SPATIAL IMPACT OF REYNOLDS JAMAICA MINES LIMITED ON EMPLOYMENT OPPORTUNITY: A SIMULATION ANALYSIS

SPATIAL IMPACT OF REYNOLDS JAMAICA MINES LIMITED ON EMPLOYMENT OPPORTUNITY: A SIMULATION ANALYSIS

By

PAUL EDWARD JONES, B.A.

A Thesis

Submitted to the School of Graduate Studies

in Partial Fulfilment of the Requirements

for the Degree

Master of Arts

McMaster University

November 1969

MASTER OF ARTS (1969)
(Geography)

McMASTER UNIVERSITY
Hamilton, Ontario

TITLE: Spatial Impact of Reynolds Jamaica Mines Limited on Employment Opportunity: A Simulation Analysis

AUTHOR: Paul Jones, B.A., (McMaster University)

SUPERVISORS: Dr. William Found; Dr. Lloyd G. Reeds

NUMBER OF PAGES: x, 147

SCOPE AND CONTENTS:

An investigation into the impact of the Reynolds Bauxite Company, a decentralized industry in north-central Jamaica, on the spatial pattern of employment in the surrounding area. The spatial impact is simulated using the Polya-Eggenberger distribution.

ACKNOWLEDGEMENTS

The author wishes to acknowledge the assistance given by the following people:

Dr. William Found for allowing him to go to Jamaica to do the research and for his freely given advice and encouragement at different phases of the work.

Dr. David L. Anderson for his advice during the development of the model.

Mr. Fridtjof Nolte for the two months spent writing the computer program for this research.

Mr. Harold Fritz for the many hours spent drawing the maps and graphs.

Finally, Mrs. D. Brown for sparing her time and patience to type the thesis.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

Chapter 1: INTRODUCTION

1.1 General Problem

To alleviate regional income disparities, governments commonly establish industries in low-income rural areas. Theoretically these "decentralized" industries should produce higher local incomes by providing job opportunities for surrounding residents, and should help to solve the social and economic problems in the more urbanized parts of these countries by decreasing the flow of "rural poor" into the slums.

Study of the spatial aspects of employment provided by rurally located industries is important and overdue. Usually these industries are established in areas with an excess of labour and other resources. It is assumed that the locally unemployed will benefit. "Who actually benefits?" and "from which geographical area does he come?" are two questions only vaguely considered, and seldom analysed afterwards. On the other hand, a sizeable literature has been amassed regarding the social impacts on family and community life[1], and regarding the overall impact of the industry on the national economy[2].

Before examining the study area selected for this research, it is necessary to examine the general nature of "decentralized industries". The most obvious characteristic of such an industry is

---

[1] e.g. Leatrice D. MacDonald and John S. MacDonald, "Motives and Objectives of Migration: Selective Migration and Preferences Toward Rural and Urban Life", Social and Economic Studies, December 1968, pp. 417-437.

[2] e.g. R.N.S. Harris and E.S. Steer, "Demographic-Resource Push In Rural Migration: A Jamaican Case Study", Social and Economic Studies, December 1968, pp. 398-406.

its distance from the country's complex industrial centres. The labourers living around these plants have no comparable industrial employer for whom they could work. Thus the decentralized industry has a free choice of the available personnel. A second characteristic is that the local potential workers have different skills and backgrounds than those of city dwellers. Very few have any industrial experience and most of them are either farm workers or unemployed.

The spatially homogeneous nature of the above two characteristics provides a simple situation for model construction. An additional feature, which appears to the author to be a fairly general condition, is that decentralized industries are under local (parish) or national political pressure to hire local residents. Such pressure, formal or informal, is particularly evident if decentralization occurs specifically to remedy regional disparities in income.

1.2 Purpose of the Study

The purpose of this thesis is to present an analysis of the impact of the Reynolds Bauxite Company, a decentralized industry in north-central Jamaica, on the spatial pattern of employment in the surrounding area. A probability model based on the Polya-Eggenberger distribution will be used to "test" the significance of several variables thought to influence the pattern, and to simulate what patterns should look like under various conditions.

1.3 The Study Area Selected

The analysis described in the succeeding chapters was part of a widely-ranging study of the impact of Reynolds Jamaica Mines Limited on the economic and social life of north-central Jamaica. The bauxite company, which owns c.80,000 acres of land, centres its operations at Belmont, where the bauxite is mined and dried for shipment, and at Ocho Rios, where employees load the ore on ships destined for the United States. The plant site at Belmont is joined to the north coast operations by a 6.3 mile overland belt conveyor, with over twice the capacity of the two tramways which it replaces. The conveyor belt system from Belmont to Ocho Rios is shown in Figure 1.

Reynolds is not typical of decentralized industries, in that it was not located specifically to alleviate regional poverty. Its location was, of course, determined by the availability of natural resources. As will be shown in the following chapters, this appears to make little difference as far as its impact on local employment is concerned. In all respects its influence on the spatial distribution of employment is the same as if it were a highly mobile, labour-based plant.

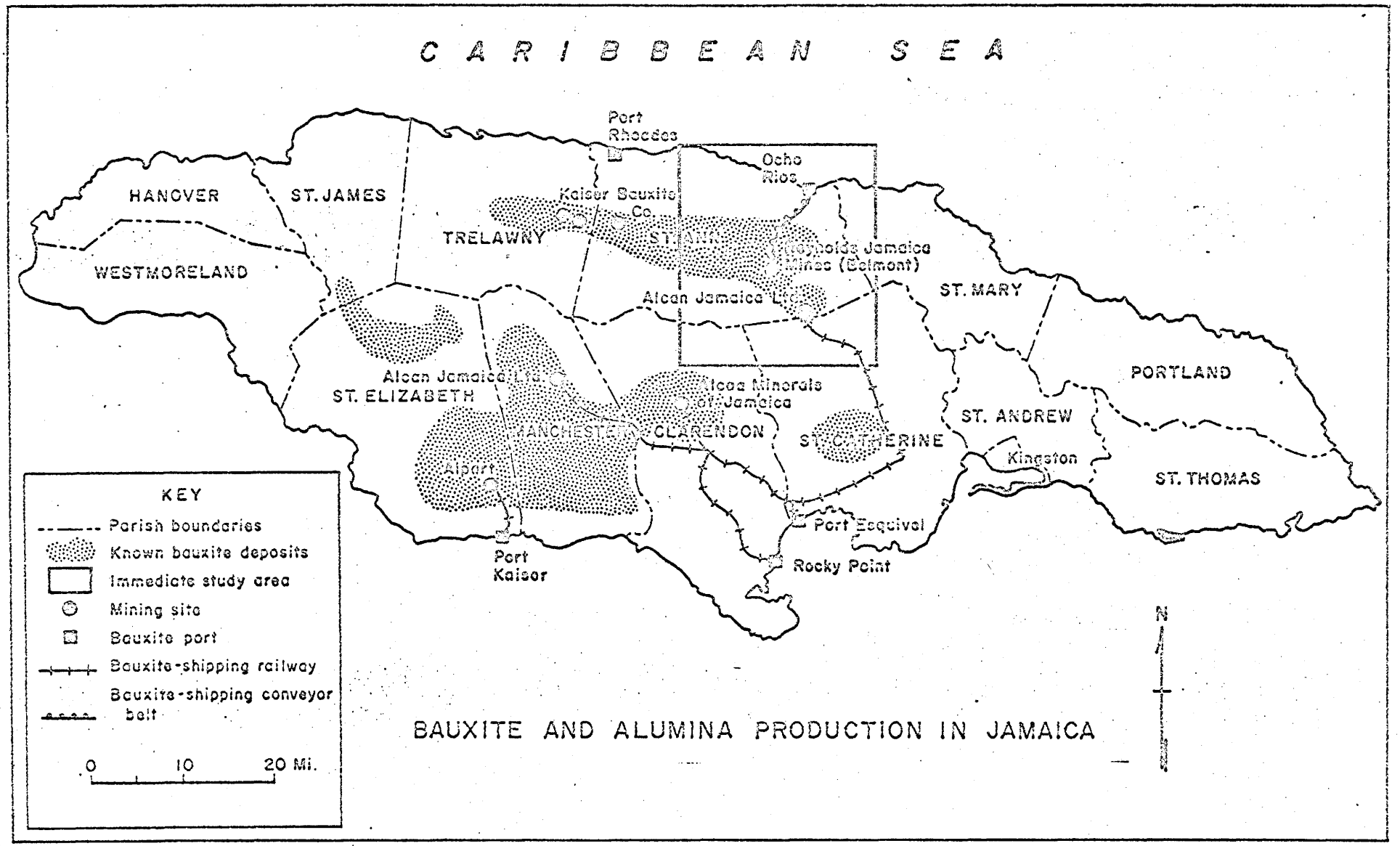
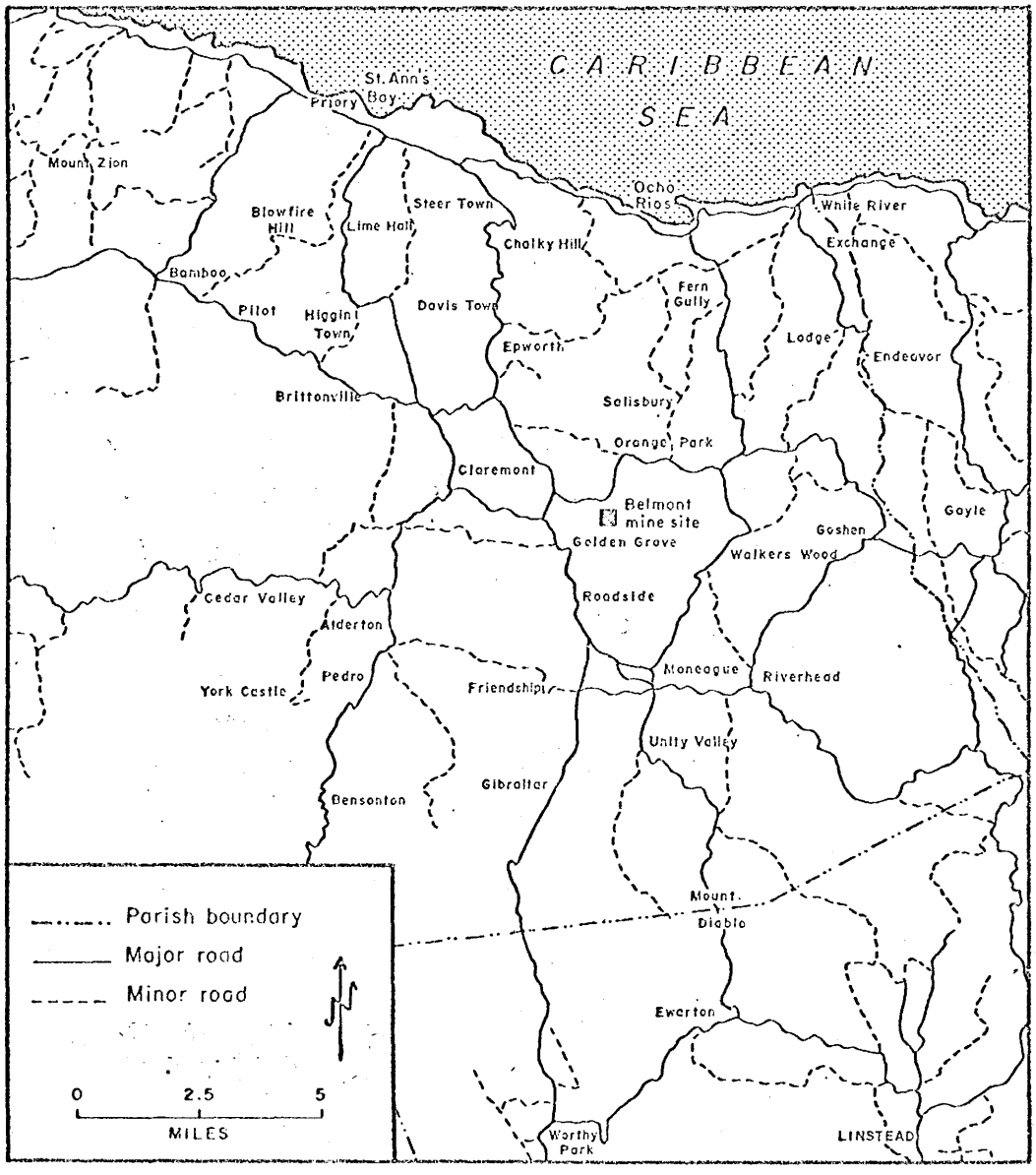

CARIBBEAN SEA
Port Rhoades
Ocho Rios
HANOVER
ST. JAMES
Kaiser Bauxite Co.
TRELAWNY
ST. ANN
Reynolds Jamaica Mines (Belmont)
WESTMORELAND
Alcan Jamaica Ltd.
ST. MARY
Alcan Jamaica Ltd.
ST. ELIZABETH
Alcoa Minerals of Jamaica
PORTLAND
MANCHESTER
CLARENDON
ST. CATHERINE
ST. ANDREW
Kingston
Alpart
ST. THOMAS
Port Esquivel
Port Kaiser
Rocky Point
KEY
Parish boundaries
Known bauxite deposits
Immediate study area
Mining site
Bauxite port
Bauxite-shipping railway
Bauxite-shipping conveyor belt
0 10 20 Mi.
N
BAUXITE AND ALUMINA PRODUCTION IN JAMAICA

Figure 1

The "immediate study area", which is outlined in Figure 1, has rolling topography with some steeper-sided and somewhat conical-shaped hillocks. Outcrops of limestone on the sides of these hillocks are evident while in the hollows thick deposits of red bauxitic soils are found. The area around the Belmont plant ranges from approximately 800-2,400 feet above sea level; but to the south of the study area, in St. Catherine Parish, even higher altitudes are found.

Figure 2 shows, in much more detail, those portions of St. Ann, St. Mary and St. Catherine Parishes which form the immediate study area. The map indicates the pattern produced by the transportation network and the distribution of the more important towns and villages within a commuting distance of forty minutes. On the map, different road types are indicated. "Major roads" include Class A and B surfaces which are the fastest routes available. These two types are utilized mostly by through traffic, whereas "minor" or parochial roads are restricted mainly to local traffic.

Bauxite extraction is not the only economic activity in the study area, but is perhaps the most lucrative from an employment point of view. Many of the rural residents in the Parishes are agriculturally employed. Plots of land in the valleys and on the hillslopes are devoted to the growing of many different crops and also to the raising of livestock. Acreages are usually small, with very few people owning and operating properties larger than five acres. The study area, especially near Belmont, does not abound with these small mixed farms because of the existing land tenure conditions with Reynolds owning most of the properties.



STUDY AREA ROAD NETWORK

Figure 2.

1.4 Formation of Bauxitic Deposits

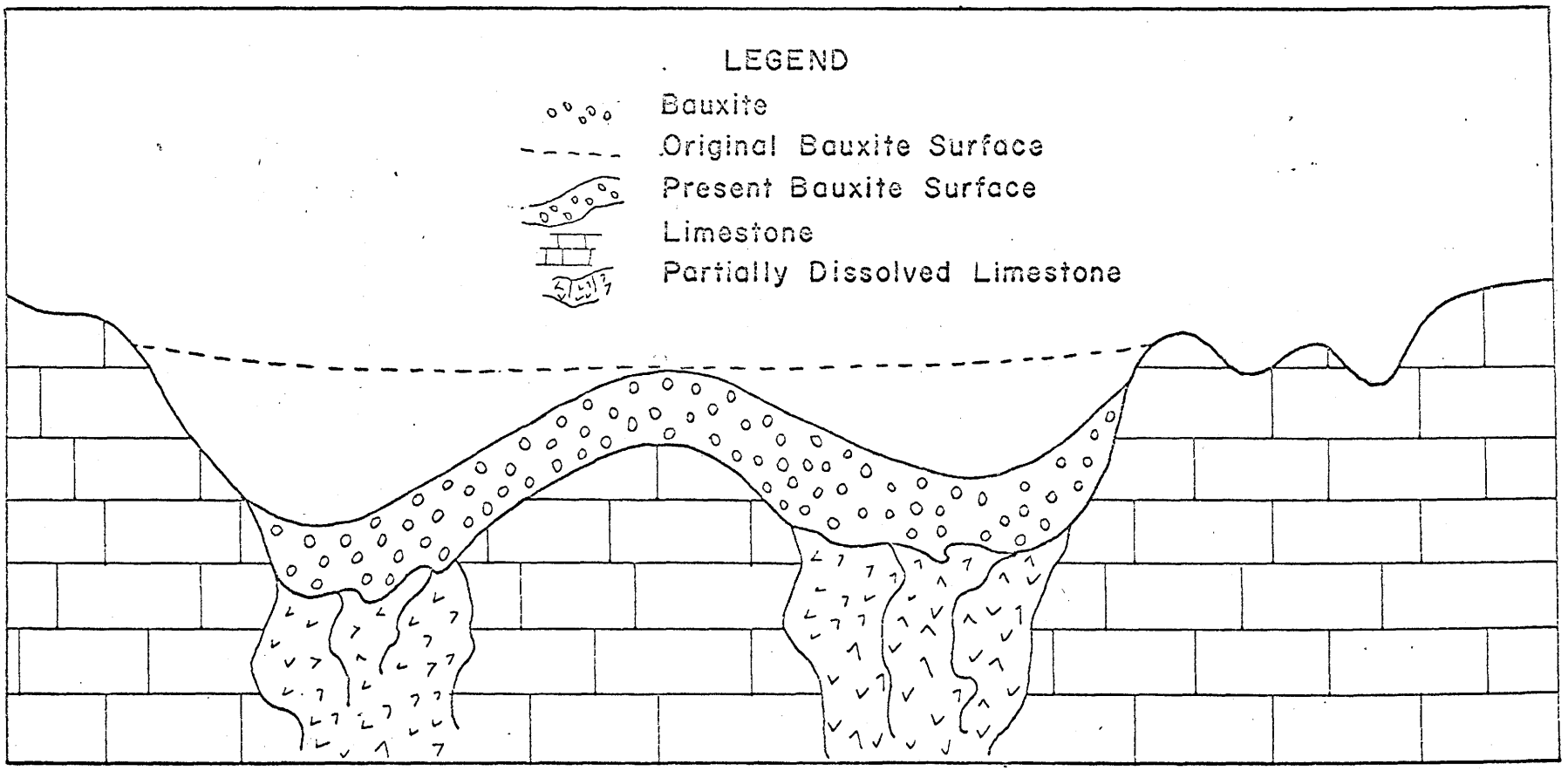
Jamaica has become one of the world's few sources of commercially valuable bauxite. Before discussing the distribution of these deposits on the Island and the location and growth of the extracting companies, it would be worthwhile outlining how bauxite deposits are formed and where they are deposited.

Bauxite results from the weathering of aluminum-bearing rocks under tropical conditions. It has been shown that it may form residual deposits replacing the original rock or it may be transported from its place of origin and be re-deposited elsewhere. In Jamaica the deposits usually fill depressions in the underlying limestone. Sometimes, such as in the Belmont area of St. Ann Parish, there is hillside ore resulting from additional caving within the area of a previous large subsidence of the ground due to earth movements (see Figure 3).

1.5 Growth of the Bauxite Industry in Jamaica

Prior to 1942 there was little interest shown in the bauxitic deposits of Jamaica. Perhaps the first significant study of these "red earths" came in a 1938 investigation of certain poor yielding agricultural soils near Claremont (see Figure 2) in St. Ann Parish. The severe World War II shortage prompted Britain and the United States to examine the possibilities of extracting the Jamaican ore. Not only were deposits reportedly small but also they were impossible to process at that time.

The first private company to become seriously interested in the potential of bauxite extraction in Jamaica was Reynolds Metals



BAUXITE DEPOSITS NEAR BELMONT

Figure 3.

Company. Their research began in 1943 and by September 1950, the Governor in Executive Council issued an Order declaring Reynolds Jamaica Mines a recognized bauxite producer, the first to be so designated.[3]

In a development proposal submitted to the Jamaican Government on the 6th of April 1949, the Company stated that the construction work "is expected to require the employment of about 500 Jamaicans of all skills and crafts for a period of up to two years".[4] In that same proposal, Reynolds Metals Company of the United States, declared that "every effort will be made to man supervisory posts with Jamaicans".

It is interesting to note that in a letter to the Colonial Secretary dated 12th of June 1951, it was stated that the construction in April 1951, had seen the employment of 1,600 Jamaicans. This increase was due to the doubling of the yearly output to be obtained from the plant. In that letter, reference is also made to long-term mining employment estimates. At that time it was reported that 200 employees, to be trained by the Company, would be sufficient to give them the 800,000 tons a year that they wanted. They estimated that yearly agricultural employment would more or less stabilize at 400.[5]

Fluctuations in the Company's yearly totals of hourly-paid mining employees is revealed in Figure 4. It indicates that the number of employees hired increased rapidly to 927 in 1956, and has been declining since.

---

[3]"Reynolds Jamaica Mines Limited: Its Origin and Development 1943-1953", Reynolds Metals Company, Economic Research Department, August 1956, page 5.

[4]Ibid: page 28

[5]Ibid: page 37

YEARLY FLUCTUATIONS IN THE NUMBER OF HOURLY-PAID MINING EMPLOYEES

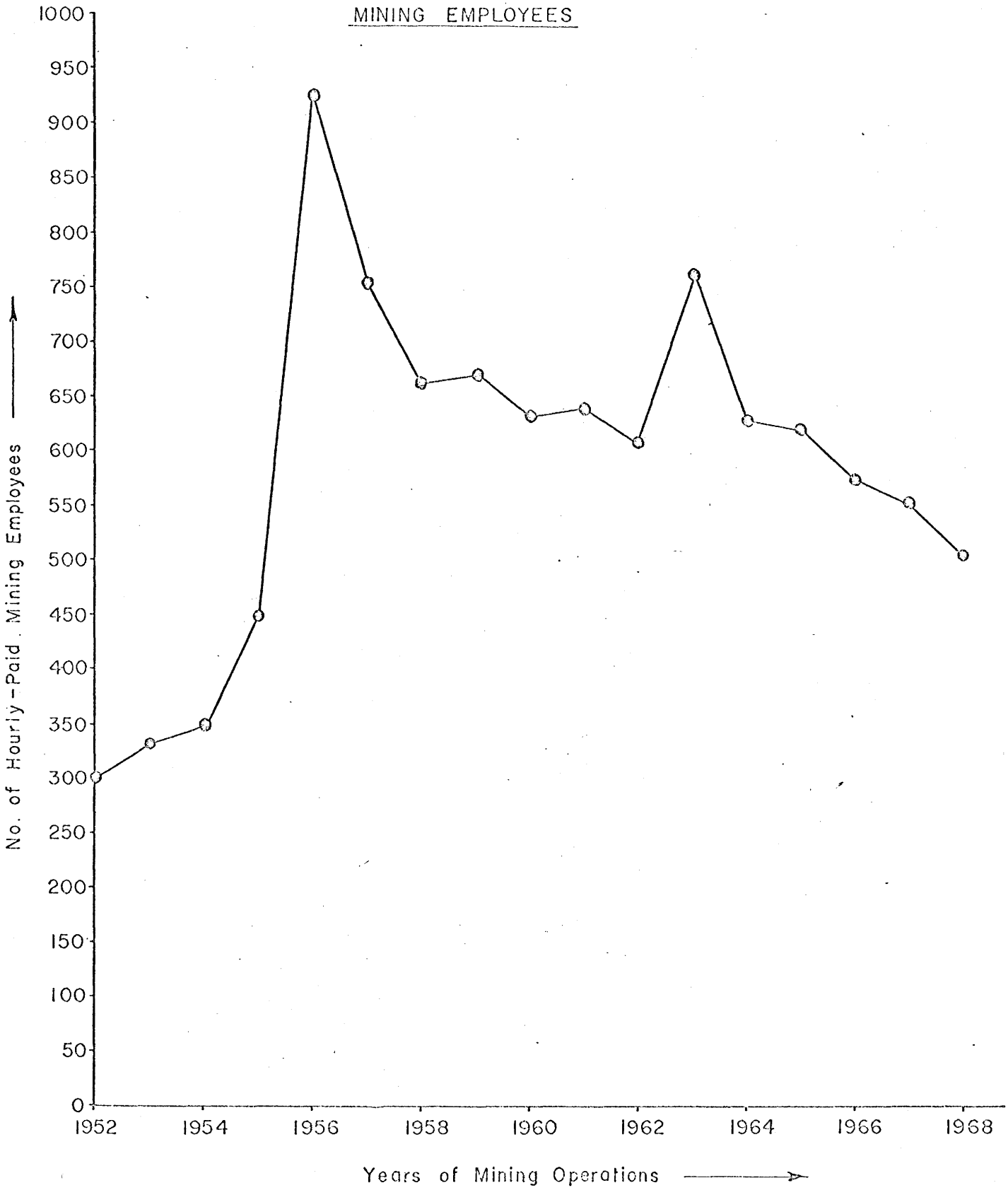


Figure 4.

