnel files of Dominion Bridge Limited, B.C. Sugar Refineries Limited, Canadian White Pine, Hudson's Bay Company, and MacMillan, Bloedel and Powell River.

Conclusions

Certain conclusions may be drawn from this discussion of the labour force distributions of centrally and eccentrically located workplaces. In general terms the labour force of centrally located workplaces had a wider residential distribution than that of eccentrically located workplaces. This would seem to confirm the observations of Carrol,⁶ Burke,⁷ and Taafe, Garner, and Yeates,⁸ although with certain clear reservations. Above all, the clustering effect would seem to be related to the nature of the residential accommodation available locally rather than to the public transportation network. This is indicated by:

1. The suggestion that the majority of workers both in plant and office occupations use cars to get to work. Parenthetically, this is typical of peripherally located workplaces, as Taafe, Garner and Yeates have shown.⁹
2. The residential distribution of office workers straddles zones of varying residential quality and cost.

Obviously in this connection, the workers current income may not be of supreme importance. Many industrial workers will in fact draw higher wages than those of many office workers in the same plant. Several other factors should perhaps be borne in mind here. First, the office worker is in all probability not the sole or chief breadwinner of his/her household. Second, the jobs of

⁶Douglas Carrol, op. cit.

⁷Everett J. Burke Jr., op. cit.

⁸E. J. Taafe, B. J. Garner, and M. H. Yeates, op. cit.

⁹Ibid.

industrial workers are frequently less secure than those of office workers and consequently their ability to finance the purchase of an expensive home is reduced. Third, the style of life of industrial workers is often different from that of white-collar workers and a different system of priorities determines the apportionment of the weekly wage packet.

A further reservation which must be borne in mind is that, although the labour force of downtown workplaces is residentially widely distributed, compared with that of peripheral workplaces, this is likely to be due as much to the type of employment offered by downtown workplaces as by centrality per se. This has been indicated already by the marked separation at Main Street of the residences of high- and low-income downtown workers and by the resulting bias of the downtown labour catchment area towards the west. It is confirmed by the labour force distribution of two specific downtown workplaces. That with a labour force of fairly varied incomes (the Hudson's Bay Company store) draws its workers from a more varied area residentially than that in which there are essentially only two categories of employee (MacMillan, Bloedel and Powell River head office).

In conclusion, it may be affirmed that the cost of residential space is a prime determinant of residential location. Proximity to the place of work would seem to carry greater weight for peripheral rather than central workplaces. This is, however, in large measure due to the close juxtaposition of industrial workplaces and residential accommodation, the costs of which are within the reach of industrial workers.

There is obviously an interaction here which it is dif-

difficult to disentangle. Proximity to industrial activity may itself be a factor which discourages high cost construction and the clustering of industrial workers about their peripheral place of work may simply be the result of this artificial site condition.

However, given uniform costs of housing in an area, it seems likely that there will be some desire to minimize the journey to work if possible. This desire will be easier to pursue in areas which are furthest from main centres of economic activity, since in such areas there is less competition (in the ecological sense) for residential space. Thus the clustering of workers is greatest in those plants which are furthest from the downtown area.

CHAPTER VI

THE NEED FOR A NEW APPROACH

The majority of attempts to formulate a theory of urban spatial structure have assumed the frictional effect of distance. Liepman's¹ pioneer study suggested that social and economic costs accrue to the worker who undertakes a journey to work of any length. Later writers have suggested that the spatial structure of urban residence results from the attempt of individuals in competition for residential space to minimize the length of the journey to work. Carrol's² study is the definitive statement of this view and uses as its basis the principle of least effort. In the same ecological school of thought, Duncan³ and Schnore⁴ have concurred with Carrol's use of the minimum equation, but have added refinement by suggesting that the need to minimize the journey to work is greater with workers of low than with high socio-economic standing. More recently, studies have explained labour force distributions in terms of gravitation concepts in which the number of trips generated to a given workplace varies inversely with the distance from that workplace. It is significant in this respect

¹Kate Liepman, The Journey to Work (London: Routledge and Kegan Paul, 1944).