Once it became known that bauxite deposits in Jamaica exceeded 350,000,000 tons and that Reynolds had perfected a method of economically processing the ore, other bauxite producers became interested in establishing operations on the Island. One of the earliest was Canada's Alcan Jamaica Limited; others included Kaiser Bauxite Company and Alcoa Minerals of Jamaica, all of which are subsidiaries of their parent companies. Recently a consortium has been formed to help facilitate a re-organization of bauxite holdings that should benefit all the companies involved. This new bauxite company is Alpart, which will ship its bauxite out via Port Kaiser (see Figure 1). Figure 1 shows the location of known bauxite deposits and the distribution of bauxite companies mentioned above.

1.6 Summary

The introduction has outlined the problem to which this research will address itself. In addition this first chapter has pointed-up the characteristics of the study area and has reviewed the historical development of the bauxite industry in Jamaica.

Chapter II: HYPOTHESES TO BE "TESTED" AND A REVIEW OF RELEVANT LITERATURE

2.1 Statements of the Hypotheses

Prior to the detailed data collection and analysis, a number of hypotheses were put forward by the researcher. Firstly, it was noted that there were actually two patterns to be considered -- one reflecting the location of employees when they first obtained employment with Reynolds and a second indicating their residence location after receiving employment. The two patterns should not be identical as it was common for some individuals after obtaining a job with the Company to relocate themselves in better homes or in places more accessible to the plant. The pattern of employee distribution, then, was a dynamic one, constantly being altered as new people obtained employment and as existing workers relocated themselves in space.

A second complicating factor was that there were two plant locations and two types of employees (unskilled, hourly-paid workers, who came primarily from the local area, and skilled, salaried employees, who came from much farther distances, i.e. Kingston). The author realized that any meaningful analysis would have to distinguish among the patterns generated by these different employment characteristics. It was also recognized that the original distribution of skilled personnel (salary-paid) would be not only wide-spread, but lacking the high degree of spatial regularity thought to be exhibited by the pattern of local, unskilled workmen.

With respect to those employees who could have been hired from among local people, it was hypothesized that their original location should form a pattern which clustered around the two plant sites in St. Ann. This was proposed for three reasons: (a) the Company would

be under political pressure, informal for local people and formal from the Parish Council of St. Ann, to hire local individuals; (b) the Company would prefer to hire people living close to the Belmont and Ocho Rios plant sites since the short journeys-to-work would help ensure that the employees were on-time and well-rested; (c) people living nearest to the above industrial sites would have the greatest opportunity and motivation to seek work with the Company. Under these conditions it was hypothesized that the number of people obtaining employment living at various time-distances from the plants should give rise to a concave decay function, as depicted in Figure 5, if the population was assumed to be uniformly distributed. The shape of the curve would result from a maximum number of persons being chosen by the personnel officer from as close to the plants as possible, with others being selected from farther distances until the Company's labour demands were satisfied. Time-distance was considered to be much more important than road-distance, since most of the Jamaicans concerned were well aware that the local roads varied greatly in quality and safe driving speeds. An analysis of the modes of travel of Company employees revealed that almost all workers travelled to work each day in automobiles. It was hypothesized further that from the standpoint of the employment officer attempting to hire local people, actual time-distance was not as relevant as his perception of time-distance.

Population density has never been uniform in the study area (see Figure 2) due to the presence of towns, roads, a highly variable farming resource base, and varying rural land tenure conditions on the undulating Parish landscape. So it was hypothesized that the

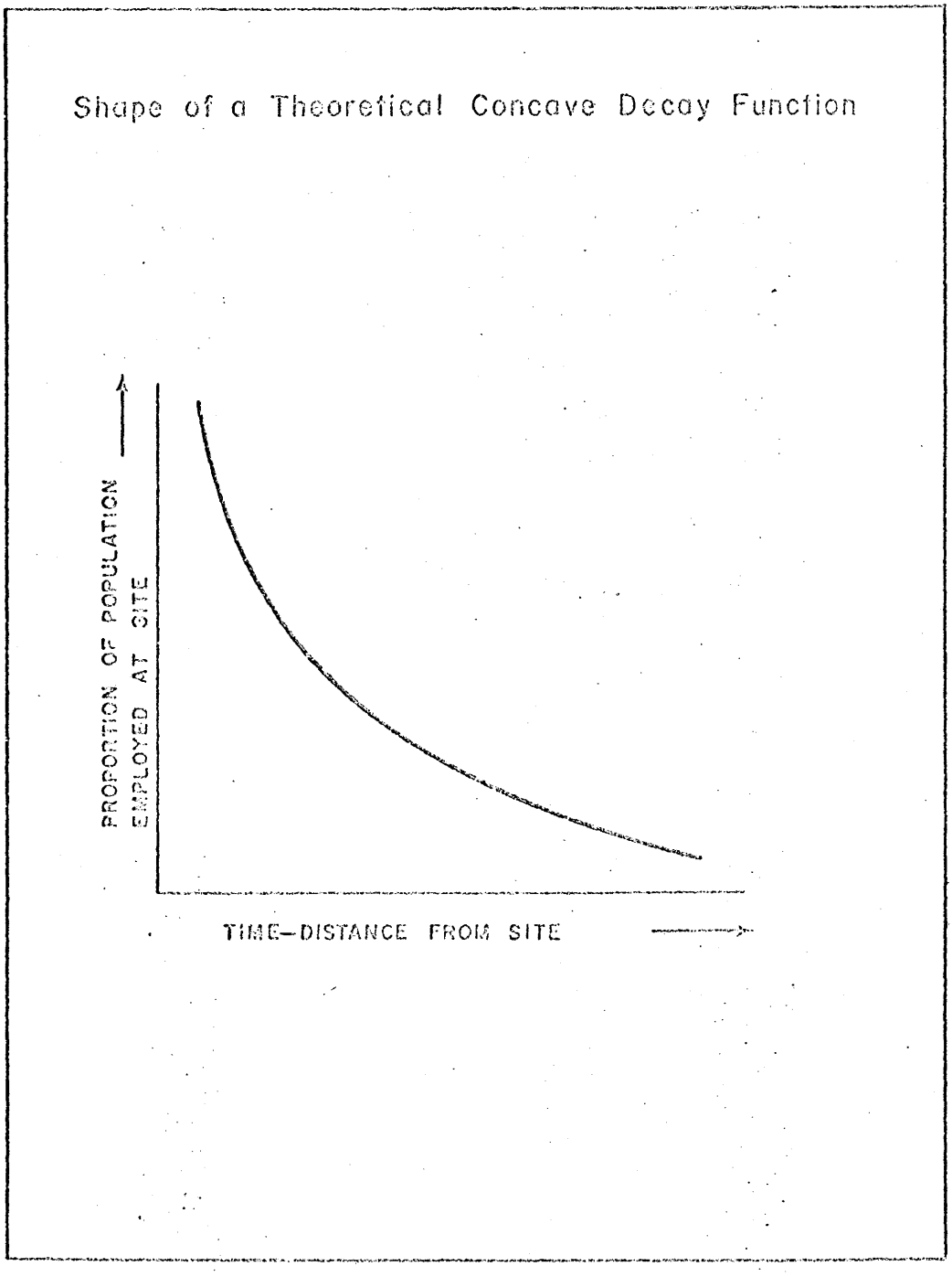

Shape of a Theoretical Concave Decay Function
PROPORTION OF POPULATION EMPLOYED AT SITE
TIME–DISTANCE FROM SITE

Figure 5.

pattern of original employee locations should reflect the original population distribution. Further, population density was not considered to be as important as the distribution of qualified persons who would be seeking bauxite employment. The significance of these variables would be "tested" in the model.

Two personal or psychological variables considered to be important in accounting for the original distribution of employees were the Company's impressions of the different towns and districts around the plant and an inter-employee neighbourhood effect. It was recognized during field work that Jamaicans normally have strong value judgements about the quality of people living in specific towns or districts, and it was felt that these impressions should be reflected in the hiring policy of the Company. With regard to the inter-employee neighbourhood effect (H), it was hypothesized that the friends and/or existing employees would have a better chance of securing employment than those with no such contact or "pull". Aside from favoritism shown to these applicants, it was felt that the Company would be reducing its risk by hiring individuals known and recommended to Mr. X by existing workers.

As mentioned above, it was proposed that the actual distribution of employees at any given time would reflect both their location just prior to obtaining employment and the tendency for some of them to relocate themselves. The relocation process should have occurred so that workers could live in areas regarded as more attractive for residence and/or more accessible to the plant. The increased income from bauxite employment would facilitate their moving. The relocation

patterns should tend to centre on towns in the study area regarded as preferred residential sites, and should reflect an adjustment to accessibility measured in terms of actual time-distance. The latter process should give rise to a concave decay function, again as illustrated in Figure 5, as this distribution would reflect a saturation of housing proximous to the industrial sites. Functions of this shape were also reported from a number of journey-to-work studies (see below).

2.2 Review of Relevant Literature

(a) The Interaction Concept and its Various Uses

The distance variable, needless to say, is discussed in connection with many different types of geographical studies. It has always been of major importance in interaction studies.

Geographers, who have found the use of analogy helpful in solving their problems, drew the interaction concept from physics and attempted to adapt it to their needs. Despite the apparent similarity in certain areas of the two subjects, there is one basic difference. In physics, it is the behaviour of molecules which is being predicted while in geography it is the interaction of human beings, who, at times, are not completely rational in their actions, which is being considered.

A good review of the interaction hypothesis and its historical development is provided by Carrothers 1965a.[6] In this paper he provides the reasoning on which the interaction hypothesis is based. One of these conditions is that the friction against communication between

---

[6] Gerald A.P. Carrothers; "Discussion: Gravity and Potential Concepts of Human Interaction", Journal of the American Institute of Planners, Volume 22, 1956a.

people is directly proportional to the intervening physical distance between the individual and the given location. The above indicates a linear relationship. The validity of this sort of relationship will be examined at a later stage.

Carrothers reveals that one of the earliest formulations of the interaction (gravity) concept came from E.G. Ravenstein.[7] He concerned himself with explaining migration movements. He was able to show that migration tended towards large cities and that the volume of movement decreased with the distance between the source of the migration and the centre of absorption.

E.C. Young in the late 1920's, attempted to measure migration flows.[8] He saw the force of attraction of a point as the controlling element. Unlike Ravenstein, Young considered that the relationship varied inversely with the square of the distance. Others have tested the concept also. Some of the characteristics used to measure the energy of interaction included telephone calls, bus passenger movements and newspaper circulation.

The distance factor has been a source for much debate over the years. J.D. Carroll[9] and D.O. Price[10] have in their work found that the effect of distance varied over space. They did not feel that

---

[7]E.G. Ravenstein; "The Laws of Migration", Journal of the Royal Statistical Society, Volume 48, Number 6, 1885, pp. 167-235, and Volume 52, Number 6, 1889, pp. 241-305.

[8]E.C. Young; The Movement of Farm Population, Bulletin, 426, Cornell Agricultural Experiment Station, Ithica, New York, 1924.

[9]J. Douglas Carroll; "Spatial Interaction and the Urban-Metropolitan Description", PPRSA, Volume 1, 1955.

[10]D.O. Price; "Distance and Direction as Vectors of Internal Migration, 1935-1940", Social Forces, 27:1 (10/48), pp. 48-53.

its relationship was a simple inverse one as Ravenstein implied but one in which distance was raised to some power other than unity. Various exponents have been used, with values ranging from 0.5 to more than three. This variation seems to be the result of the varying purposes of the trips and the type of transportation media used. For example F. Iklé[11] obtained an exponent value of 0.69 for car trips in Texas, 2.57 for car trips between Fort Wayne and various counties in Indiana, and found that for most air travel on the North American continent values are about 1.07. These are empirical values and have as yet no theoretical base.

The distance variable is usually measured as a straight-line distance. Gunnar Olsson[12], in his book entitled Distance and Human Interaction makes reference to this method of calculating distance values but also comments on several other studies which have utilized other forms of the distance measure.

Ellwood 1954 [13] and Voorhees 1955 [14] represented "dij", found in the general interaction models, by computed values for travel-time rather than just using a straight-line measure. Other variations include, the use of transport costs by Harris in 1954 [15] and the use

---

[11] Fred Charles Iklé; "Sociological Relationships of Traffic to Population and Distance", Traffic Quarterly, Volume 8, 1954.

[12] Gunnar Olsson; Distance and Human Interaction, Regional Sience Research Institute, Bibliography Series, No. 2, Philadelphia, 1965.

[13] Leon W. Ellwood; "Estimating Potential Volume of Proposed Shopping Centres", The Appraisal Journal, Volume 22, 1954, pp. 581-589.

[14] Alan, M. Voorhees; "A General Theory of Traffic Movement", Proceedings of the Institute of Traffic Engineers, 1955, pp. 46-56.

[15] Chauncy D. Harris; "The Market as a Factor in the Localization of Industry in the United States", AAAG, Volume 44, 1954, pp. 315-348.

of transfer and time costs by Ullman in 1957 [16]. Finally Garrison in 1955 [17] worked with road-distances, weighted according to the different surface conditions.

Although the use of straight-line measures is the most common, there is no theoretical basis for it, and its use results more from convenience than anything else. For the purposes of this research project, the use of straight-line measures from the plant site to the various census subdistricts would imply more or less equal ease of movement in all directions which is certainly not the case. It seemed that by using time-distance measures one could take into account variations in road surface conditions as well as variations in route length.

Human interaction as outlined by Carrothers, requires communication between individuals and usually includes physical movement of people. Closely related to this movement, as indicated earlier, are studies of migration. A great deal of literature exists on the subject of human migration and various types have been isolated. For instance, Wolfe 1966 [18] sees three major types. They include:

(1) movement out of the country towards large cities,
(2) journey-to and from work, and
(3) migrations within regions, within countries, across continents and throughout all parts of the world.

---

[16] Edward L. Ullman; American Commodity Flow, Seattle, Washington: University of Washington Press, 1957.

[17] William L. Garrison; "The Spatial Impact of Transport Media: Studies of Rural Roads", PPRSA, Volume 1, 1955, pp. T1-T14.

[18] Roy L. Wolfe; "Recreational Travel: The New Migration", Canadian Geographer, Volume 10, No. 1, 1966.

The "pull" of large cities is influencing rural areas throughout the world. Two papers focussing on this type of migration problem in Latin America are written by Harris 1968 [19] and MacDonald 1968 [20]. In both the above research papers, the push-pull concept is said to be operating. Gunnar Olsson stresses the economic factor when he states that "migrations are a means of achieving a state of spatial income equilibrium".

Porter[21], in his paper entitled "Approach to Migration through its Mechanism", stresses economic factors. His main hypothesis was that migration only takes place in connection with changes of employment. The relocation of employees in the second part of the research described in this thesis results from the obtainment of a job with the bauxite company. In Porter's research, distance was involved in so far as he made the assumption that employers always hired the worker who lived closest to the work place.

Raimon 1962 [22] also stresses economic or wage factors in determining migration, but claims that the causal relationship is stronger for long distance than for short distance movements.

---

[19] R.N.S. Harris and E.S. Steer; "Domographic-Resource Push in Rural Migration: A Jamaican Case Study", Social and Economic Studies, December 1968, pp. 398-406.

[20] Leatrice D. MacDonald and John S. MacDonald; "Motives and Objectives of Migration: Selective Migration and Preferences Toward Rural and Urban Life", Social and Economic Studies, December 1968, pp. 417-434.

[21] R. Porter, "Approach to Migration through its Mechanism", Geografiska Annaler, Volume 38, 1956, pp. 317-343.

[22] Robert L. Raimon, "Interstate Migration and Wage Theory", The Review of Economics and Statistics, Volume 54, 1962, pp. 428-438.

A number of journey-to-work papers were examined by the author in the hope of gaining an insight into the relationship between distance and number of employees so that the relationship might be used in the model to be developed here. No such definitive statement was found. Most papers stress the importance of the distance factor in work-trips but don't go into it any further. Wolfe[23] in his comparison between work and recreational-trips states:

> "The journey-to-work takes place for most people at fixed times on every working day of the year and between a fixed origin and a fixed destination, whereas recreational-travel has only a fixed origin -- home, and in every other respect is discretionary".

The type of relationship that exists between the proportion of the population employed at the mine site and the time-distance of these employees might be viewed as a "distance decay function" (see Figure 5). This concept grew from the diffusion research of Torsten Hagerstrand[24]. Hagerstrand noted that many of man's attributes have a nebula-like cluster-form. Many spatial distributions have a concentrated core surrounded by a boarder zone of outwards decreasing density. He attempted to examine the process behind this cluster-form, and to do so studied the diffusion of two farm techniques. He attempted to explain the concentration of adopters at certain points in space by the "neighbourhood effect". Here the probability of adoption was affected by a potential adopter's proximity to a past adopter. Hagerstrand stressed the importance of face-to-face contacts as opposed to the effects of the mass media. He combined the distance decay relationship with the neighbourhood effect in developing his model.

---

[23] Roy L. Wolfe, "Recreational Travel: The New Migration", Canadian Geographer, Volume 10, No. 1, 1966.

[24] Torsten Hagerstrand; "A Monte Carlo Approach to Diffusion", Archiv. Europ. Sociol., Volume 6, 1965, pp. 43-67.

The existence of a social communication system in the countryside around the bauxite plant in Jamaica is not questionned. It was hypothesized at the beginning of this chapter that non employees would seek the aid of employees in order that they might obtain jobs. Since the presence of an existing employee in a census subdistrict makes it a more viable source of additional employees, a multi-clustering process might be envisaged. The importance of the neighbourhood effect in the decision to adopt at the local level has also been indicated by Wolpert[25].

2.2(b) Diffusion Research

Perhaps the major review work in this particular field, comes from Lawrence A. Brown. In his 1965 review paper[26], he examined many different models of diffusion. He cited, for example, epidemiology models and logistic curve models.

The epidemiologists have studied the spread of communicable disease but have failed to adequately incorporate the spatial element into their diffusion work. The work done with the logistic curve was suitable for predicting the rate of adoption or change (growth) through time but also failed to adequately handle the spatial element. One of the best examples of the use of the logistic curve was found in the work of Zvi Griliches[27]. The process implied by his model was

---

[25]Julian Wolpert; "The Decision Process in Spatial Context", AAAG, Volume 54, 1964, pp. 537-558.

[26]Lawrence A. Brown; Models for Spatial Diffusion Research, A Review, Technical Report No. 3, Spatial Diffusion Study, Department of Geography, Northwestern University, June, 1965.

[27]Zvi Griliches; "Hybrid Corn: An Explanation in the Economics of Technological Change", Econometrica, Volume 25, 1957, pp. 501-522.

that the rate of growth through time of acreage in hybrid corn was proportional to the percentage of corn acreage already in hybrid corn and the maximum area that could possibly be in hybrid corn in that state.

Likely the basic reason that Hagerstrand was able to adequately take account of the spatial element was his observance of a distance decay phenomena. He was able to get measures for this from marriage-migration and telephone-call data, and the results formed the bases for the development of his field of contact. This field was known as the mean information field and consisted of twenty-five regular cells. By knowing the probability in the central cell and the nature of the distance decay function, one could then ascribe probability values to all of the cells in the matrix. These probability values could then be accumulated in any sequence from 0.000 to 0.999 so that the interval in each cell was determined by its respective importance. This made it possible to use random numbers to represent the diffusion process.

Waldo Tobler[28] criticised Hagerstrand's use of a symmetrical distance decay function. Tobler realistically indicated that the possibility of asymmetrical weightings was due to tendencies for easier movement in particular directions.

2.2(c) Simulation Studies

With increasing emphasis in the last few years on stochastic or random models of complex processes, few methods could be derived

---

[28] Waldo R. Tobler; "Of Maps and Matrices", Journal of Regional Science, Volume 7, No. 2, 1967, pp. 275-280.

that would adequately represent a diffusion process. The simulation of the actual distributions by the use of Monte Carlo (gaming) techniques seems to allow for such complexities. The following pages will provide some discussion of simulation methods and how they have been used in different problem areas.

The rules for a simulation procedure, reported by an author whose identity is unknown, include the following:

(1) Start with a given distribution of acceptors.
(2) The rules are then developed which are thought to govern the ensuing spread of the innovation. All other factors not included in the rules are said to interact randomly.
(3) Develop a series of game operations which control the working of the simulation model itself.
(4) Generate the diffusion of the innovation with this framework.
(5) A comparison is made between the generated distributions and some actual distribution in order to discern other factors that might be important but which were ignored in the formation of the first set of rules.

William Garrison in his 1962 paper[29] indicates that very little systematic discussion of the simulation technique can be found in the literature. In his paper and several others, the point is made of how important it is to have a "large" computer to help operationalize the model. This is due to the need for storing and reassessing probabilities after each time period or iteration. Garrison does not adequately clear-up the confusion that has developed between the terms Monte-Carlo and simulation but does state that simulation stresses the construction of an abstract model of the system being studied, whereas Monte Carlo refers to a random technique.

Richard Morrill in his 1962 paper[30] sees growth as being a

---

[29]William L. Garrison; "Toward Simulation Models of Urban Growth and Development", Symposium of I.G.U., Lund, K. Norberg (eds.), 1962, pp. 91-108.

[30]Richard L. Morrill; "Simulation of Central Place Patterns over Time", Symposium of I.G.U., Lund, K. Norberg (eds), 1962.

random process. He thus uses a Monte Carlo type of model in which a set of probabilities govern behaviour. These probabilities change over time as opposed to Hagerstrand's probability values which were temporally constant but spatially variable. Morrill sees the Monte Carlo technique as an experimental procedure for the mathematical evaluation where unique mathematical solutions are not possible. Morrill varied the shape of his grid, using both rectangular and hexagonal forms. The research project to be outlined in this report not only allows the probabilities for the areal units to vary over time but also uses irregularly shaped cell units unlike both Hagerstrand and Morrill.

The time component in many simulation models is treated as a discrete unit. It is reported that the simulation of the time component is very difficult if feedback is allowed in the model. For the purposes of the model to be suggested in this research, discrete time units will be used.

One of the major areas of controversy with simulation models is the methods used to test them. Hagerstrand generated five distributions and relied on a visual comparison to test his model.

Robert Colenutt 1969[31], discusses at length the problems one faces when attempting to test a simulation model. He says that the testing is more demanding than the construction of the model. He also points out that it is not enough to estimate an average solution nor should a researcher choose the simulated pattern closest to the

---

[31]Robert L. Colenutt; "Linear Diffusion in an Urban Setting: An Example", Geographical Analysis, Volume 1, No. 1, 1969, pp. 106-114.

actual. It is also very difficult to decide how many simulations must be obtained before one has exhausted all the possible variation. Whereas Hagerstrand did five simulations, Colenutt did one hundred and yet Colenutt claimed he still did not find a close correspondence between the actual and simulated patterns.

2.3 Summary

The above review has outlined some of the research which has been done in the field of human interaction. The review has shown the applications of the interaction concept to the study of migration and diffusion. Both were seen as being relevant to certain aspects of the following research and much useful comment was derived from these papers. Finally the examination of some articles dealing with the simulation technique have clarified its purpose and the problems one faces when it is used.

The discussion of the actual simulation model developed and used in this research project will be outlined in Chapter IV. The nature of its form and operating rules have been strongly affected by the above review.

Chapter III: SOURCES OF DATA

3.1 Sources of Information

Materials utilized in this study have come from three principal sources: publications, interviews and questionnaires.

(a) Publications

Publications were obtained from the Department of Statistics of the Jamaican Government, from the Town and Country Planning Institute and from other government departments. Volume 1 Parts C and D of the 1960 census were very useful for providing data on the "environment" of the 109 study area subdistricts. Various publications, related to wage rates, internal migration flows[32], economic surveys for 1966 and 1967 and the annual abstract of statistics for 1967 were also obtained from the Department of Statistics.

The Town and Country Planning Institute was of great assistance to the project. They were able to provide us with: (a) blue-print copies of the parish population maps at a scale of 1:50,000. On these maps the population distribution in each census subdistrict was shown. These maps, especially the ones related to the study area selected, have been very helpful in the formulation of the simulation model.

In addition to the above population maps, maps were obtained at 1:50,000 which stated the "enumeration district" number of each of the census subdistricts in the study area. Without these maps, the census data could not have been applied to specific areal units. These maps allowed the author to pinpoint accurately conditions in each census subdistrict related to educational levels, unemployment

---

[32] Kalman Tekse, Internal Migration in Jamaica, Demography and Vital Statistics Section, Department of Statistics, April 1967.

levels and age characteristics for all of the 109 subdivisions. Smaller scale maps were obtained showing the distribution of bauxite producers (see Figure 1), and net migration movements from parish to parish between 1943-1960. At the Surveys Department were obtained two complete sets of 1:50,000 topographic maps of the Island and two copies of the 1:250,000 sheet of Jamaica.

At the Government Printer's Office, copies of the numerous laws related to mining regulations and land tenure conditions were purchased. Publications obtained from Reynolds Jamaica Mines Limited were generally of limited use. However, a copy of a booklet published in 1956 [33], was obtained which outlined the historical development of Reynold's involvement in Jamaican bauxite extraction. This has been the most useful publication obtained from the Company itself. Other "publications" which must not be overlooked are the many articles read and reviewed in the previous chapter.

(b) Interviews

Interviews were conducted with different government and private officials during the course of the summer months. In Kingston, we introduced ourselves to the personnel at the various government departments, some of which have been mentioned above, and informed them of our project. At the plant site, Mr. Rudolph Jobson, Reynold's Chief Personnel Officer was interviewed.[34] He informed us of the size of the Company's operations and assured us that he would help us in any way that he could.

---

[33] "Reynolds Jamaica Mines Limited: Its Origin and Development 1943-1953", Reynolds Metals Company, Economic Research Department, August 1956.

[34] Mr. R. Jobson will be referred to in most of the text as Mr. X or the personnel officer.

The sample of employees to be studied in this research was drawn from an I.B.M. 360 computer print-out of the May, 1968 employee payroll lists which included the names and department numbers of all employees still on the payroll at that time. From this master list a forty percent spatially-random sample was systematically selected. This produced a total of approximately 327 names. The complete list of employees is shown in Appendix A. It was from the addresses recorded here that the employees had to be located. The department number of each employee was very useful in determining where the individual actually worked. For example, the department 230 indicated that the individual was employed at the dock facilities in Ocho Rios, whereas department number 400 referred to the farm operations in Manchester and St. Elizabeth Parishes.

The forty percent sample was required because of the expected difficulty in locating the residences of many of the employees. When a request was made to examine the Company's personnel files in order to obtain the addresses of the employees selected, we were informed that no up-to-date addresses were kept by the Company of their hourly-paid workers. Mr. X stated that he could recall by memory the addresses of most of the hourly-paid workers and virtually all of the salaried employees. Once these lists were completed, they were reorganized and grouped according to postal addresses.

As expected, much difficulty existed in accurately locating the residences of many of the employees on the list. In many cases the addresses we had been given were wrong. It had been originally suggested that the author take the lists of names for each post office

to the postmistress and have her state the actual residence location of each employee who gets his mail from her. We attempted to use this method in Moneague and Golden Grove (see Figure 2) but found that even the postmistresses did not really know where the employees resided, because many of them came from surrounding districts. It was obvious that any map produced from the postmistress' comments would have been almost totally incorrect.

After several weeks of locating and interviewing employees, we returned to the plant with a list of names of those employees whom we had not yet located or whose addresses recorded on the initial list of names had been found to be incorrect. This list consisted of 87 names. We picked it up one week later, hoping that it would be filled in and corrected where necessary. Very few of the addresses had been altered and the similarity in the other addresses indicated that the personnel officer likely just did not have records of changes of address for those workers. The form of this completed list is shown in Appendix B.

The total number of Company employees located by the research team totalled 205. On topographic maps were plotted the "present"[35] residence location of those employees whom had been found. A short interview with these employees usually allowed the plotting of their "original" location[36] on a separate 1:50,000 sheet. Figure 6 reveals the present location of a portion of the 205 employees located. It

---

[35]"Present" refers to the 1968 location of the residence of the employee.

[36]"Original" refers to the location of the residence of the employee before he obtained his job with the bauxite company.

shows the residence location of the hourly-paid mine workers living in the study area. On this map 142 workers were plotted, whereas Figure 7 shows the original residence location of 114 of the above employees who resided in the study area before they got their jobs. In some cases it was not possible to determine where an employee resided before obtaining employment.

Although not indicated in Figures 6 and 7, other employees located were plotted on other maps. On these maps, employees were differentiated one from the other by their place of work, which included one of the following in most cases:

(a) Belmont plant site,

(b) Ocho Rios port facility, and

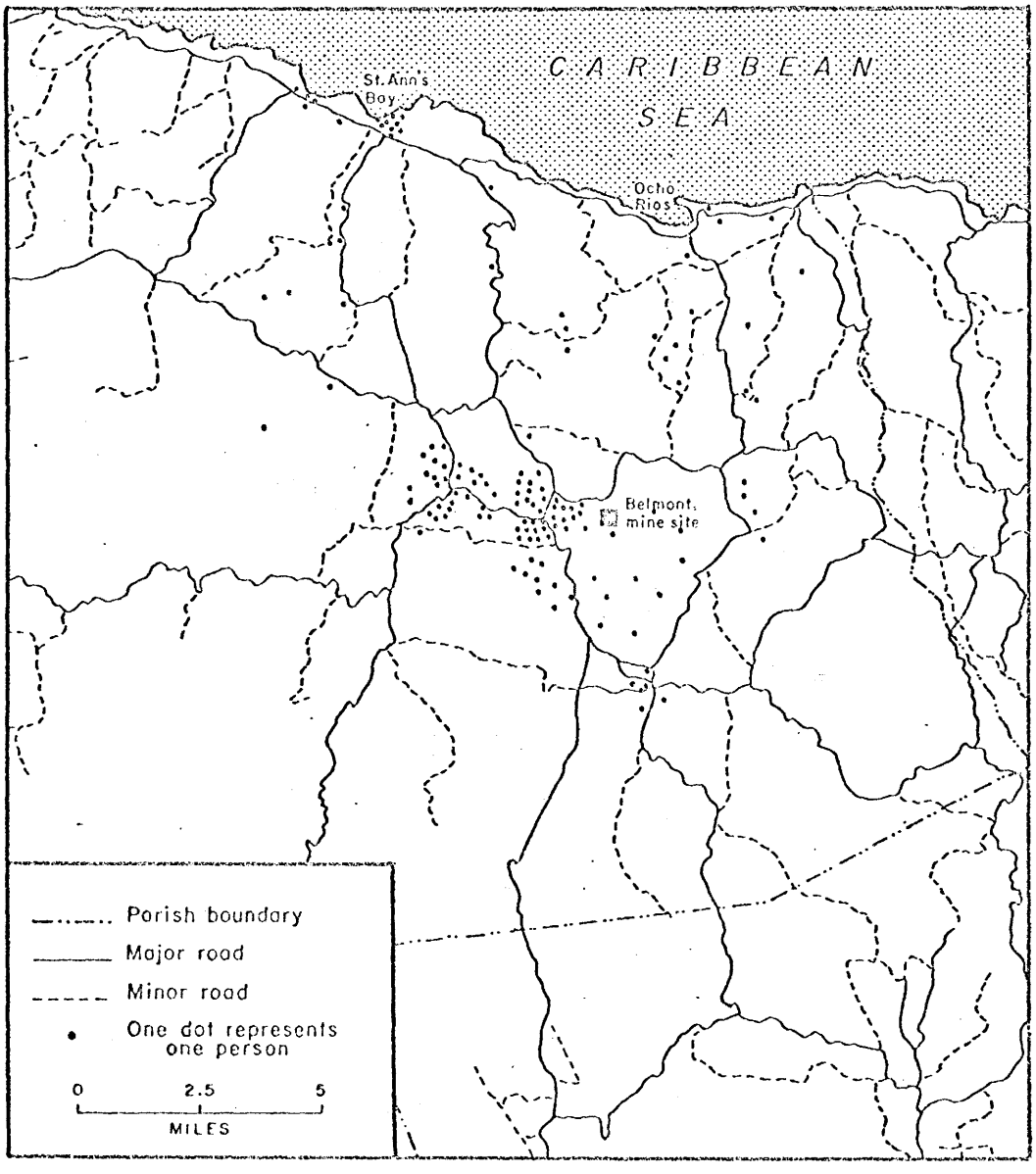
(c) the various farm properties located in different parts of the Island.

On these maps, each employee was differentiated on the basis of his employment status (salary-paid or hourly-paid).

The 205 employees who had their present and original residence locations mapped, represented twenty-five percent of the total labour force. It was at this stage necessary to collect data which provided an insight into the spatial process controlling the hiring of employees and their subsequent patterns of residence locations around the plant.

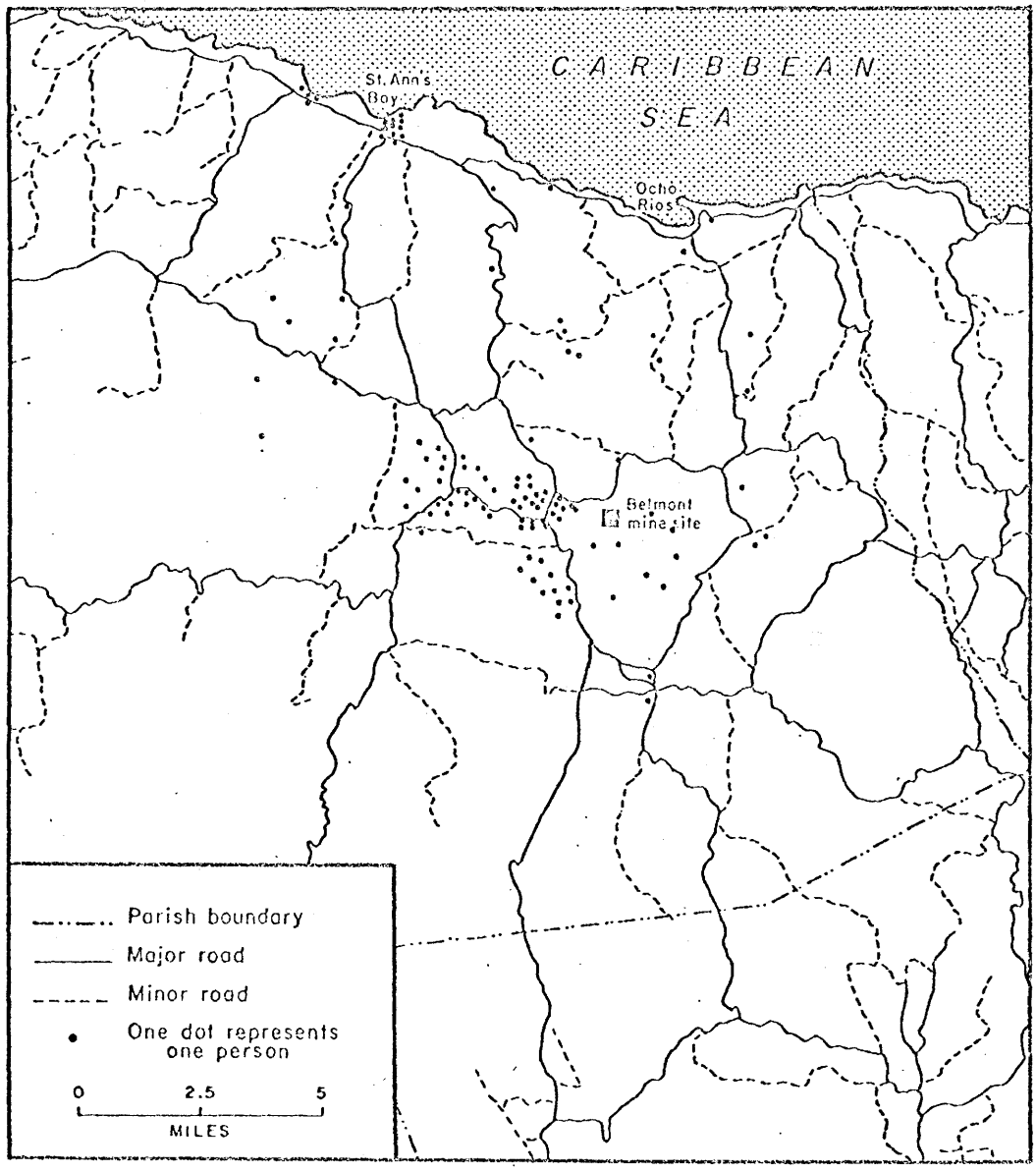
3.1(c) Questionnaires

Questionnaires were to be administered to a sample of the employees located, and a separate questionnaire was designed for the personnel officer. The nature of the information requested in the



Actual 1968 Location of Belmont's Hourly-Paid Mine Workers

Figure 6.



Actual Original Location of Belmont's Hourly-Paid Mine Workers

Figure 7.

employees' questionnaire can be noted in Appendix C. Generally speaking, the author requested information related to the employee's educational background, his age, his seniority with the Company, the importance of a medical check-up when he applied for a job, his method of getting-to-work each day, an indication of his past work experience, reference to any assistance in getting the job and finally an indication of his social contact with fellow employees in Church groups and other organizations.

The author was able, in the time remaining for the field research, to administer 63 such questionnaires by personal contact at pre-arranged times. The problem here was not due to a lack of co-operation from those to be interviewed but rather the difficulty of making appointments in the evenings and the miles of travelling necessary to reach most of the employees. For these reasons it was usually only possible to see four or five men per night.

The questionnaire to be administered to Mr. X (see Appendix D) was intended to produce results that would tie in closely with the questionnaires that were applied to other Company employees. Aside from questions related to the importance of education, age, and job experience, variables were also added to the questionnaire to help us gain a further insight into the hiring policy of the Company. Perhaps the most important to this particular research project was the attempt to observe certain elements of the perception of the employment officer. He was asked to draw a map showing the location of certain prescribed towns and districts and to trace the road-route he would use between

certain points. He was also asked to offer his impressions of various locations, and finally he was instructed to rank ten groups of five locations in terms of their "distance" from the plant site.

In addition to these questions related to his perception of the physical and social environment, he was asked to comment on such topics as the existence of local parish pressure to hire local people, the significance to him of employee reliability, the importance of a person's state of health, and the relevance of a person's family background. The form of the actual questionnaire administered to Mr. X and a reduced photo-copy of the actual "mental map" that he produced are found in Appendix D.

3.2 Summary

This chapter has dealt with the types of publications and other data sources that were obtained in Jamaica and Canada to assist in the research. Following this general review of the publications obtained and comments on initial interviews that were carried-out, the chapter outlines chronologically the procedure followed and problems encountered during the collection of the detailed information from the employees of the bauxite company.

Chapter IV: METHODS OF ANALYSIS

4.1 Introduction

In this chapter, the various analytical techniques which were utilized will be discussed. However, the chapter will concern itself mainly with the model developed to simulate patterns of employee locations.

4.2 Simple Mapping

Here, locations of the employees were plotted. Two maps were involved, one which showed the original locations of the employees prior to their gaining employment and the second which showed the present distribution of the employees that were located during the summer of 1968. Portions of these two distributions were plotted at a scale of 1:50,000 and can be seen as Figures 6 and 7 in Chapter III.

4.3 Simple Graphing

In the following chapter, various graphs that were prepared will be analyzed. It suffices to say at this point that histograms and scattergrams were prepared to note the relationship between different distance measures and the proportion of employees in the 109 census subdistricts in the study area.

4.4 Regression Analysis

A multiple regression computer program which was compiled by Mr. D. Ingram from the I.B.M. 360 Scientific Subroutine Package, was "run" on the I.B.M. 7040 computer at McMaster University. The purpose of the regression analysis was basically, to show that the relationship between the two variables mentioned in the previous section was not linear but curved. The results of this analysis will be outlined in

in more detail in Chapter V in conjunction with the graphical analysis.

4.5 The Polya-Eggenberger Probability Model

The most important method of analyzing the employee selection process was the model which was adapted and operationalized on an I.B.M. 360 computer at York University. Mr. F. Nolte, a senior student at York University, wrote the program.

It was realized that the original selection and later relocation of employees were very complex processes. Various possible model forms were examined (see Chapter II). The author felt intuitively that some form of probability model should be used to analyze the data. An urn-scheme type of model was suggested by Mr. D. Anderson. Here workers were randomly chosen from the 109 census subdivisions surrounding Belmont, and the probabilities of being chosen from specific subdivisions were determined by the Polya-Eggenberger distribution. The model could be used to simulate spatial patterns of employees by assuming various weightings of the variables to be examined.

The Polya-Eggenberger distribution has been described by Feller[37] and recently by Dacey[38]. It was selected for use in this study because (1) it was simple enough that average or "expected" frequencies of assignments in given subdivions could be directly calculated without dozens of simulated "runs"; the advantage of this feature was that one simulated pattern could be derived and considered as the "true" or average one with which to compare reality, thus avoiding the problem

---

[37] William Feller, An Introduction to Probability Theory and its Applications, 1957, Volume 1, Ed. 3, John Wiley and Sons, Inc., New York.

[38] Michael Dacey, Location Processes Described by the Ordinary and Compound Polya-Eggenberger Probability Distributions, Unpublished Paper, Department of Geography, Northwestern University.

present in some Monte Carlo models where no unique mathematical solution was known. (2) The Polya-Eggenberger distribution could conveniently consider the neighbourhood effect, if one assumed that the people affected by an existing employee lived only in the same subdivision as he did. The major drawback of the distribution was that it did not allow for a recalculation and lowering of probabilities as the potential employees of a subdivision were used up.

According to the distribution, the probabilities of employees being located in given subdivisions are calculated as follows: if n employees have already been located in the study area (see Figure 1), and k employees have been selected from the j^{th} census subdistrict with the attribute r_j, the probability that the next or $n+1^{th}$ employee will be selected from the j^{th} census subdivision is:

$$P\left\{X_j(n+1) = k+1 / X_j(n) = k\right\} = \frac{r_j + kh}{R + nh},$$

where X_j the number of employees in the j^{th} census subdivision, r_j a number measuring the attributes of the j^{th} census subdivision, h[39], a number weighting the importance of the neighbourhood effect, and R the sum of the attribute indexes for all census subdivisions. The probability, then, is a function of some general attribute (measured by r_j) and the neighbourhood effect of employees already selected from the subdivision (measured by hk). The sum of all probabilities for each census subdivision is obviously 1.0.

For this research, the value of the attribute r_j was calculated for each of the 109 census subdistricts in the study area according

---

[39] In this thesis no difference is intended in the meanings of h and H. Both refer to the importance of the neighbourhood effect.

to the formula:

$$r_j = a_1\left(\frac{X_{1_j}}{\bar{X}_1}\right)^{b_1} + a_2\left(\frac{X_{2_j}}{\bar{X}_2}\right)^{b_2} + a_3\left(\frac{X_{3_j}}{\bar{X}_3}\right)^{b_3} + \cdots a_{10}\left(\frac{X_{10_j}}{\bar{X}_{10}}\right)^{b_{10}},$$

where X_{1_j} ..... X_{10_j} correspond to the units described in the Table of Data in Appendix E for all census subdivisions, and

$$\bar{X}_1 = \sum_{j=1}^{109} X_{1_j}, \quad \bar{X}_2 = \sum_{j=1}^{109} X_{2_j}, \ldots\ldots \bar{X}_{10} = \sum_{j=1}^{109} \bar{X}_{10_j}.$$

The ratio $\frac{X_j}{\bar{X}}$ was used instead of simply X_j to avoid the weighting problem caused by the different variables X_1.....X_{10} having units of greatly different dimensions. a was an experimental parameter which could be varied to give different weightings to the variables X_1.....X_{10}, just as h could give different weightings to the neighbourhood effect; similarly, b could be varied to permit the variable to have limited influence on r_j (where h = 0), to have a linear relationship (where b = 1), or exponential influence (when $b \neq 1$). If X_j was to have no effect on r_j, one could set $a_j = 0$.