²J. Douglas Carrol, "The Relationship of Home to Workplace and the Spatial Pattern of Cities", Social Forces 30 (March, 1952), pp. 271-282.

³Beverly Duncan, "Factors in Work-Residence Separation: Wage and Salary Workers, Chicago, 1951", American Sociological Review 21 (February, 1956), pp. 48-56.

⁴Leo F. Schnore, "The Separation of Home from Work: A Problem for Human Ecology", Social Forces 32 (May, 1954), pp. 336-343.

that Taafe, Garner, and Yeates found distance not to be an important factor within a distance of four miles.⁵

The findings of the present study suggest that distance from work has little effect as a determinant of residential location in Vancouver, except for limited groups of workers.

1. Females employed in clerical occupations downtown would seem to prefer relatively expensive apartment living close to downtown. Even in this case, apartment-living may be valued for other reasons than that it permits a short journey to work.
2. Married women who are employed, on the average travel short journeys to work. Since the husband makes a correspondingly long journey to work, this fact is not indicative of residential location being chosen close to employment, but rather of the wife's employment being sought close to home.
3. More significantly, a clustering of workers was observed about peripheral workplaces.

This last mentioned observation evidently demands further comment. Clustering occurs only among plant workers and is strongest in areas in which the costs of housing are uniformly low. No clustering is observed for office workers in peripheral workplaces who tend, if anything, to favour high-cost residential locations at some distance from the place of work.

The findings of the present study suggest that theories pertaining to the distribution of central area workers should be modified. Although downtown draws workers from a city-wide distribution as suggested by Carrol,⁶ and others, there is a marked ten-

⁵E. J. Taafe, B. J. Garner and M. H. Yeates, The Peripheral Journey to Work (Evanston, Ill.: Northwestern University, 1963).

⁶J. Douglas Carrol, op. cit.

dency for it to draw more strongly from some sectors of the city than from others.

In addition, the higher-income component of the downtown labour force is drawn more strongly from the high-cost residential areas, and the low-income component from the low cost residential areas, especially those which are not close to alternative work concentrations. These two facts together account for the westward bias of Vancouver's downtown labour catchment area. Both West Vancouver and the Point Grey peninsula west of Main Street are areas of predominantly high-cost housing and relatively few employment opportunities.

In Vancouver, the pattern of residence is sectoral rather than concentric. The reasons for this are to be found not in growth patterns along major arteries, but as a response to locally favourable or unfavourable site characteristics.

The central conclusion of this study is that workers of high income live in high-cost residential areas, while workers of low income live in low cost residential areas irrespective of the distance of these areas from centres of employment.

In Vancouver at least it would appear that the distance from employment is not a major determinant of residential location. Commuting patterns are superimposed upon an existing urban spatial structure the determinants of which are the city's site and sequence of growth. Theories of commuting based upon the minimization of effort may be applied in a meaningful way only within the context of this uniquely determined urban structure. Even the ecological concepts of the dominance of central workplaces and the sub-dominance of peripheral workplaces apply in their ideal form in a

homogeneous residential matrix. In Vancouver, they are distorted once again by the vagaries of residential structure.

Further research should be directed towards an examination of other cities in order to determine whether the same considerations apply. In cities with a concentric residential zonation, it may well be that high income workers commute longer distances than low income workers. The reason is to be found not in their greater ability to meet the costs of work-travel, but in the nature of the residential structure itself. High cost housing is usually found on the periphery, low cost housing at the centre. Where this tendency is reversed as for example with low cost public housing, there is no marked tendency for low-income workers transplanted to the periphery to find, or in many cases to seek, employment closer to home.⁷

In conclusion, the journey to work is a result rather than a cause of urban spatial structure. A further consideration is required of what Liepman⁸ termed the topographic causes of work-travel. An understanding of these factors is to be achieved through the analysis of the unique site conditions and sequence of growth in each city.

⁷R. F. Whiting, "Home-to-Work Relationships of Workers Living in Public Housing Projects in Chicago", Land Economics 28 (August, 1952), pp. 283-290.

⁸Kate Liepman, op. cit.