Several patterns of employment distribution were simulated giving different weightings and functional relationships for the variables X_1.....X_{10}, and the neighbourhood effect. Some patterns were simulated using random numbers in order to locate employees successively through time, on the basis of the probabilities of the subdivisions. This method was analagous to that described by researchers such as Hagerstrand. Such patterns were not ideal for comparison with reality,

however, as they varied somewhat according to the random numbers selected. For a comparison with reality, patterns were simulated by calculating the most probable as well as the "expected" frequency of employees for each of the 109 census subdivisions in the study area. The formula:

$$P(X_j/n,r_j,s_j,h) = \binom{n}{X} \frac{r_j(r_j+h).....(r_j+Xh-h)s_j(s_j+h)..(s_j+nh-Xh-n)}{(r_j+s_j)(r_j+s_j+h).....(r_j+s_j+nh-h)}$$

where $s_j = R-r_j$, gives the probability of a given number of employees (X) being located in subdivision j if the total number of employees is n. The "expected" frequency for each census subdistrict or subdivision was determined by adding the products

$P(0) \times 0 + P(1) \times 1 + P(2) \times 2 + \ldots P(n) \times n.$

To compare the simulated patterns with reality, a somewhat original statistical test had to be derived. The tests usually utilized were inapplicable for a number of reasons, particularly the very small expected frequencies for many of the subdivisions and the fact that the shape of the Polya-Eggenberger distribution varied for all areas. The procedure used was to calculate for each subdivision the probability of all frequencies of employees, and to find the frequency having the greatest probability (see Figure 8). A standard percentage of the value (e.g. 50 percent) was then calculated. A given subdivision was said to "fit" the model if the probability of the observed number of employees occurring was greater than or equal to the standard percentage value. The number of subdivisions in which

TEST OF THE SIMULATION MODEL

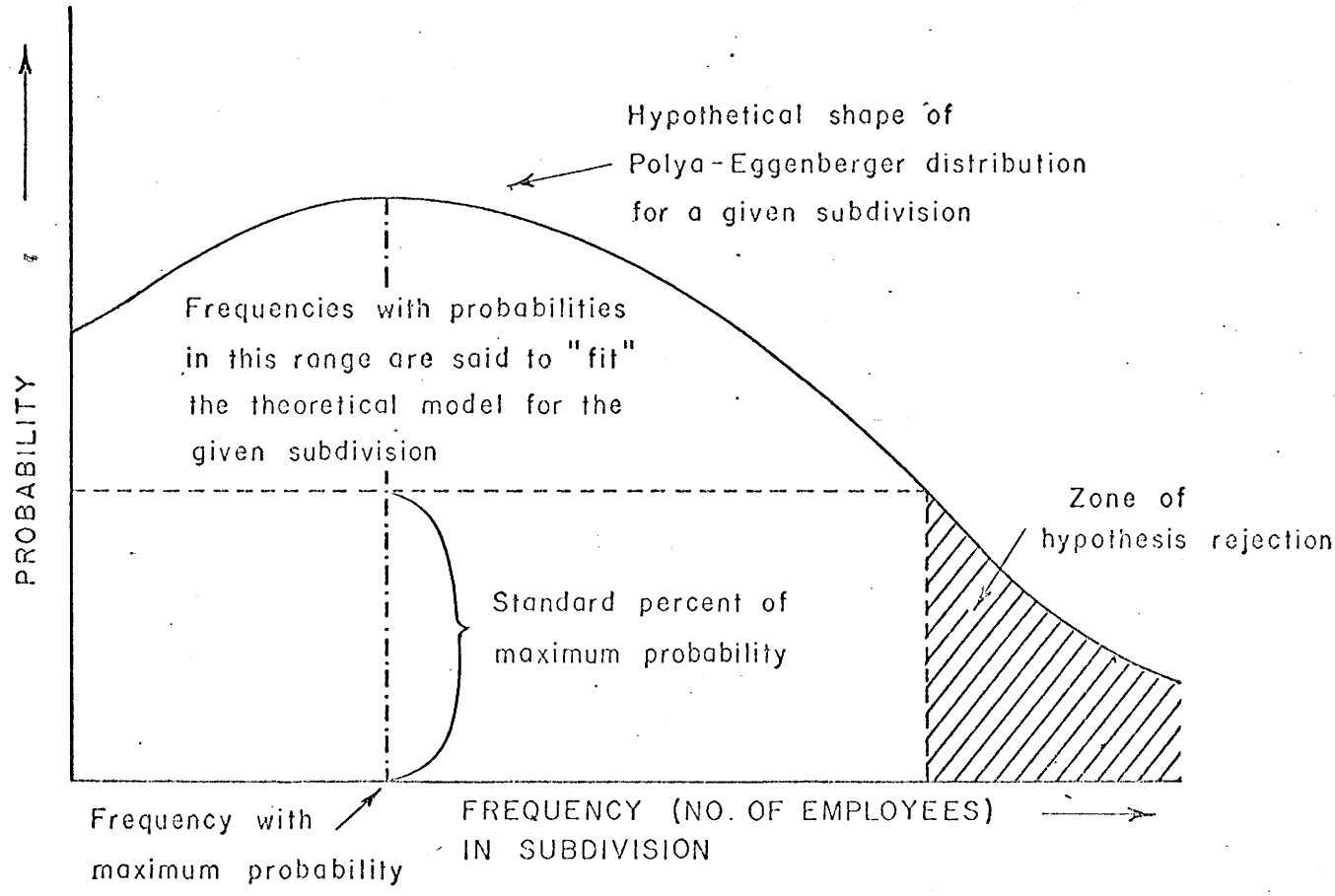


Figure 8

observed values "fit" those predicted by the simulated model was then calculated and used as a measure of the accuracy of the model.

The results of the various simulation runs will be examined and evaluated in Chapter VI which deals with the tests of the model.

4.6 Summary

This chapter has indicated the methods of analysis which were utilized in this research project. Brief comments were made on the use of simple mapping and graphing techniques, which will both be outlined in more detail in the next chapter, and on the use of a multiple regression computer program in order to fit least-squares quadratic curves to several scattergrams. The major purpose of this chapter was to outline the characteristics of the Polya-Eggenberger urn model which was utilized to "test" the various hypotheses stated in Chapter II.

Chapter V: PRELIMINARY DATA ANALYSIS

5.1 Introduction

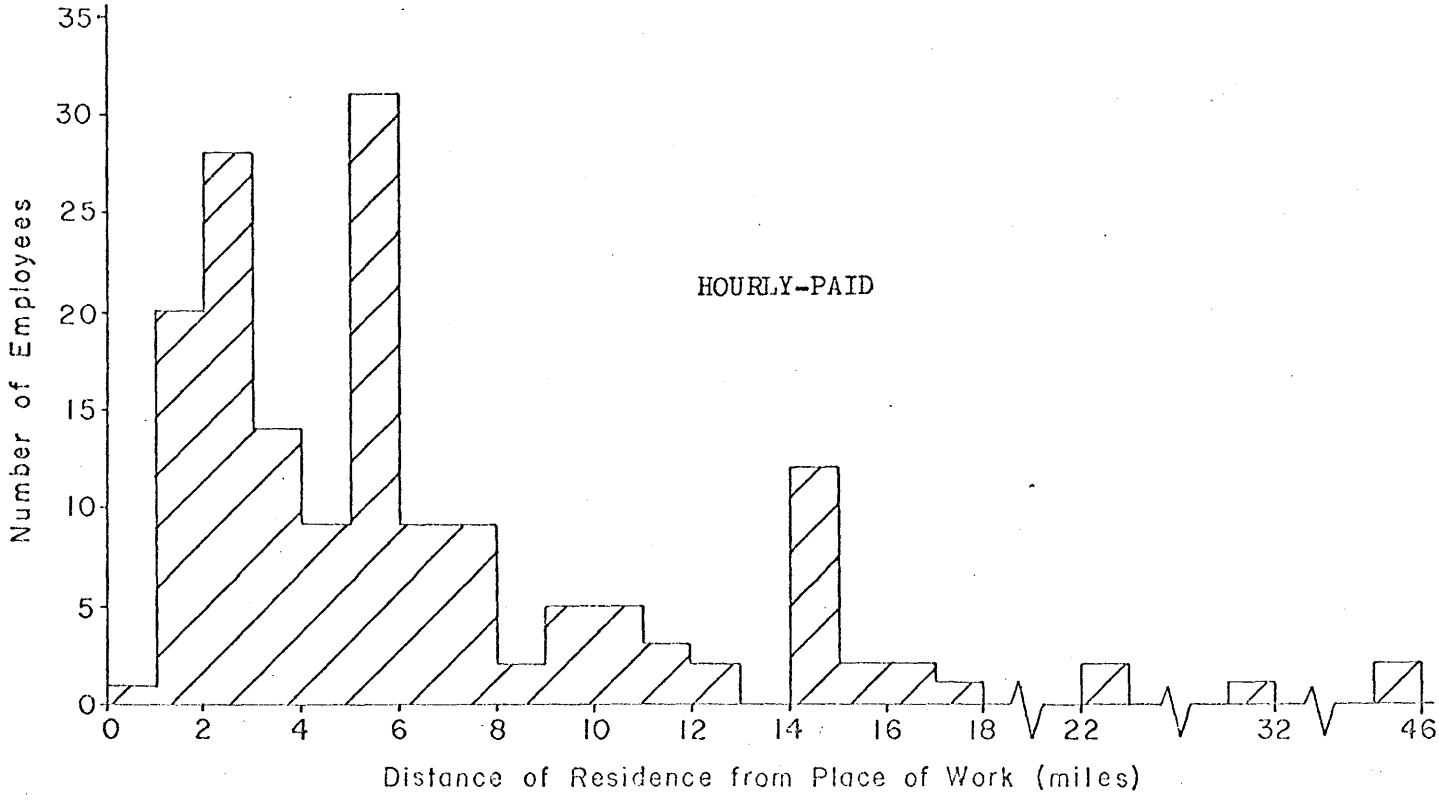
This chapter focuses on a discussion of the maps, scattergrams and histograms which were prepared to indicate the shapes of the distance decay functions for the different classes of employees reporting to different work locations and also to indicate the amount of relocation which takes place after employees are hired. Secondly, it outlines the ten variables which were selected to provide attractiveness measures for the 109 census subdivisions in the immediate study area (see Figure 1).

5.2 Mapping of the Original and Present Employee Distributions

The plotting of the residence locations on the 1:50,000 topographic sheets of St. Ann Parish revealed concentrations of employees living in the towns and districts surrounding the plant. In the case of the map of the present residence locations of the hourly-paid workers, more noticeable clustering near Belmont was noted. However, as in the distribution of the original residence locations, concentrations of employees were still noticeable in the surrounding towns. Figure 9 indicates the proximity (road-miles) of the hourly-paid and the salary-paid employees to the Belmont plant site as of the summer of 1968. The fluctuations in the histograms which make-up this Figure relate mainly to the distributions of the towns around the Belmont plant site. Figures 6 and 7 in Chapter III show the present and original distributions of the hourly-paid employees.

As was indicated in Chapter III, several distinctions between different types of employees were made. First, hourly-paid workers were separated from the salary-paid employees. In addition, the

ACTUAL ROAD-DISTANCE TRAVELLED BY BELMONT EMPLOYEES



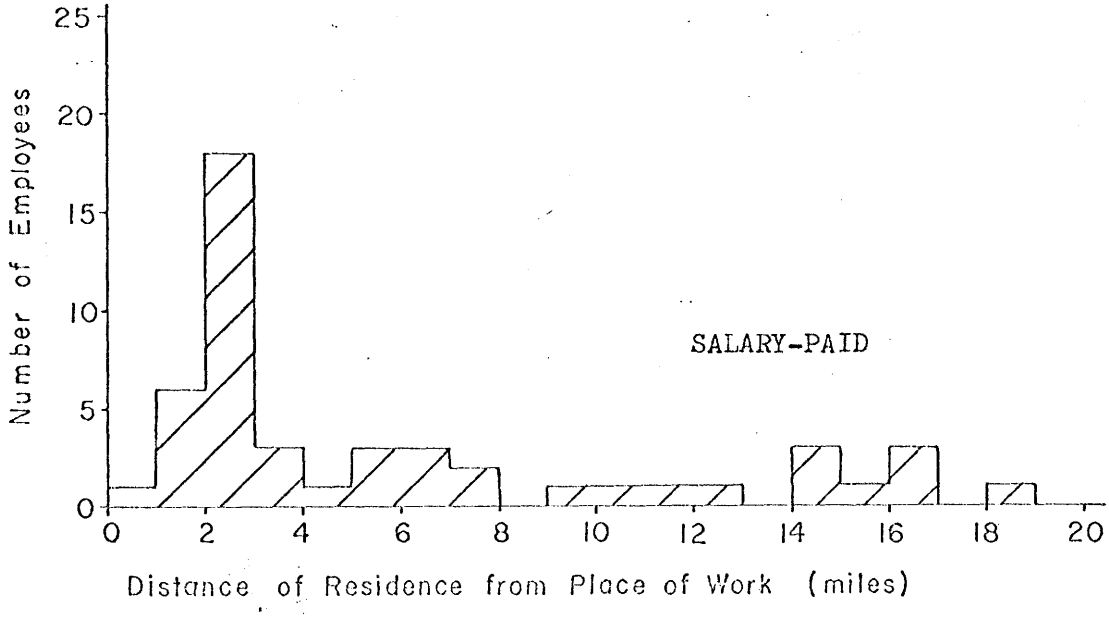


Figure 9.

different employment locations were noted during the mapping procedure. The largest proportion of all the employees in the 40 percent spatially-random sample were the hourly-paid workers who reported to work at Belmont. The other groups mentioned above, for the most part, represented relatively few workers.

5.3 Elimination of Certain Workers

Field research indicated that the farm-property workers, did not actually have any connection with the Belmont plant. They all lived in the countryside and reported to work at one of the various farms owned by Lydford Feed Enterprises, a subsidiary of Reynolds Jamaica Mines Limited. This small group of workers was excluded from any further analysis in this project.

Another group of employees that were ultimately excluded from use in the model were those reporting daily to the port facility at Ocho Rios. It was not known when the sample was obtained just how many of the employees in the initial sample worked at the port. Field work revealed too few such employees to necessitate complicating the actual simulation model by creating two separate work locations. This sample would also be too small to base any conclusions on.

The final significant refinement to the type of employee to be used in the analysis involved the elimination of all salaried employees from the sample. This group was recognized as an important part of the work-force of any decentralized industry. However, due to the greatly different characteristics of this group from the hourly-paid worker, they were excluded from the simulation analysis. Most of these salaried employees lived in other parts of the Island prior to

being hired by the bauxite company. When they were moved to the area around the plant, many of them were located in company owned houses and travelled to work each day in company vehicles. They were, then, quite different from the larger group of hourly-paid workers.

Although the employees who reported to Ocho Rios and all salaried personnel were excluded from the model, they were included in the preliminary scattergram analysis. To determine the shapes of the distance decay functions resulting from the use of different distance measures (see Figure 5), the relationship between the proportion of employees in each census subdivision and road and time-distances were plotted. Figures 10 and 11 indicate the nature of this relationship for the present distribution of salaried and hourly-paid personnel who report to Belmont and also for those who report to Ocho Rios. Distances in these scattergrams were measured in road-miles. Another set of scattergrams for the present distribution were prepared (see Figures 12 and 13) using travel-time instead of road-distances in order to see if a stronger relationship was evident.

Two similar sets of scattergrams were drawn-up on the basis of information obtained during the field research about the employees' original locations. These scattergrams (see Figures 14 and 15) and (see Figures 16 and 17) indicated a weaker relationship between these original locations and the plant site at Belmont. Due to a lack of observations, the same can not necessarily be said about the port facility at Ocho Rios.

An examination of the scattergrams of present and original employee residences indicates a relocation of workers after gaining

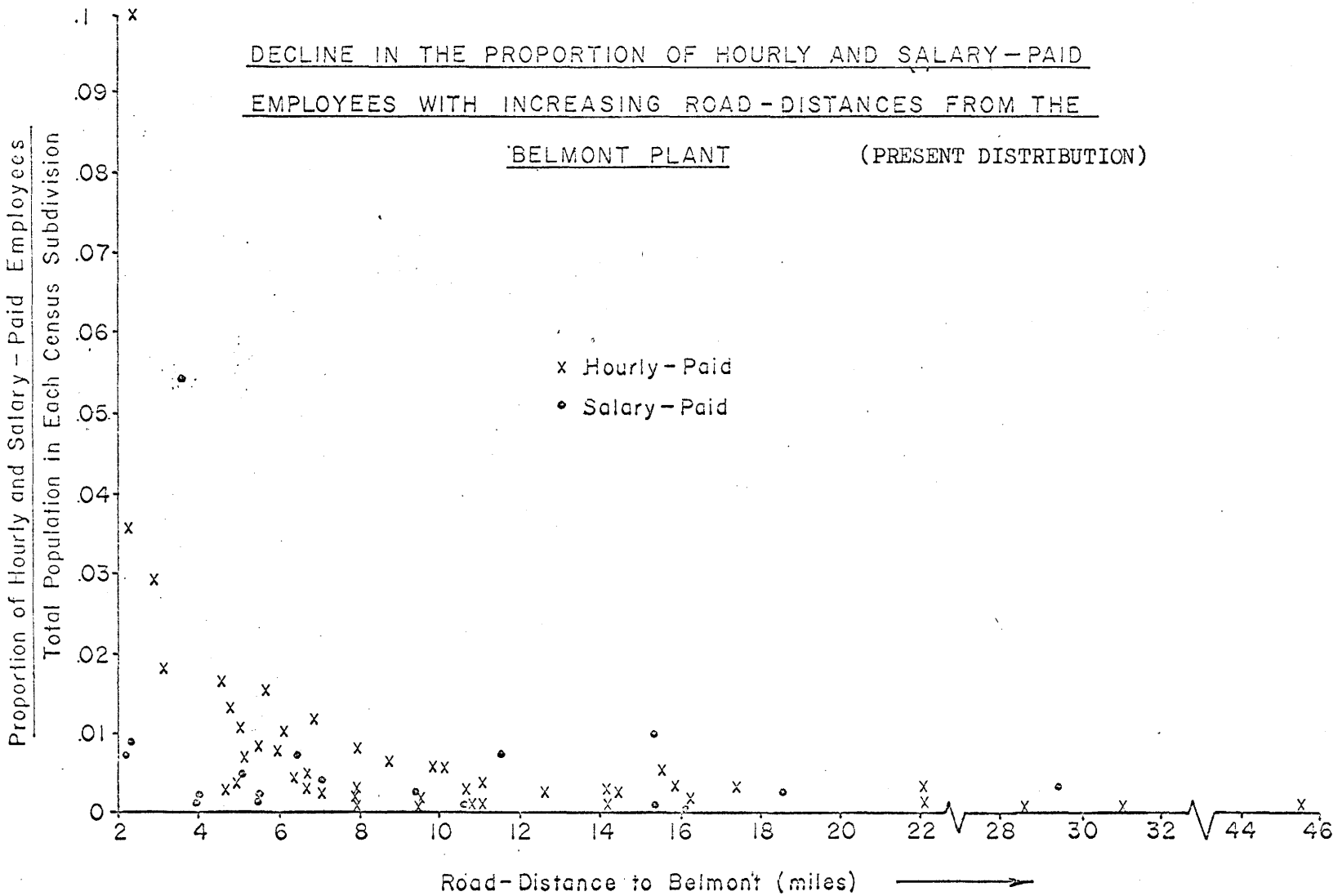

DECLINE IN THE PROPORTION OF HOURLY AND SALARY-PAID EMPLOYEES WITH INCREASING ROAD-DISTANCES FROM THE BELMONT PLANT (PRESENT DISTRIBUTION)
Proportion of Hourly and Salary-Paid Employees / Total Population in Each Census Subdivision
x Hourly-Paid
o Salary-Paid
.1
.09
.08
.07
.06
.05
.04
.03
.02
.01
0
2
4
6
8
10
12
14
16
18
20
22
28
30
32
44
46
Road-Distance to Belmont (miles)

Figure 10.

DECLINE IN THE PROPORTION OF HOURLY AND SALARY-PAID EMPLOYEES WITH INCREASING ROAD-DISTANCES FROM OCHO RIOS

(PRESENT DISTRIBUTION)

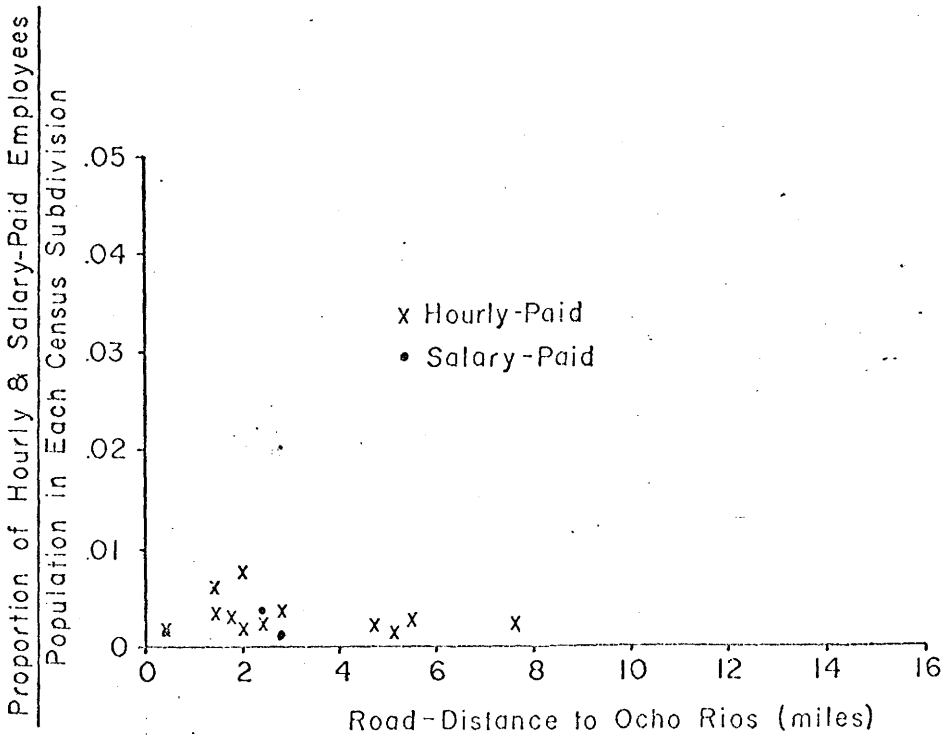


Figure 11.

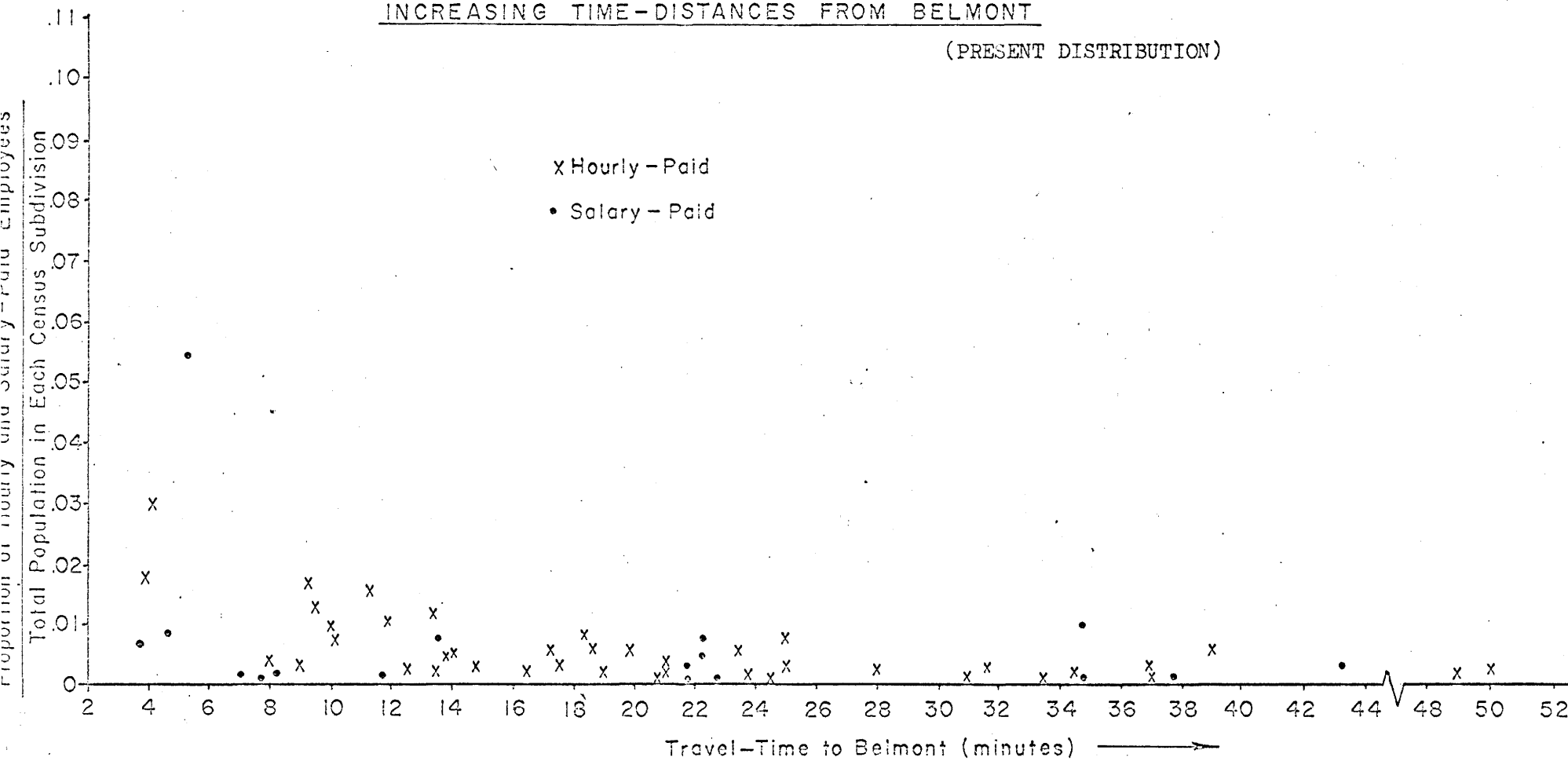

DECLINE IN THE PROPORTION OF HOURLY AND SALARY-PAID EMPLOYEES WITH
INCREASING TIME-DISTANCES FROM BELMONT
(PRESENT DISTRIBUTION)
X Hourly - Paid
• Salary - Paid
Proportion of Hourly and Salary-Paid Employees
Total Population in Each Census Subdivision
.11
.10
.09
.08
.07
.06
.05
.04
.03
.02
.01
0
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 48 50 52
Travel-Time to Belmont (minutes)

Figure 12.

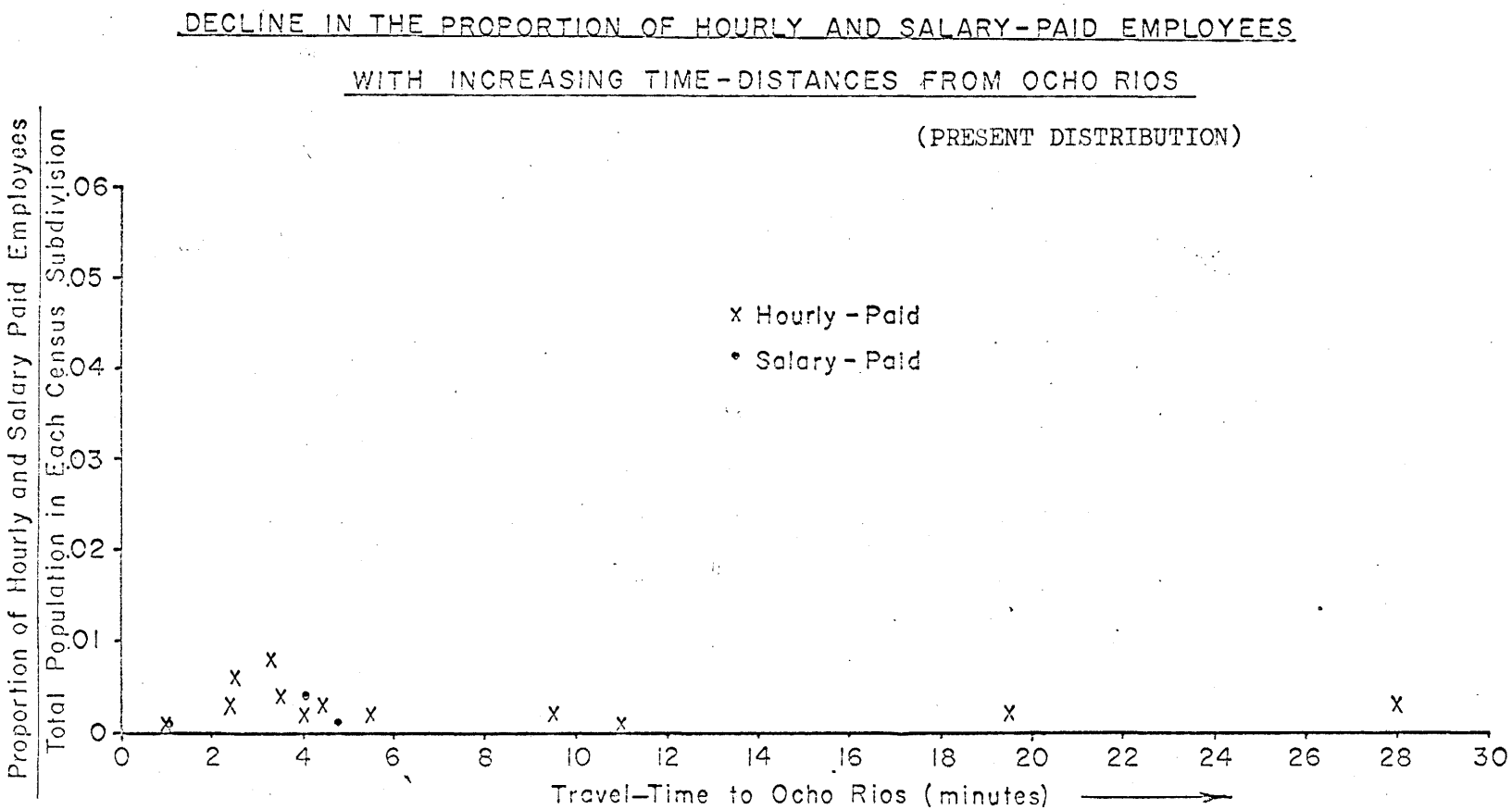

DECLINE IN THE PROPORTION OF HOURLY AND SALARY-PAID EMPLOYEES
WITH INCREASING TIME-DISTANCES FROM OCHO RIOS
(PRESENT DISTRIBUTION)
Proportion of Hourly and Salary Paid Employees
Total Population in Each Census Subdivision
.06
.05
.04
.03
.02
.01
0
x Hourly - Paid
• Salary - Paid
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Travel-Time to Ocho Rios (minutes)

Figure 13.

DECLINE IN THE PROPORTION OF HOURLY AND SALARY-PAID EMPLOYEES WITH INCREASING ROAD-DISTANCES FROM BELMONT

(ORIGINAL DISTRIBUTION)

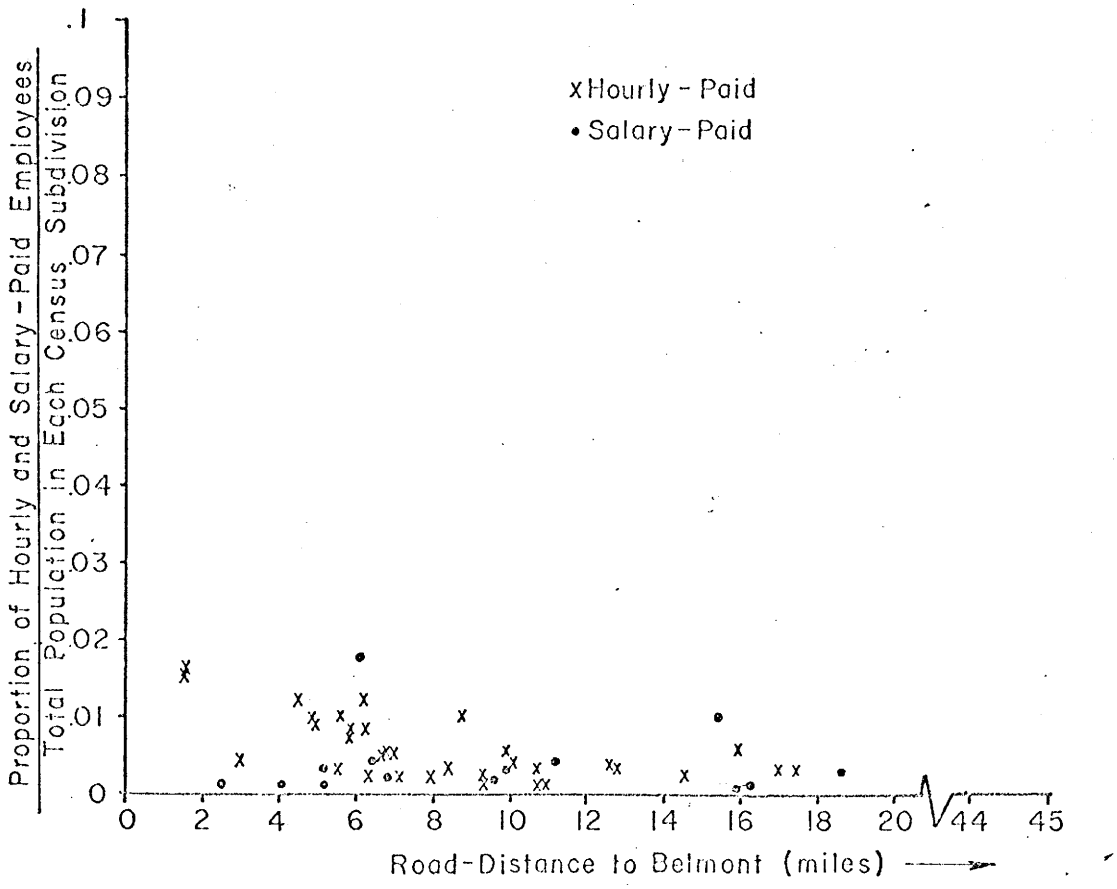


Figure 14.

DECLINE IN THE PROPORTION OF HOURLY AND SALARY-PAID EMPLOYEES WITH INCREASING ROAD-DISTANCES FROM OCHO RIOS

(ORIGINAL DISTRIBUTION)

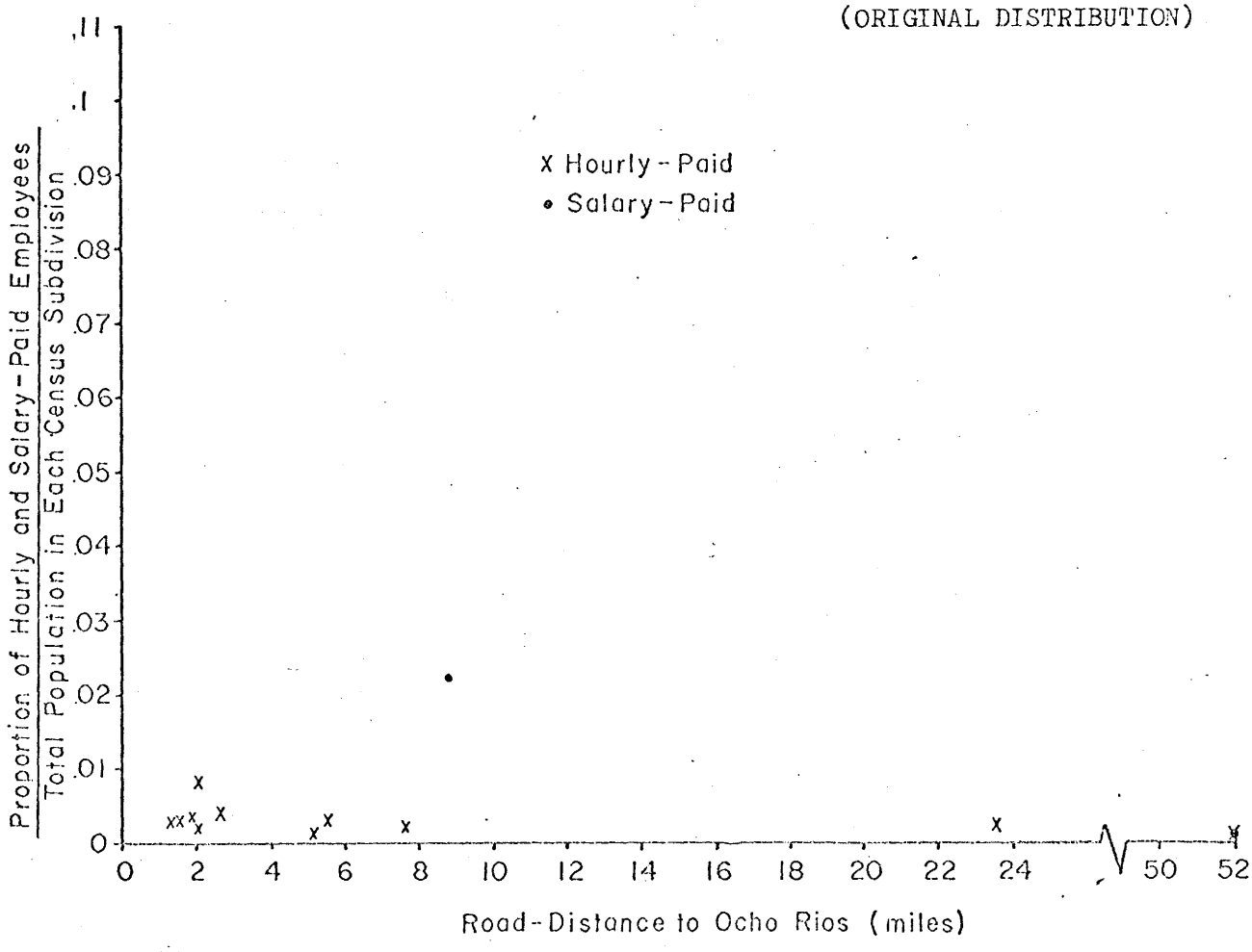


Figure 15.

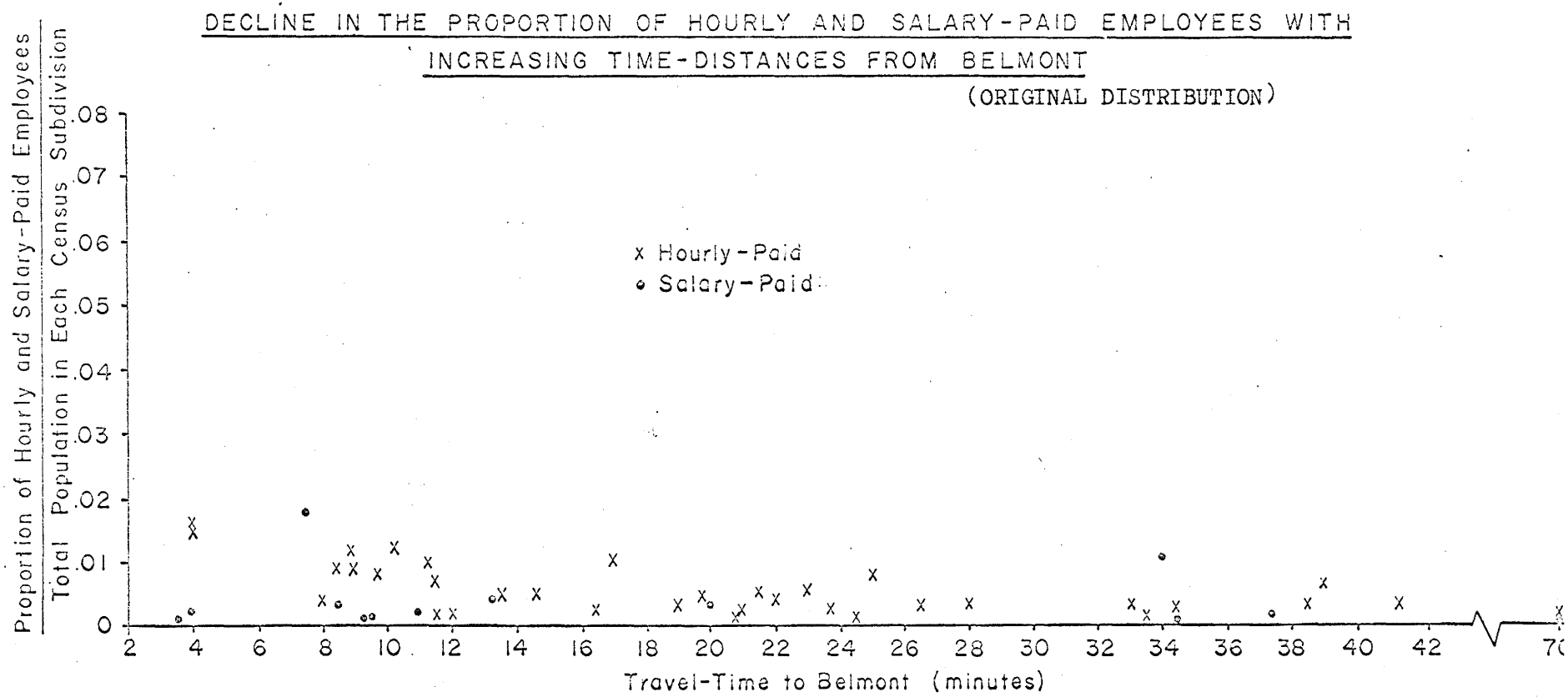

DECLINE IN THE PROPORTION OF HOURLY AND SALARY-PAID EMPLOYEES WITH INCREASING TIME-DISTANCES FROM BELMONT
(ORIGINAL DISTRIBUTION)
Proportion of Hourly and Salary-Paid Employees
Total Population in Each Census Subdivision
.08
.07
.06
.05
.04
.03
.02
.01
0
x Hourly-Paid
o Salary-Paid
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
Travel-Time to Belmont (minutes)

Figure 16.

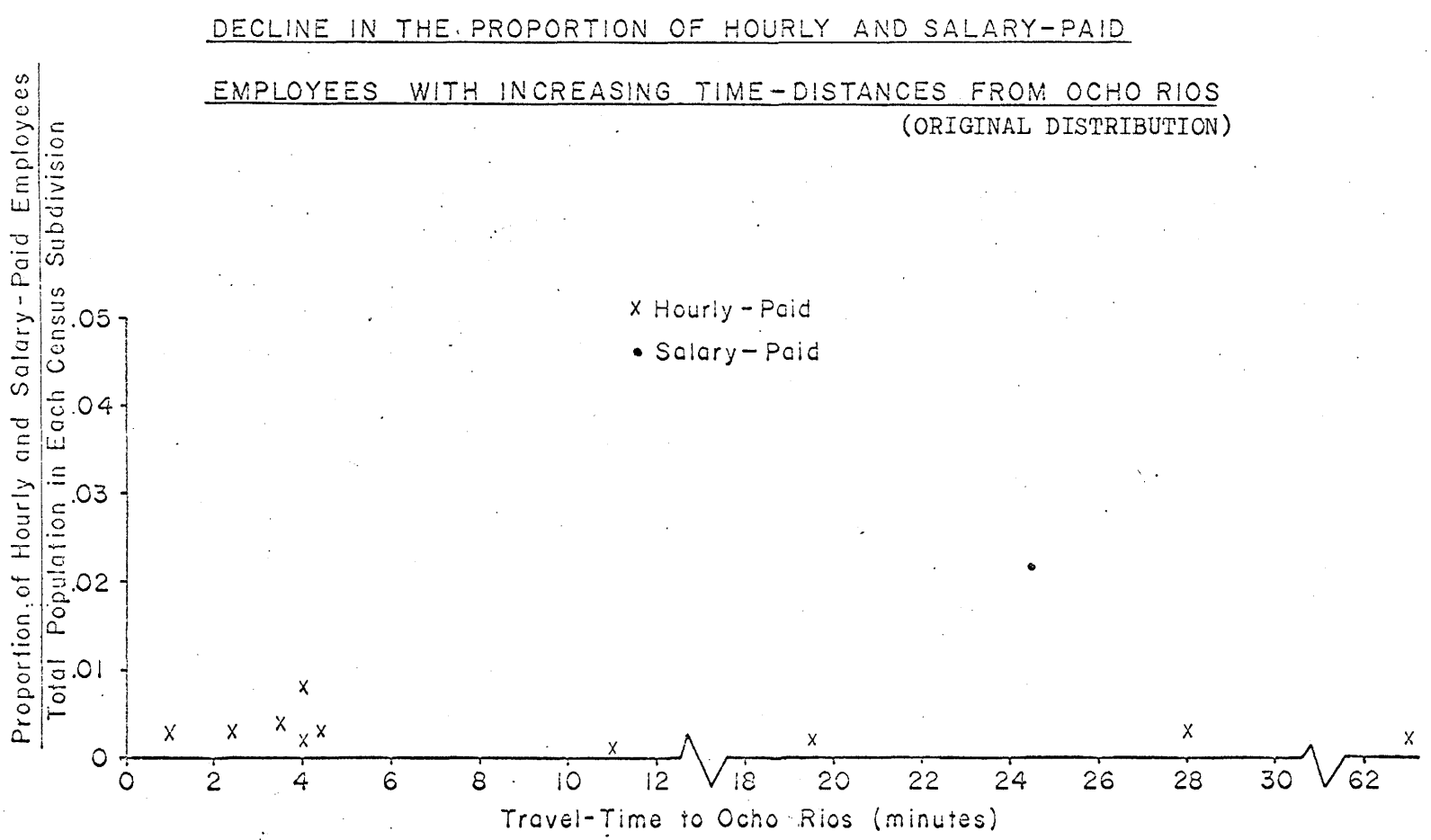

DECLINE IN THE PROPORTION OF HOURLY AND SALARY-PAID
EMPLOYEES WITH INCREASING TIME-DISTANCES FROM OCHO RIOS
(ORIGINAL DISTRIBUTION)
Proportion of Hourly and Salary-Paid Employees
Total Population in Each Census Subdivision
X Hourly-Paid
• Salary-Paid
.05
.04
.03
.02
.01
0
0
2
4
6
8
10
12
18
20
22
24
26
28
30
62
Travel-Time to Ocho Rios (minutes)

Figure 17.

employment with the Company. The amount of movement is indicated on Figure 18 which consists of two histograms. These histograms reveal that the hourly-paid workers generally relocated themselves only short distances after gaining the new employment. However, a few moved many miles closer to Belmont or Ocho Rios and there were even instances where employees actually moved away from the two work locations after gaining their jobs. The second of the histograms shown in Figure 18 indicates the relocation distances of the salary-paid employees. In this case, the largest proportion moved many miles closer to Belmont or Ocho Rios depending on where they were to be employed.