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APPENDIX A

THE VANCOUVER CITY DIRECTORY

The Vancouver City Directory for 1963 was used as a basic source of data. A sample of 1775 persons was taken by selecting the persons closest to the top of the first and third columns on each page. Persons not shown as being employed were omitted. This sample represents 0.78 percent of the residential labour force of Vancouver, Burnaby, North Vancouver, and West Vancouver, the area covered by the Directory.

Persons are listed in the directory as follows:

Doakes, Joe, mechanic, ABC Garage, h, 2000 Main.

From entries of this kind it was possible to record the following:

1. Occupation

The occupation of each individual was coded according to nine categories of employment; professional and technical workers (coded as 1), managers, officials, and proprietors (2), clerical workers (3), sales workers (4), craftsmen and foremen (5), industrial operatives (6), service workers (7), primary workers (8), and labourers (9).

2. Sex and Marital Status

From the name of the individual the sex was inferred. Married women are so designated. By cross-reference to the street directory it was possible to infer the marital status of men. Similarly, it was possible to determine whether the spouse was

working in each case. Six categories were now distinguished according to sex and marital status; married men (1), married men with working wives (2), single men (3), married women (4), married women with working husbands (5), single women (6). Those assigned to category 4 were women listed as Mrs. _____, but for whom it was not possible to trace a spouse.

3. Home and Work Address

The house address of each person in the sample and the work address, obtained by cross-reference to the employer, were recorded. These were coded by traffic zone (Fig. 19). In cases where the address of the employer could not be found, where the employer carried on activities at several locations (e.g. T. Eaton Co.), or where no employer was listed, a distinct coding was used.

4. Work-Residence Separation

For the persons listed closest to the top of the first column on each page of the City Directory and for whom an address of the workplace could be recorded, the distance was measured between work and home. Air-line distances were used except where a journey would involve crossing a body of water, in which case the distance was measured across the nearest bridge. This partial sample included 825 persons.

5. Workplace Information

For each person in this partial sample, the first two digits of the standard Industrial Classification (S.I.C.) index were recorded. This information was derived from Dun and Bradstreet's directory, from Contacts Influential, or was in a few

FIGURE 19

TRAFFIC ZONES, VANCOUVER, BURNABY, NORTH VANCOUVER, AND WEST VAN-
COUVER

cases inferred.

The information for each person in the sample was coded onto IBM cards and sorted mechanically.

APPENDIX B

THE DOWNTOWN PARKING SURVEY

The Downtown Parking Survey was carried out in May and June of 1962 by the Vancouver City Engineering Department. Its findings with respect to parking are presented in the report Vancouver Downtown Parking.¹ The survey was concerned with parking in downtown Vancouver from 8 a.m. to 6 p.m. Monday to Friday. The following information was elicited from parkers.

1. Parking location.
2. Day the interview was made.
3. Type of vehicle.
4. Type of parking space occupied.
5. Time of arrival and departure.
6. Principal destination of the driver.
7. Other destination of the driver.
8. Principal purpose of the driver's trip.
9. The number of passengers.
10. The principal purpose of the passengers' trip.
11. Origin of trip.
12. Home address of the driver.

The area of primary interest for the survey was the Core, consisting of zones 910, 920, 930, 940, 970, and 980 (Fig. 20). All parkers were interviewed within this area, but parkers destined for the Core were also interviewed in surrounding areas. In all,