When all of the sets of scattergrams had been completed and examined and the previously mentioned groups of employees had been eliminated from further analysis, it was decided to attempt to fit least-squares quadratic curves only to the scattergrams related to the hourly-paid workers who reported each day to Belmont.

In all four cases, the quadratic curves were statistically significant at the .01 level. The results did not indicate that time-distance measures were that much more useful than simple road-distances; however, time-distances permitted the incorporation of road surface conditions as a frictional barrier to the easy movement of commuting employees. The four least-squares quadratic curves have been plotted and represent the distance decay functions of the observed data. An examination of Figures 19 and 20, will indicate that with both the road and time-distance measures, the present distributions show a much steeper slope than do those of the original distributions. It would seem, then, that distance is a more important variable in

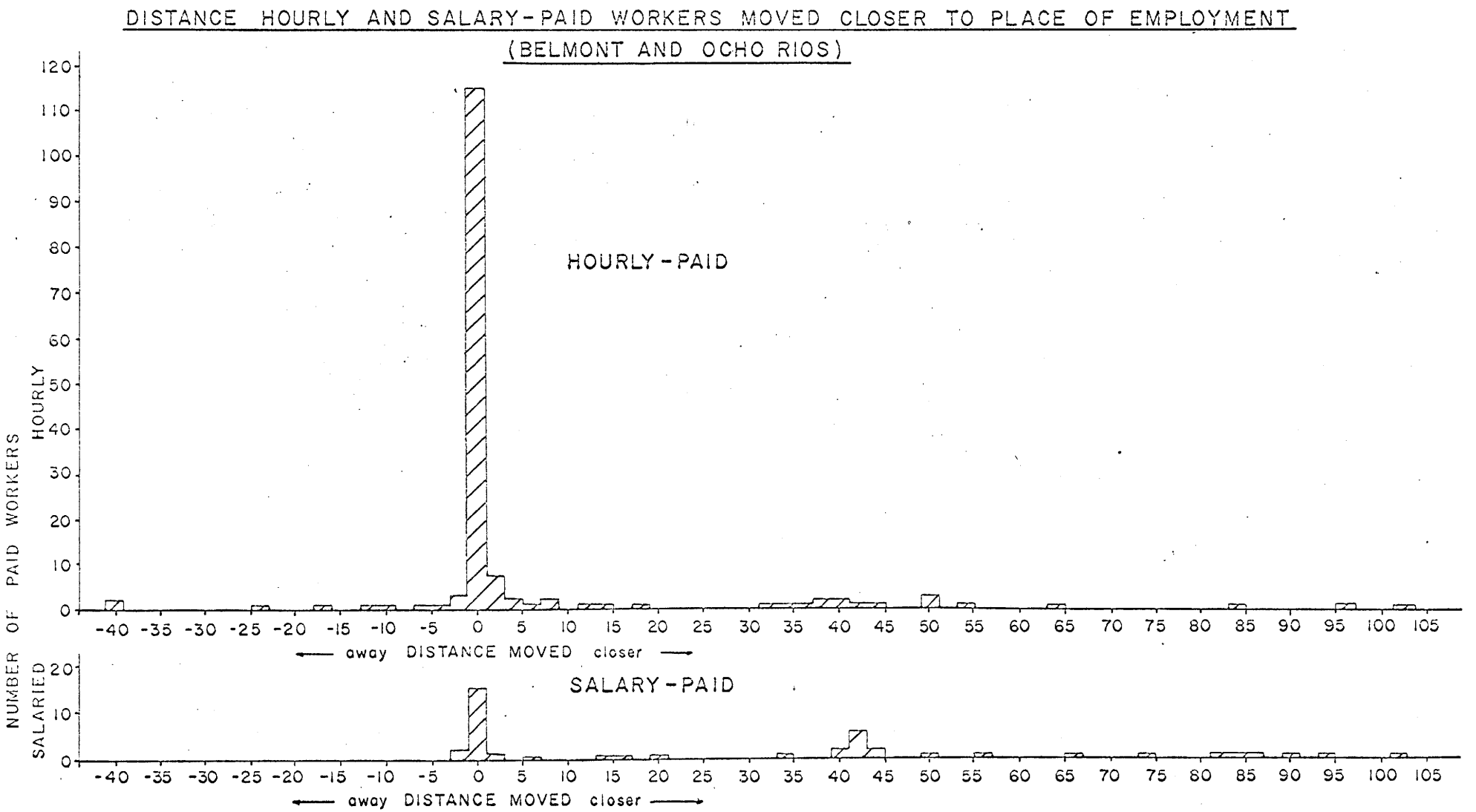

DISTANCE HOURLY AND SALARY-PAID WORKERS MOVED CLOSER TO PLACE OF EMPLOYMENT
(BELMONT AND OCHO RIOS)
NUMBER OF PAID WORKERS
HOURLY
HOURLY-PAID
SALARIED
SALARY-PAID
away DISTANCE MOVED closer
away DISTANCE MOVED closer

Figure 18.

LEAST-SQUARES QUADRATIC CURVES USING ROAD-DISTANCES

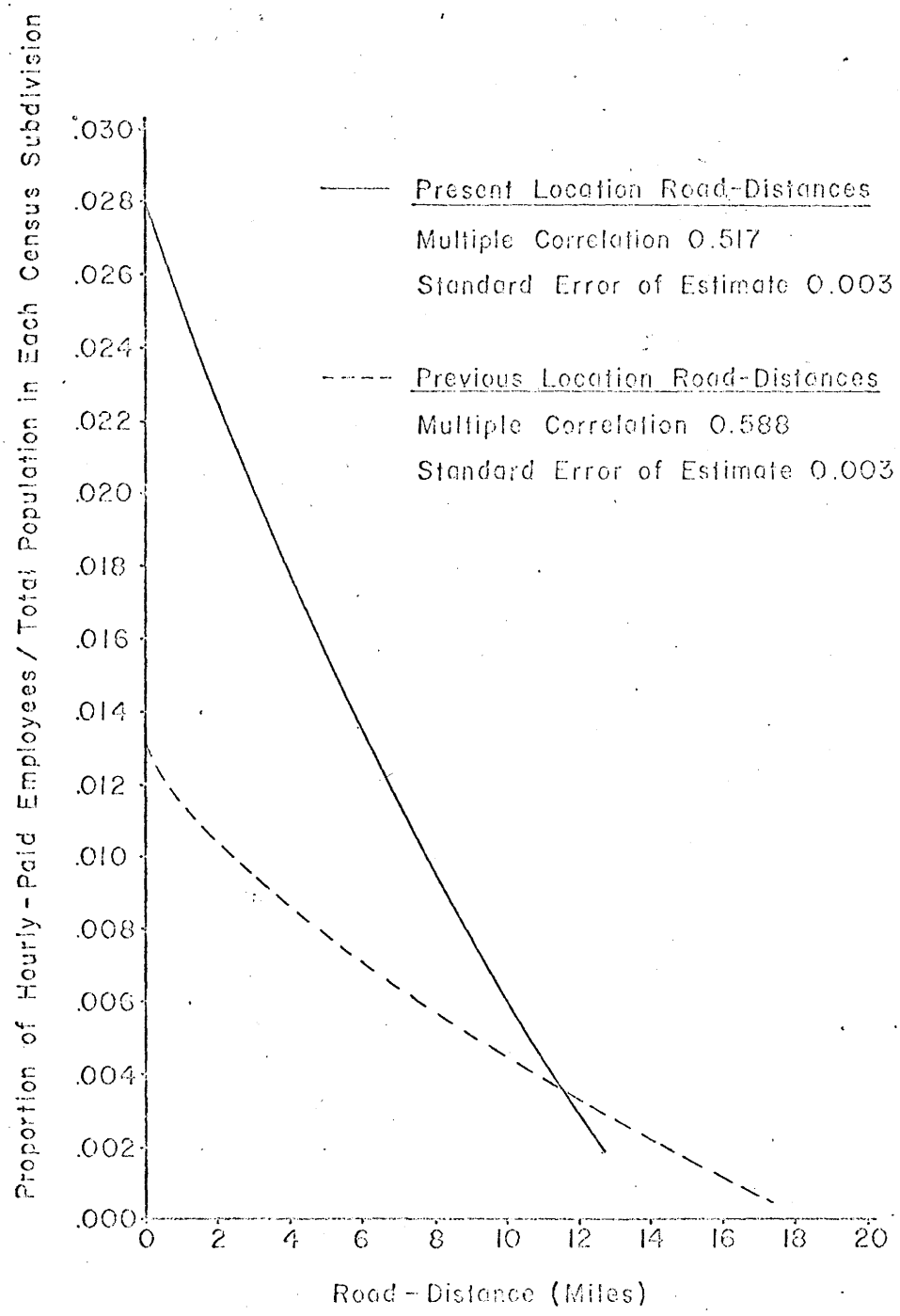
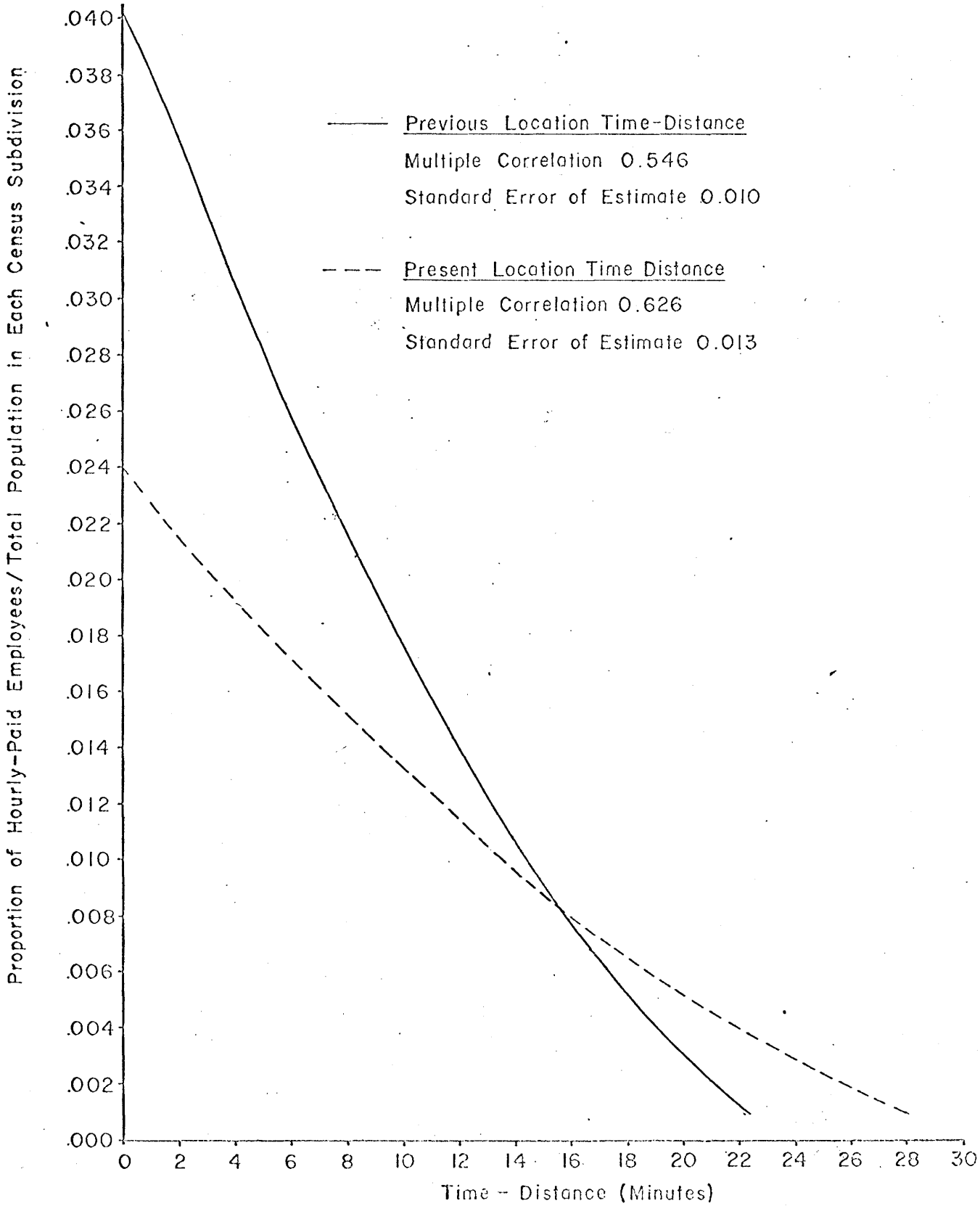


Figure 19.

LEAST - SQUARES QUADRATIC CURVES USING TIME-DISTANCE



explaining the present distribution of employees than it was for explaining the original distribution.

The first portion of this chapter has commented on the preliminary analysis that was performed on the data, to determine the validity of our notions about the relocation of employees, and the belief that the distance decay relationship could be detected and incorporated into a simulation analysis. The determination of the degree of significance of these relationships was felt to be essential to the research project.

At this point, a discussion of the variables to be incorporated into the model, which was outlined in the previous chapter, is in order. The variables will be discussed in the following pages, more or less in the order in which they appear in the Table of Data in Appendix E.

5.4 Variables To Be Used in the Simulation Model

(a) Actual Time-Distance

On the basis of the literature review, questionnaires, and preliminary analysis, it was decided to use time-distance measures instead of the road-distances to represent our particular distance decay function.

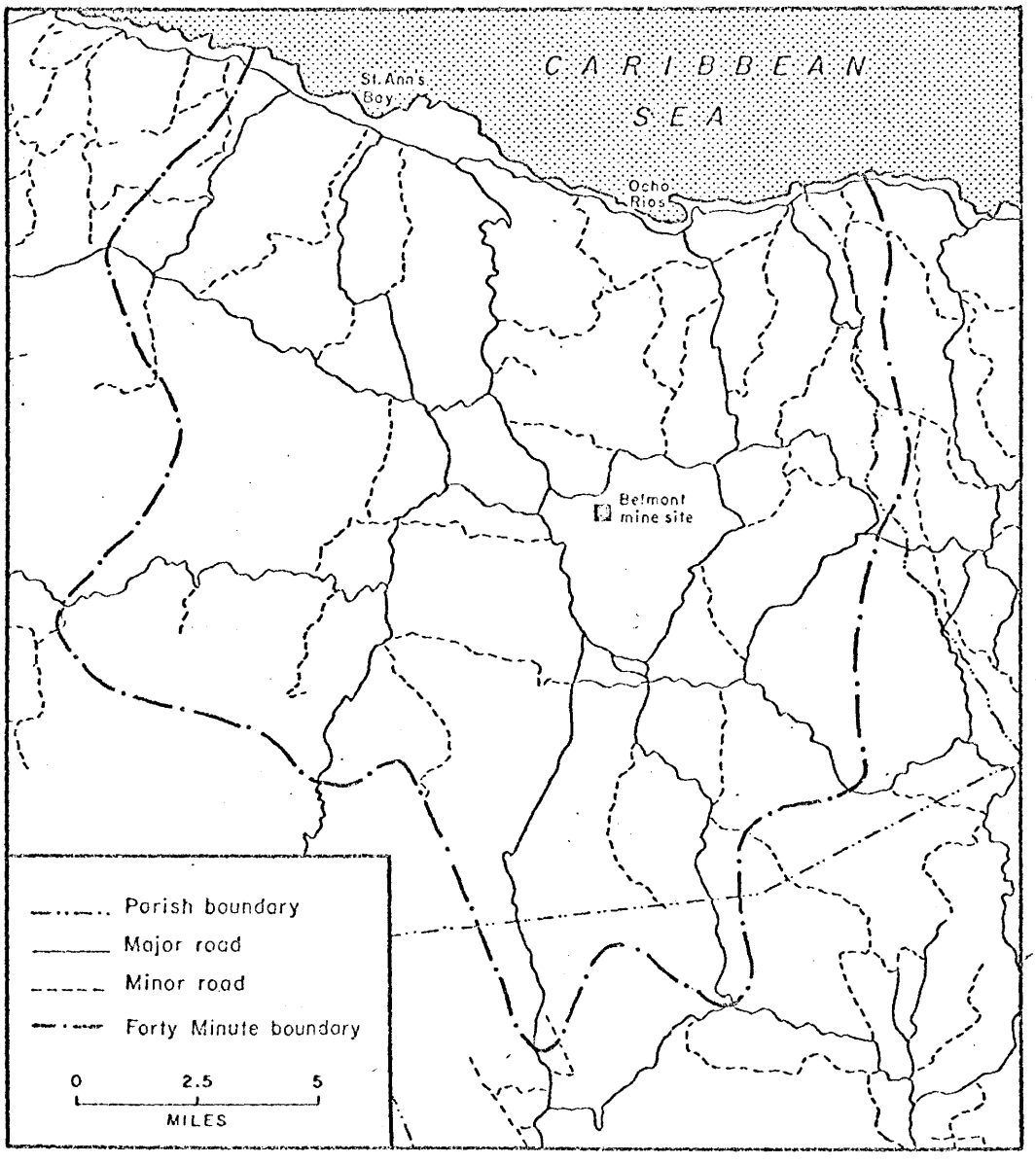
In order to calculate a time-distance value for a particular census subdivision, it was necessary to visually determine the centre of population gravity for each of the 109 census subdivisions in the immediate study area from the population distribution maps and thus obtain a distance measure which would represent the length of time taken by the average individual in any subdistrict to drive to the

main plant site at Belmont. As shown in Appendix E, the time-distance variable was calculated to the nearest half-minute.

Before discussing the next variable, a comment should be made on how the size of the study area (see Figure 1) was determined. By including all census subdivisions in the parish of St. Ann, 275 areal units would have been involved. To make the number of districts more manageable, the author established a "commuting zone". This zone was based on observed travel-time distances of forty minutes out from the plant to the centres of population gravity of the different census subdivisions. Figure 21 indicates the extent of this commuting zone. It was from this boundary that the author decided on the size of the immediate study area depicted in Figure 1. By eliminating many of the isolated subdistricts in the western portion of the Parish, the number of districts to which job allocations could be made, dropped to 109. Using a travel-time boundary of forty minutes for the immediate study area necessitated the inclusion of small portions of St. Mary and the northern part of St. Catherine (see Figure 1) which are actually much closer to Belmont than the western portions of St. Ann. The possible choice of employees from subdivisions outside of St. Ann allowed us to gain some insight into the significance of local Parish Council pressure on Mr. X's hiring policies.

(b) Total Population

One of the hypotheses in the second chapter made reference to the controlling influence of the original population distribution around the plant in determining the pattern of original employee locations. The total population values for each census subdivision



Extent of the Forty Minute Commuting Zone

Figure 21

were derived from the 1960 census, and they were used to form one possible element of the attributes of the census subdivisions.

(c) Parish Residence

The residence of a prospective employee within St. Ann appeared from the questionnaire, that was completed by Mr. X, to be an asset due to the existence of the Parish Council pressure mentioned above. On the Table of Data, a value of two was given to all those residing in St. Ann and a value of one to those who lived in St. Mary and St. Catherine Parishes. It was realized that the importance of living in St. Ann might not be two times that of St. Mary or St. Catherine, but these relative weightings could be adjusted and the resulting effects examined by changing the value of the exponent used for this variable during the running of the simulation model.

(d) The Number of Males Between 15-44 Years of Age

Age characteristics of the male population in the census subdivisions around the plant were viewed as one of the expressions of the distribution of qualified persons who would be seeking bauxite employment. Mr. X had indicated in his questionnaire (see Appendix D) the importance to him of the age of the applicant for certain types of work. In order to determine a critical age range, it was necessary to examine not only Mr. X's questionnaire but also the individual questionnaires handed out to a systematic sample of the employees initially selected for the study.

Mr. X's comments indicated that for hourly-paid positions he preferred men from eighteen to thirty-five years of age. However,

from an examination of the ages when hired, of a sample of the hourly-paid workers, it was noted that the ages ranged from sixteen to forty. The 1960 census had data available which gave the number of males in each census subdivision between the ages of fifteen and forty-four. This age range was suitable for our purposes because it closely approximated both age ranges.

(e) The Number of Males with More Than Four Years of Education

The only relevant data for educational levels to be found in the 1960 census related to the number of males with more than four years of schooling. These figures were used to help point-up the relative differences in the distribution of qualified, prospective employees living in the study area.

(f) The Number of Inexperienced Males Seeking Employment

This variable attempted to show relative unemployment conditions in the census subdivisions around the plant. The unemployed would undoubtedly be the ones seeking-out existing employees who might assist them in gaining employment. This variable indicated the numbers who wanted employment but who had never been employed outside the home previously.

(g) The Number of Experienced Males Seeking Employment

It was felt that perhaps the numbers of experienced workers seeking employment would be more useful than the number of inexperienced workers reported in the previous variable. Answers to question 5(b) of Mr. X's questionnaire indicated that the work experience of the prospective employee is not important for labourers, but is of significance

for those wanting the more responsible hourly-paid positions, such as truck drivers and crane operators. The above four variables were included to see to what extent they could be helpful in showing the greater importance of the distribution of qualified persons than the basic population distribution. Each variable was "tested" in different runs of the model and will be reviewed in the next chapter.

(h) Mr. X's Attraction Index

It was expected that one of the most important controlling factors behind the spatial pattern of employee selection was related to Mr. X's own personal feelings about, and impressions of the different environmental characteristics of the towns and districts around Belmont.

It was difficult to be completely objective when interpreting his comments for the attraction index. Mr. X had been asked his impressions of thirteen towns and districts, with the belief that he might indicate a preference for certain towns, regardless of their size or distance from Belmont. From his responses a rank-scale, ranging from one to five, was developed. Initially any district that had not been asked about was given a "0" rating but this was later changed to "3" in order to not downgrade a location on which he had expressed no negative opinion. Thus all "0" values seen in Appendix E under variable 8 were interpreted by the computer as equalling "3". Mr. X's actual responses are found in Appendix D, question 4. Since employment allocations in this model are being made by census subdivisions, all subdivisions abutting one of the thirteen towns on which he commented were awarded the same attraction index value.

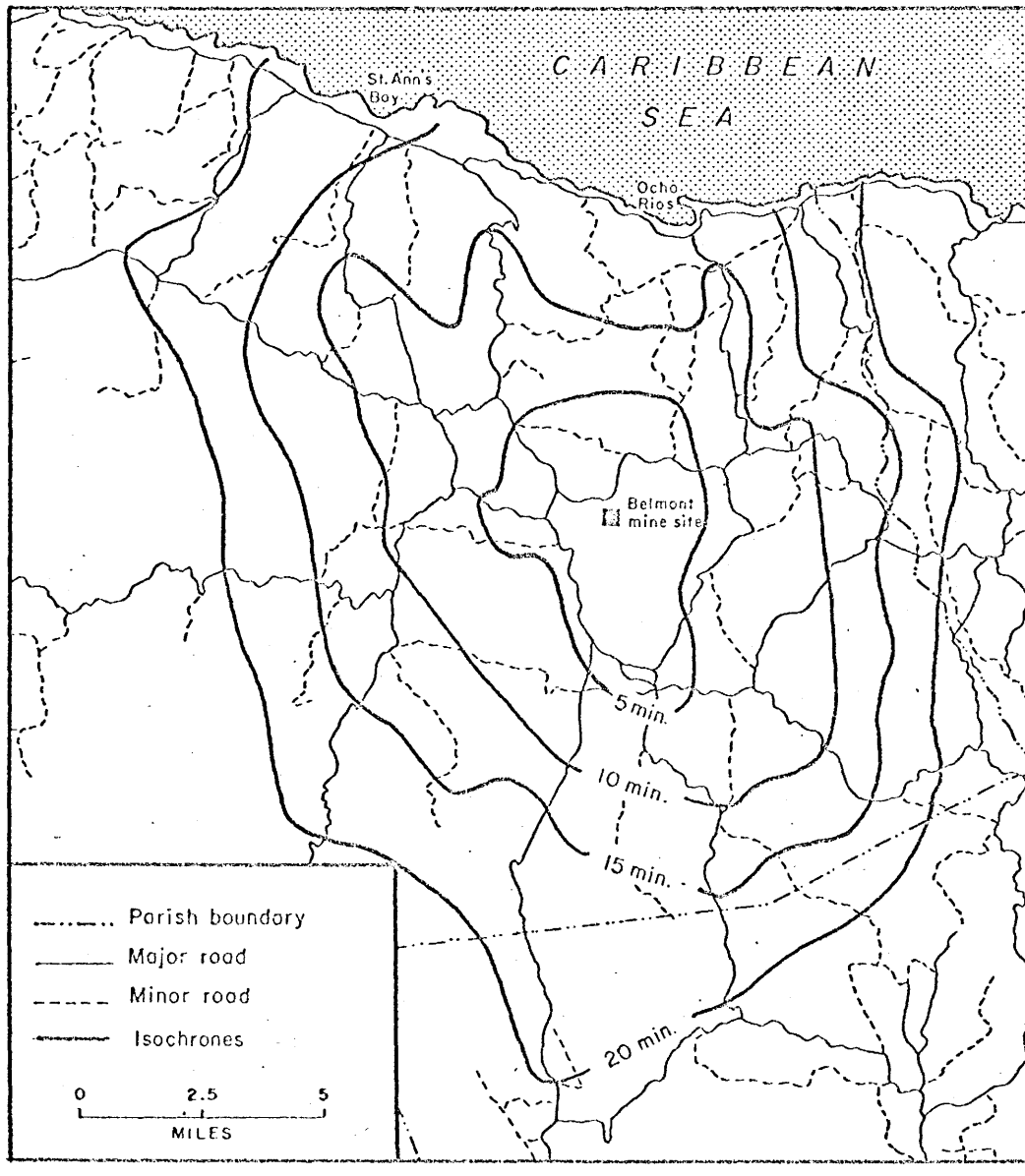
(i) Mr. X's Perceived Time-Distance

This variable attempted to examine the effects of Mr. X's spatial perception of the physical environment, on his hiring policies, as shown in his mental map (see Appendix D). To assist in obtaining perceived time-distance values for the various census subdivisions, not only was his mental map utilized but also his time-distance rankings. Due to incomplete information for his perception of the time-distances to all the census subdivisions in the study area, it was necessary to construct an isochrone map (see Figure 22). The travel-time intervals used were five minutes. The rankings of districts mentioned above were used to help determine the path of these isochrones.

The mental map of the employment officer revealed that he grossly underestimated the distances to most of the towns and districts in the study area. Because of the great discrepancy between the actual time-distances and his perception of these distances it was felt that substitution of perceived time-distances for actual values in the model would improve the correspondence of the simulated distribution with the original distribution of the hourly-paid workers.

(j) The Employees' Attraction Index

This variable was believed to be related only to the relocation portion of the analysis. This index was to be used by itself and also in conjunction with the actual time-distance and parish location variables to help simulate the present (1968) distribution of hourly-paid employees in the study area. The preliminary analysis has shown that often a relocation of residence does take place but that for hourly-paid workers the movement is generally only to another residence in



Employee Travel-Times Perceived by Mr. X

Figure 22.

the same general area (see Figure 18).

It was felt that when the relocation takes place, the new employees want to move closer to the towns in the area because of the provision of better housing facilities and improved accessibility to the plant. It was thus decided to make the employees' attraction index equal in each census subdivision to the population of the area's largest town or district.

5.5 Summary

This chapter has outlined the preliminary analysis that was carried-out before the simulation model was run. Investigations were made into the nature of the distance decay function for the hourly-paid workers, and least-squares quadratic curves were fit to four different scattergrams. Secondly, the chapter has introduced the ten variables which will be independently and jointly grouped in the model to "test" the hypotheses put forward in Chapter II.

Chapter VI: SIMULATION MODEL ANALYSIS

6.1 Introduction

It is the function of this sixth chapter to outline the results of the running of the simulation model proposed in Chapter IV. The results obtained from different variable combinations will be shown in a series of Tables. A few of the simulations will be plotted on maps of the study area which will be visually comparable with the Figures indicating the actual original and present distributions of employees (see Figures 6 and 7).

6.2 Monte Carlo Simulations

The program written by Mr. F. Nolte had the capability of producing Monte Carlo simulations. In these simulations, the time element was inherent and the clustering of employees could thus be simulated as well as the simulation of a final distribution. The computer print-out of a Monte Carlo simulation and the comparable tested simulation can be seen in Appendix F, Parts A and B.

With the Monte Carlo model, attribute weights are assigned to each census subdivision; and then added to each of these values is the influence of the inter-employee neighbourhood effect. Then a cumulative mean information field, something like the one developed by Hagerstrand is determined, and ranges of probability values for each of the 109 census subdistricts in the study area are calculated. The sum of these probability values must always equal 1.0, but the proportion of this total value varies from district to district. Using a random number determined in the computer program, a job is allocated to that subdistrict with the appropriate probability range.

Selection of the individual causes a recalculation of the subdistrict's attribute, and correspondingly brings about a relative decrease in the total attribute of the other 108 districts. This process continues until all of the employees have been chosen.

The final frequency distribution which is derived from the Monte Carlo simulation represents only one possible outcome of the hiring process or relocation process. Perhaps the main value of the Monte Carlo type of model is its realistic (i.e. possibilistic) nature, in that it generates feasible alternatives to reality. Using this Monte Carlo simulation method, the researcher might be able to get an insight into who benefits from the presence of the decentralized industry in the early stages and certainly could simulate changes in the employment totals by increasing or decreasing the number of employees to be assigned per year. Figure 4 in Chapter 1, could be used for this purpose.

6.3 Single-Variable Runs (Original Distribution)

This section of the chapter will review the runs which examined the predictive qualities of each of the ten variables outlined in Chapter V for simulating the original distribution of hourly-paid employees.

(a) Time-Distance (Actual and Perceived)

An hypothesis in Chapter II which stated that actual time-distances were much more important than actual road-distances was not found to be sustained from the results of the correlation analysis outlined in Chapter V. It had also been stated that the perception

of the time-distances should be more meaningful than the actual time-distances from the standpoint of the personnel officer attempting to hire local people. In order that this hypothesis might be "tested" both the actual time-distance and the perceived time-distance values were run by themselves in the model. On each of the three separate runs, different exponent values for the distance variable were used. The resulting percentage of the census subdistricts accepted for different incremental values of the neighbourhood effect are shown in Table 1.

An examination of the "runs" which produced the highest levels of acceptance for each variable, reveals that in both cases this value is 84.4 percent with the neighbourhood effect equal to zero (H = 0.0) and the exponent of each distance variable set at -1.0. The comparison of these values, it had been hypothesized would show the percentage of acceptance to be higher using Mr. X's perceived time-distance values. This is clearly not the case. We have not, then, been able to prove that the simulation model will more closely resemble the actual original distribution of employees when perceived distance values are used. Figure 23 indicates the plotted distribution of the frequencies resulting from the use of actual time-distances.

It appeared during the preliminary analysis (see Chapter V) that with an under-estimate of approximately forty-five percent, the perceived time-distance variable would be more revealing than it was. Its failure may be due to a lack of data on the mental map and the other spatial tests. Secondly, it became quite clear that although Mr. X had grossly underestimated time-distances, he had, at least,

COMPARISON OF TIME-DISTANCE RESULTS

(ORIGINAL LOCATION)

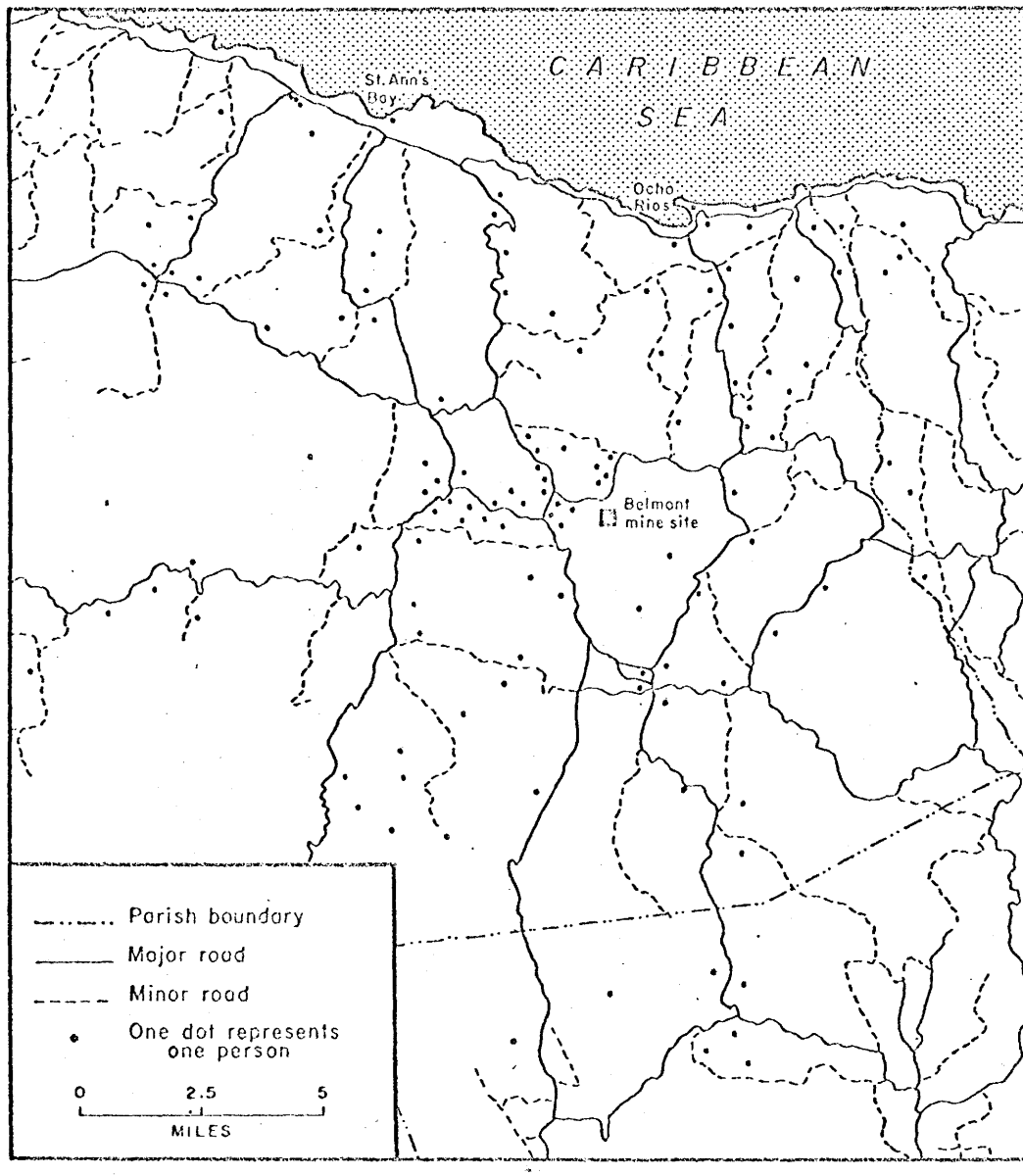
	Var. Name	Const. Value	Exp. Value	H values are below with increments of 0.2 .0	.2	.4	.6	.8	1.	1.2	1.4
*	ATD.	1.0	-1.0	84.4	83.5	80.7	80.7	80.7	77.1	76.2	73.4
	PTD.	1.0	-1.0	84.4	83.5	83.5	82.6	81.7	76.2	76.2	76.2
	ATD.	1.0	-1.5	80.7	80.7	80.7	78.9	78.0	77.1	74.3	74.3
	PTD.	1.0	-1.5	81.7	81.7	81.7	82.6	77.6	77.1	76.2	76.2
	ATD.	1.0	-2.0	77.1	77.1	75.2	75.2	75.2	75.2	75.2	75.2
	PTD.	1.0	-2.0	79.8	79.8	74.3	76.2	76.2	76.2	75.2	75.2

ATD. is a short-form for the actual time-distance

PTD. is a short-form for Mr. X's perceived time-distance

* This run has been plotted. See Figure 23

Table 1.



Simulated Distribution of "Original" Worker Location
Using Time-Distance

Figure 23.

been quite consistent. The significance of the value of any variable or combination of variables is its proportion of the average variable value for the 109 subdistricts.

In summary, perceived time-distances did not produce any higher percentages of acceptance than the highest value from the use of actual time-distance data. In this study, the hypothesis can not be accepted. Due to the outcome from running the two time-distance measures, it was decided to run the remaining combination runs for the simulation of the original distribution with the use of actual time-distance measures.

(b) Total Population

An examination of the expected hypothetical frequency for St. Ann's Bay, the most heavily populated town in the study area, in the above runs indicated a very low expected value of 0.6, or, when rounded-off, one employee. The observed original frequency for this subdistrict was eleven. Distance alone, due to the uneven nature of the population distribution, could not adequately predict all values. Population figures were important, and it was hoped that later runs using combinations of distance and population variables would give a high level of acceptance and less discrepancy between the actual and simulated values for those districts with "unusually" high observed frequencies.

Total population was "run" first, and it resulted in an 83.5 percent acceptance of the model and is shown in Table 2. Related to this variable, and initially believed to be more meaningful, were the other variables related to specific "qualities" of the total population. Population density had not been considered as important as the distri-

COMPARISON OF POPULATION VARIABLE RESULTS

(ORIGINAL LOCATION)

Var. Name	Const. Value	Exp. Value	H. values are below with increments of 0.2							
			.0	.2	.4	.6	.8	1.	1.2	1.4
* TP.	1.0	1.0	83.5	82.6	80.7	78.0	77.1	73.4	72.5	71.6
NM.	1.0	1.0	82.6	81.7	80.7	77.1	76.2	74.3	73.4	71.6
NEM.	1.0	1.0	80.7	80.7	78.9	78.0	77.1	76.2	73.4	72.5
NIM.	1.0	1.0	67.9	71.6	74.3	74.3	74.3	71.6	73.4	73.4
NExM.	1.0	1.0	63.3	65.1	66.1	67.0	66.1	66.1	67.9	67.9

TP. is a short-form for total population
NM. is a short-form for the number of males between (15-44)
NEM. is a short-form for the number of educated males
NIM. is a short-form for the number of inexperienced males seeking employment
NExM. is a short-form for the number of experienced males seeking employment

* This run has been plotted. See Figure 24

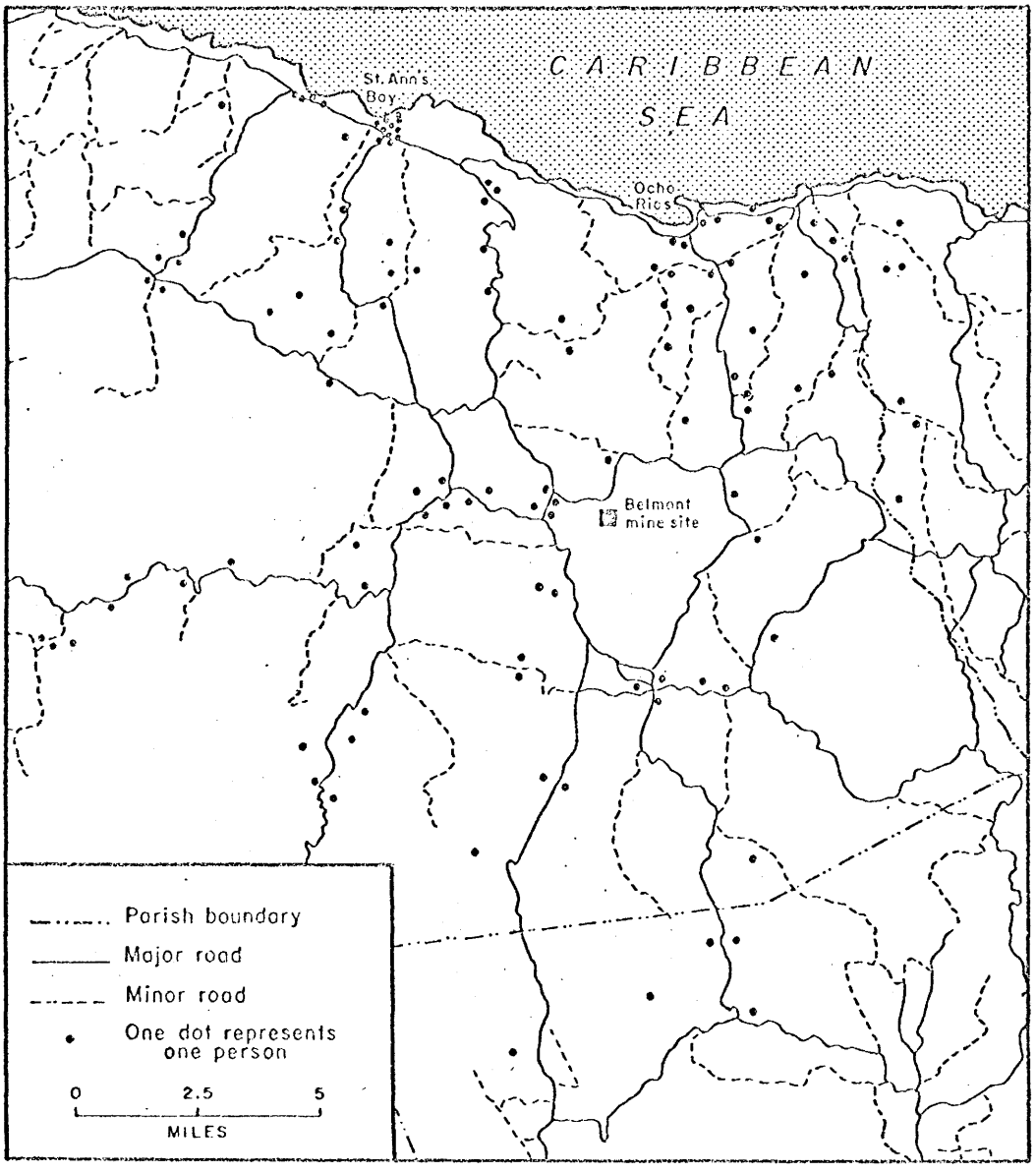
Table 2.

bution of qualified persons who would be seeking bauxite employment.

Table 2 presents the results of the running of these population variables and indicates that total population resulted in the highest level of acceptance whereas the variables related to the number of experienced males seeking employment actually resulted in the lowest level of acceptance. In the second chapter, it had been hypothesized that the pattern of original employee locations should reflect the original population distribution. An examination of the above Table does indicate a high level of acceptance.

One of the personal or psychological variables which had been considered important in accounting for the original distribution of hourly-paid employees was the operation of an inter-employee neighbourhood effect. With regard to this neighbourhood effect, it had been hypothesized that the friends of existing employees would have a better chance of obtaining employment than those with no such "pull". The set of questionnaires administered to the sample of hourly-paid workers and the questionnaire administered to Mr. X clearly indicated the importance of such social contacts.

In Chapter IV, it was mentioned that for purposes of operationalizing this neighbourhood effect, it was necessary to restrict the sphere of social contacts to the bounds of each subdistrict. It was realized at the time that such social contacts do occur across subdistrict boundaries and indeed between subdistricts quite removed from each other. Table 2 on a previous page, shows very clearly the resultant influence of small increments of $H = 0.2$ for the neighbourhood effect. In most cases increments in the value of H caused a



Simulated Distribution of "Original" Worker Location Using Total Population

Figure 24.

decline in the percentage of subdistricts accepted by the test in the model.

In this Polya-Eggenberger model, the value of H was identical for all 109 subdistricts on any one "run", but its effect varied depending on the attribute of the particular subdistrict. This led to a degree of under-prediction in some subdistricts. What seems to be happening by increasing the value of H, is that the degree of over-estimation is outweighing the reduction in the degree of under-estimation because most of the observed frequencies are zero. Therefore, for most runs, the total percentage of subdistricts whose frequencies are accepted by the test falls.

There is a tendency for the acceptance values to remain the same for a range of H from 0.0 to 0.2, but there is nothing consistent in this and in general the highest acceptance percentages occur when there is no neighbourhood effect. This might be due to the predominance of subdistricts with a very low probability of having an employee chosen. It seems to the author that considerable improvement would occur if further research could find a method of assigning different neighbourhood effect values to particular subdistricts during each "run".

(c) In-Out of the Parish

The first hypothesis stated in Chapter II indicated that the original location of employees should form a pattern clustering around the plant sites. One of the reasons given for this clustering was that the Company and Mr. X would be under political pressure, informal for local people and formal for the Parish Council of St. Ann, to hire local individuals.

This variable was run twice by itself with exponent values of 1.0 and 0.5 and in each case led to an 85.3 percent level of acceptance. The high level of acceptance obtained made it one of the variables to be included in later combined variable forms of the model. The plotted simulation map for total population (see Figure 24) revealed that a few workers were being selected from St. Catherine and St. Mary. However, the observed original distribution (see Figure 7) had shown no allocations of jobs to residents in those Parishes. Thus by incorporating the above variables into later combined variable models, job allocations outside of the Parish of St. Ann could be discouraged.

(d) Mr. X's Attraction Index

Another of the personal or psychological variables which had been considered to be important in accounting for the original distribution of employees was the Company's impressions of specific areas. Mr. X does all the hiring of hourly-paid workers so it is actually his impression of the various areas which is important. This variable, which has already been discussed in Chapter V, was run and resulted in an 82.6 percent level of acceptance when H = 0.0.

(e) The Employees' Attraction Index

This variable, which incorporates the importance of residential sites was originally intended for use with the relocation portion of the research, but it seemed that it may be applicable in the original selection of employees. Mr. X might think in terms of the size or population of towns. For instance, he may know or favour a larger town over a smaller one. The results of this "run" produced a percentage

of acceptance at 77.1 when H = 0.4. This is one of the instances when the percentage figure rose slightly as the value of H increased.