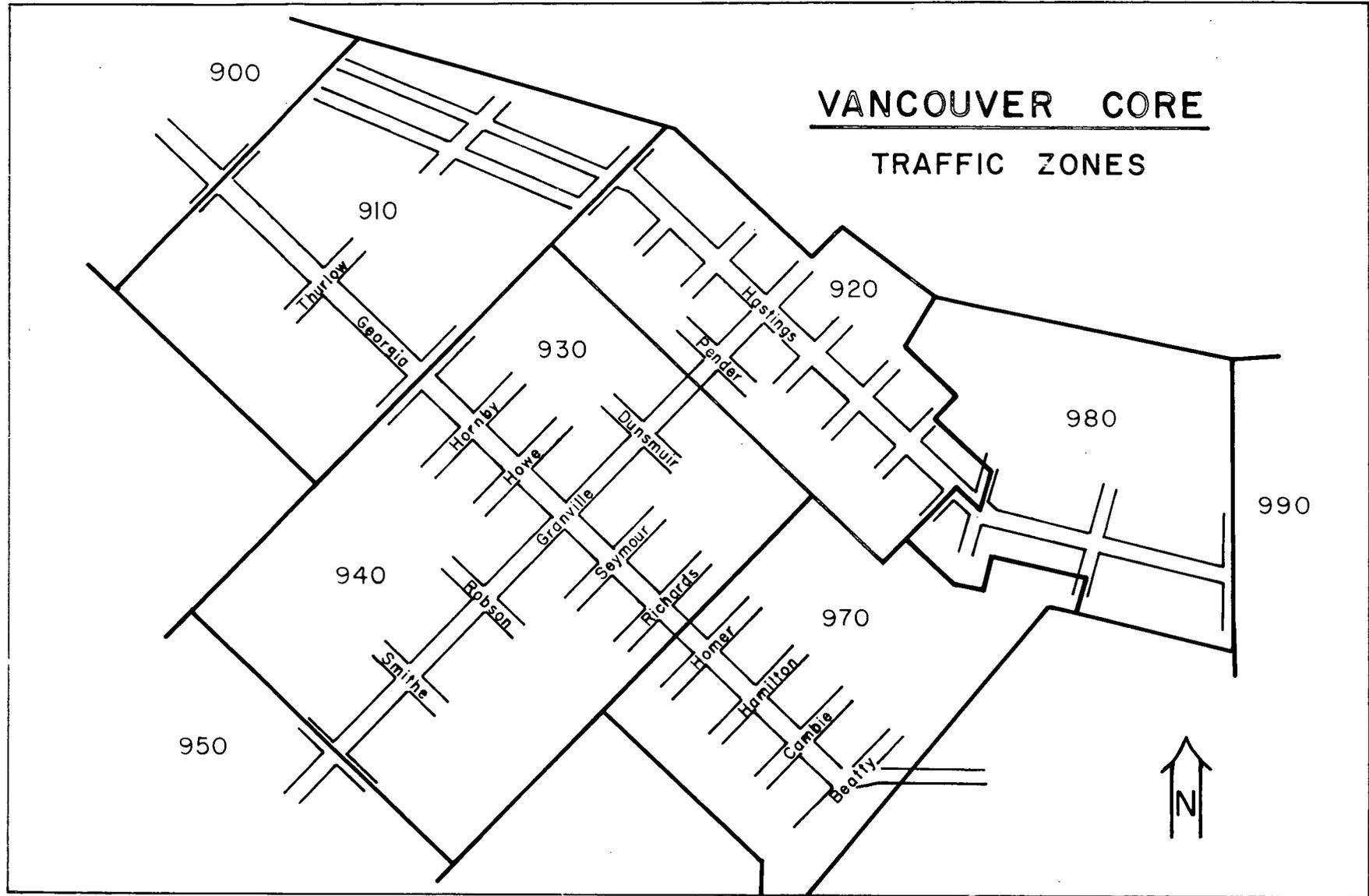
¹Transportation Engineering Branch, Vancouver Downtown Parking (Vancouver: City Engineering Department, 1962).

FIGURE 20

TRAFFIC ZONES, DOWNTOWN VANCOUVER

VANCOUVER CORE

TRAFFIC ZONES



some 60,000 interviews were carried out, representing the total number of vehicles entering the Core from 8 a.m. to 6 p.m. on an average working day. The items of particular interest to this present study were:

6. The principal destination of the driver.
8. The principal purpose of the driver's trip.
12. Home address of the driver.

The total data array was sorted by origin and destination for each of the four purposes recorded; work, shopping, business, and recreation. The resulting raw value for each residential zone could thus be taken as the number of automobile trips to the Core for each of these purposes on an average workday. This raw value was now divided by the total residential population, interpolated from census enumeration districts to give the number of trips per 1000 residential population in each residential zone. It should be noted that since the interview area of the survey was the Core rather than what has been termed the Central Area, it is this former term that has been used in all parts of the present study dealing with the Parking Survey data. Observations arising from the Survey are not therefore strictly comparable with observations arising from the City Directory sample.