6.4(a) Combination of Variables for Simulation of Original Distribution

Early results indicated the need for combining the distance variable (actual time-distance) with one of the population variables. The one selected was total population because of the high level of acceptance obtained from this variable. Different constant and exponent values were utilized as well as variations in the rate of increment of the H value. Results are shown in Table 3 and indicate that the highest levels of acceptance were obtained when the actual time-distance exponents equalled -1.5 and the total population constants equalled 2.0 and 3.0 respectively. There was no theoretical basis for the combination of such values.

An examination of the model which combined a distance exponent of -1.5 and a population constant of 3.0, revealed a closer correspondence to the observed values for those subdistricts which were removed from the plant site and relatively heavily populated. In both cases, the districts immediately around Belmont were not accepted by the test. However, the model with the lower population constant had higher theoretical frequencies than did the other in the subdivisions around the plant.

(b) Three-Variable Combinations

In this series of runs (see Table 4), three additional variables were alternated into the model. Part A of the Table indicates changes in the percentages with increments in H of 0.5, while Part B

COMPARISON OF RESULTS USING TWO VARIABLES
(ORIGINAL LOCATION)

Var. Names	Const. Value	Exp. Value	H Values are below with increments of 0.5						
			.0	.5	1.0	1.5	2.0	2.5	3.0
ATD.	1.0	-2.5	79.8	78.9	78.0	78.0	78.0	78.0	77.1
TP.	5.0	1.0							
ATD.	1.0	-1.5	83.5	83.5	80.7	79.8	78.9	78.0	77.1
TP.	3.0	1.0							
ATD.	1.0	-1.5	82.6	81.7	79.8	78.9	78.0	73.4	73.4
TP.	1.0	1.0							
			H Values are below with increments of .2						
			.0	.2	.4	.6	.8	1.	1.2	1.4
ATD.	1.0	-1.5	83.5	82.6	81.7	81.7	80.7	79.8	79.8	79.8
TP.	2.0	1.0								
ATD.	1.0	-3.0	74.3	74.3	74.3	74.3	74.3	74.3	74.3	74.3
TP.	6.0	1.0								

ATD. is a short-form for actual time-distance
TP. is a short-form for total population

Table 3.

COMPARISON OF RESULTS USING A COMBINATION OF THREE VARIABLES
(ORIGINAL LOCATION)

Var. Names	Const. Value	Exp. Value	H Values are below with increments of .5 .0	.5	1.	1.5	2.0	2.5	3.0
ATD.	1.0	-1.5							
TP.	1.0	1.0	83.5	82.6	81.7	80.7	79.8	78.9	78.0
In-Out	1.0	1.0							
ATD.	1.0	-1.5							
TP.	2.0	1.0	83.5	83.5	83.5	80.7	79.8	79.8	78.9
In-Out	1.0	1.0							
ATD.	1.0	-2.5							
TP.	5.0	1.0	80.7	80.7	79.8	79.8	78.9	78.0	78.0
In-Out	1.0	1.0							
ATD.	1.0	-1.5							
TP.	2.0	1.0	83.5	82.6	82.6	80.7	79.8	79.8	78.9
In-Out	1.0	1.0							
ATD.	1.0	-2.5							
TP.	5.0	1.0	80.7	80.7	79.8	78.9	78.0	78.0	78.0
In-Out	1.0	1.0							

ATD. is a short-form for actual time-distance
TP. is a short-form for total population
In-Out refers to the Parish of residence of the applicant

Table 4. (Part A)

COMPARISON OF RESULTS USING A COMBINATION OF THREE VARIABLES
(ORIGINAL LOCATION)

Var. Name	Const. Value	Exp. Value	H Values are below with increments of 1.0 .0	1.0	2.0	3.0
ATD.	1.0	-1.5				
In-Out	1.0	1.0	84.4	82.6	78.9	78.0
EAI.	1.9	1.0				
ATD.	1.0	-1.3				
In-Out	1.0	1.0	85.3	83.5	80.7	78.9
EAI.	1.7	1.0				
ATD.	1.0	-1.1				
In-Out	1.0	1.0	85.3	84.4	83.5	78.0
EAI.	1.8	1.0				
ATD.	1.0	-1.4				
In-Out	1.0	1.0	84.4	82.6	79.8	78.9
EAI.	1.9	1.0				

ATD. is a short-form for actual time-distance
In-Out refers to the Parish of residence of the applicant
EAI. is a short-form for the employees' attraction index

Table 4. (Part B)

of the Table indicates changes in the percentages with increments in H of 1.0.

The highest level of acceptance obtained was 85.3 percent and these resulted from two of the four runs which utilized the employees' attraction index instead of total population values. These runs are shown on the following page.

(c) Four-Variable Combinations

At this point nine runs were made of the model. In this series of runs, four variables, which had been initially felt important in a simulation of the original distribution of employees, were used. The four variables which were combined included actual time-distance, total population, parish residence, and Mr. X's attraction index. Even though the highest level of acceptance was 84.4 percent, it appears that better over-all results can be obtained by incorporating the variable which represents the population of the largest towns in the study area rather than the use of total population figures.

6.5 (a) Simulation of the Present Distribution

A similar approach was used in this second part of the research. Most of the variables deemed significant in the simulation of the present distribution were initially "run" by themselves.

The first variable to be "run" alone was time-distance. Table 5 indicates the results of the four runs in which different exponent values were used. The highest level of acceptance at 88.1 percent was obtained with a -0.5 exponent for the time-distance variable. Unlike the distance decay curves which are concave to the origin throughout their length, this decay function is somewhat convex

COMPARISON OF TIME-DISTANCE RESULTS
(PRESENT LOCATION)

Var. Name	Const. Value	Exp. Value	H Values are below with increments of .2 .0	.2	.4	.6	.8	1.	1.2	1.4
* ATD.	1.0	-0.5	88.1	88.1	87.2	85.3	84.4	78.9	77.1	70.6
ATD.	1.0	-1.0	86.2	87.2	86.2	84.4	82.6	81.7	78.0	73.4
ATD.	1.0	-1.5	84.4	82.6	83.5	83.5	80.7	77.1	75.2	75.2
ATD.	1.0	-2.0	79.8	78.0	75.2	74.3	74.3	73.4	71.6	70.6

ATD. is a short-form for actual time-distance
* This run has been mapped and those districts not accepted in the test have been singled-out on Figure 25.

Table 5.

to the origin at first, indicating a relatively slow decline in frequencies predicted out from the plant and then a very rapid decline. In St. Ann's Bay at approximately fifteen miles, this simple model would only predict one employee. Figure 25 indicates those census subdistricts in which the hypothetical frequencies were not accepted.

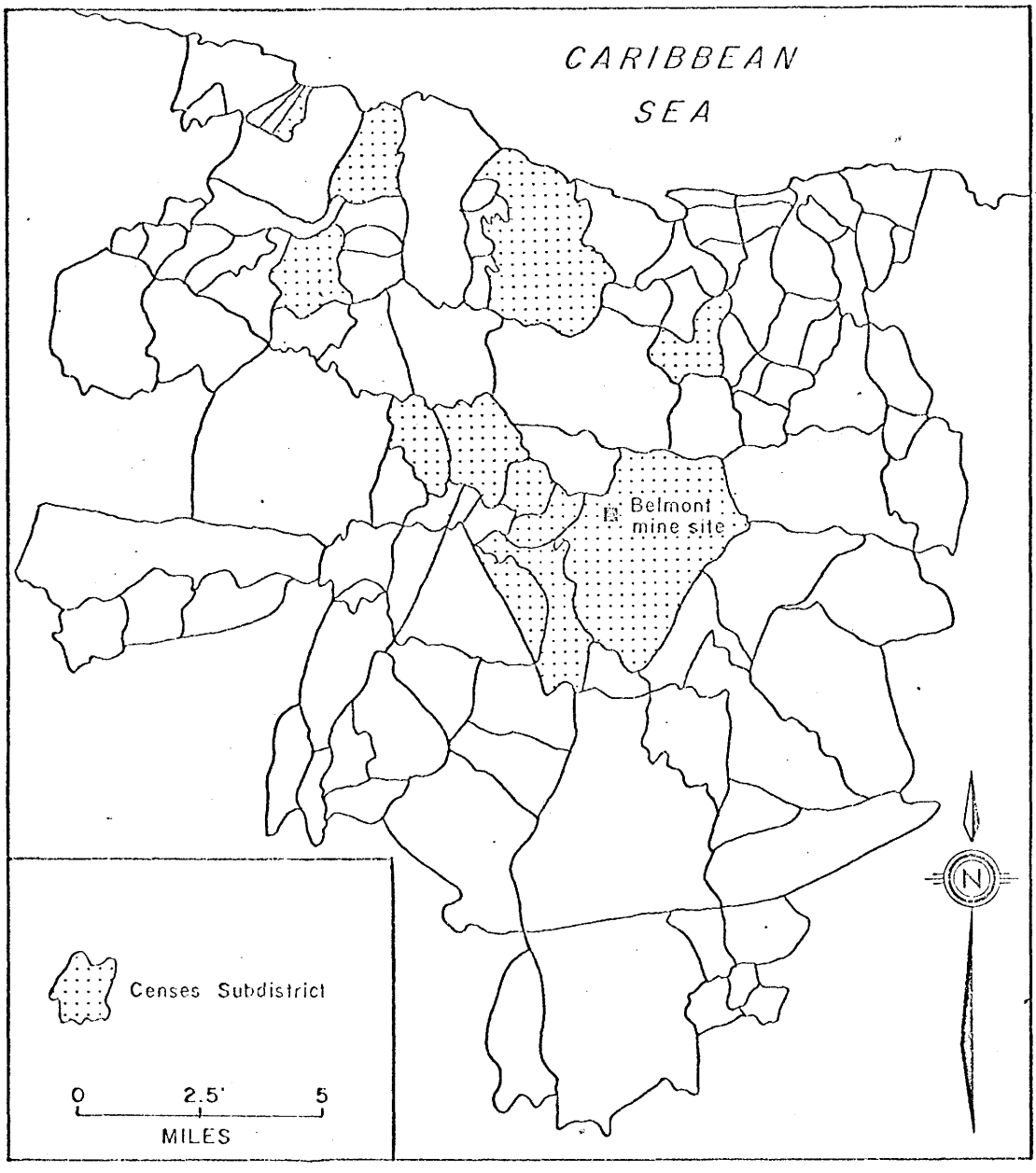
Despite the high level of acceptance, the model was unable to account for census subdistricts which had high observed frequencies. Again it is quite clear, that a population variable is necessary to help account for the irregular distribution of environmental attributes.

(b) Total Population

In this case total population was "run" with the result that with H = 0.0, the level of acceptance was 83.5 percent. This variable led to a large over-prediction of the frequency of employees for St. Ann's Bay, and under-prediction for the subdistricts around Belmont.

(c) Employees' Attraction Index

The preliminary analysis has shown that relocation of bauxite workers after they obtain employment is quite common (see Figure 18). The relocation process, it was believed, should have occurred so that workers could live in areas regarded as more attractive for residence and/or more accessible to the plant. The increased income from bauxite employment would facilitate their moving. The relocation patterns should tend to centre on towns regarded as preferred residential sites. The employees' attraction index, which represents the population of the largest town or district in each census subdistrict was used for



Districts Not Accepted in Simulation of "Present" Distribution using Time-Distance

Figure 25.

measuring the towns' influence. Using an exponent value of 1.0 and a constant value of 1.0, the level of acceptance obtained when H = 0.0 was only 77.1 percent. A closer examination of the individual frequency values for the majority of census subdistricts which had low observed values. Clearly the size of the town is important, but its significance is conditioned by its proximity to the work place. Due to the recognized fact that Jamaicans normally have strong value judgements about the quality of people living in specific towns or districts, it was expected that when relocating, an employee would not want to move to a census subdistrict outside of St. Ann Parish.

6.6 Simulation of Present Distribution Using Three Variables

The twelve runs reported below incorporated the variables time-distance, parish residence and the employees' attraction index as shown in Table 6. The highest level of acceptance obtained was 88.1 percent and we managed to come very close in simulating the frequency value for St. Ann's Bay.

Regardless of how the variables are adjusted, the model just can not accommodate areas with high frequencies adjacent to the plant and also certain selected districts which are found at considerable distances from Belmont. One of the two runs that produced an 88.1 percent acceptance has been mapped so that areas whose expected frequency values are not accepted by the model's test are distinguishable. On this diagram, Figure 26, it is immediately evident that the model has failed to adequately predict frequencies in the immediate areas of the plant. A closer examination of the individual values reveals

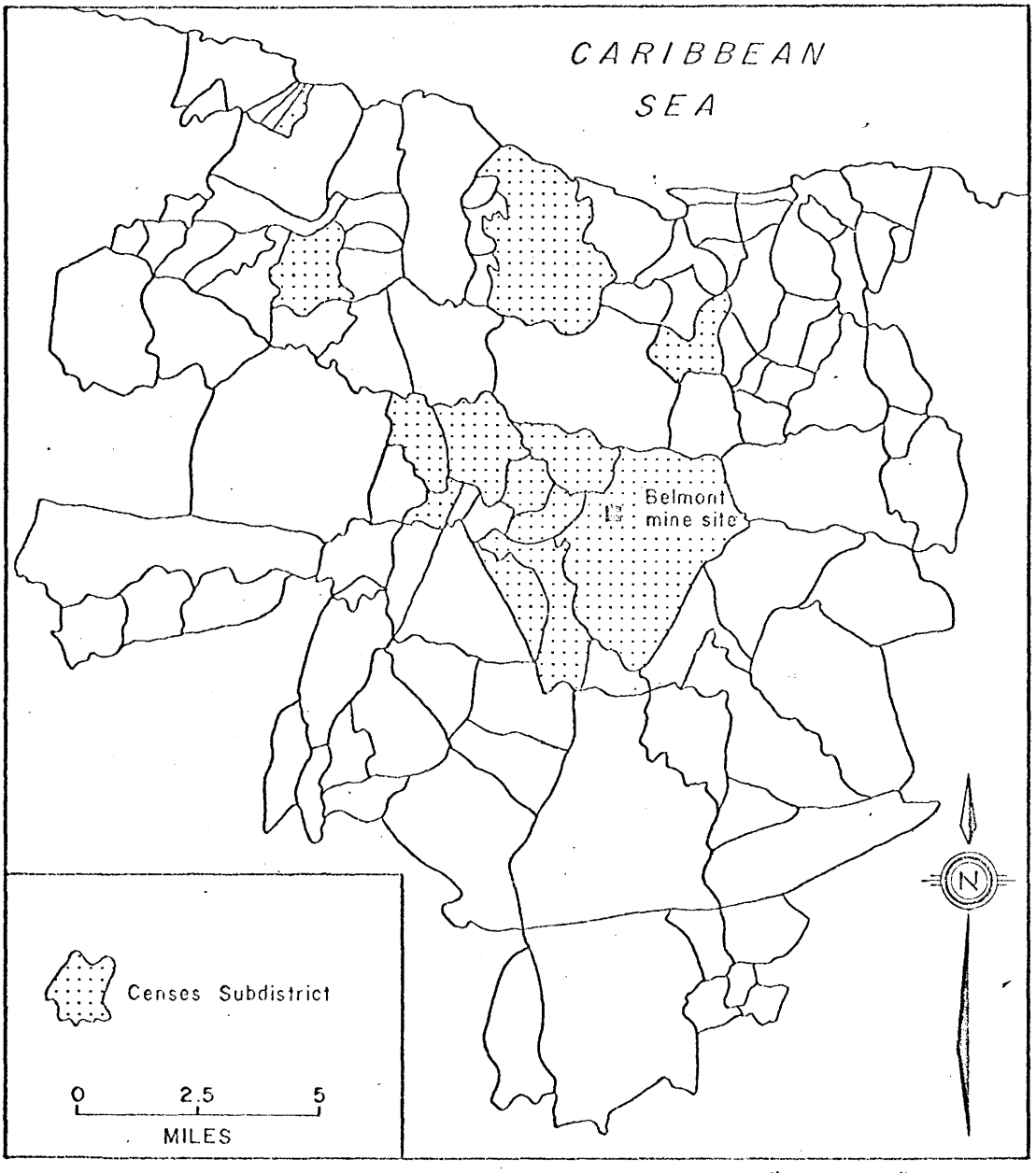
COMPARISON OF RESULTS USING THREE VARIABLES
(PRESENT LOCATION)

	Var. Name	Const. Value	Exp. Value	H Values are below with increments of 1.0 .0	1.0	2.0	3.0
*	ATD.	1.0	-1.4				
	In-Out	1.0	1.0	88.1	83.5	81.7	77.1
	EAI.	1.7	1.0				
	ATD.	1.0	-1.3				
	In-Out	1.0	1.0	87.2	83.5	83.5	78.0
	EAI.	1.7	1.0				
	ATD.	1.0	-1.2				
	In-Out	1.0	1.0	87.2	85.3	83.5	77.1
	EAI.	1.5	1.0				
	ATD.	1.0	-1.3				
	In-Out	1.0	1.0	88.1	83.5	82.6	78.0
	EAI.	1.5	1.0				
	ATD.	1.0	-1.1				
	In-Out	1.0	1.0	87.2	85.3	82.6	76.2
	EAI.	1.5	1.0				
	ATD.	1.0	-1.4				
	In-Out	1.0	1.0	87.2	83.5	81.7	77.1
	EAI.	1.8	1.0				
	ATD.	1.0	-1.5				
	In-Out	1.0	1.0	87.2	83.5	81.7	77.1
	EAI.	1.9	1.0				
	ATD.	1.0	-1.1				
	In-Out	1.0	1.0	87.2	84.4	82.6	78.0
	EAI.	1.8	1.0				
	ATD.	1.0	-0.8				
	In-Out	1.0	1.0	87.2	84.4	83.5	76.2
	EAI.	1.1	1.0				
	ATD.	1.0	-1.5				
	In-Out	1.0	1.0	86.2	84.4	83.5	76.2
	EAI.	1.1	1.0				
	ATD.	1.0	-1.5				
	In-Out	1.0	1.0	87.2	83.5	81.7	77.1
	EAI.	1.1	1.0				
	ATD.	1.0	-1.3				
	In-Out	1.0	1.0	87.2	83.5	83.5	78.0
	EAI.	1.6	1.0				

ATD. is a short-form for actual time-distance
In-Out refers to the Parish of residence of the applicant
EAI. is a short-form for the employees' attraction index

* This combination of variables has been shown in Figure 27.

Table 6.



Districts Not Accepted in Simulation of "Present" Distribution using Time-Distance, Parish Residence and Employees' Attraction Index

Figure 26.

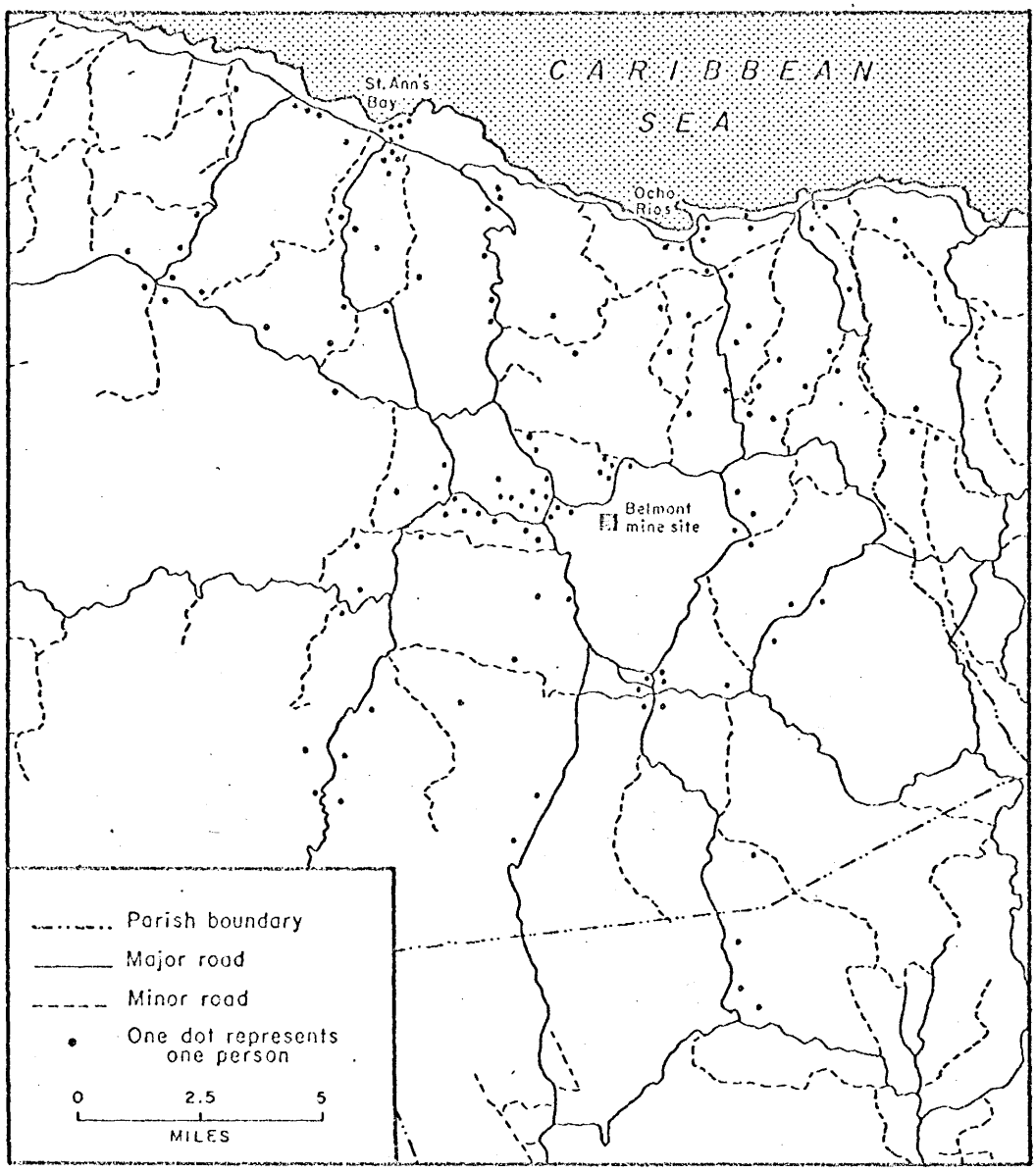
considerable underestimate of actual frequencies. It would not help to utilize a very high exponent for time-distance because not all of the census subdistricts around Belmont had equally high observed present frequencies.

In addition to the above Figure, a dot distribution map (Figure 27) showing the simulated frequencies has been prepared. Despite the high acceptance levels, the lack of concentrations of employees around the Belmont plant site is evident. Many of the subdistricts had frequency values between 0.5 and 0.99. These values were rounded-off to zero or one employee in the mapping. This helps account for the dispersed distribution. The underestimation of grequencies around the plant site is not a new outcome in this type of research project.

6.7 Implications of this Model for Future Research

This study had focussed on what is a dynamic process, that of the hiring of employees and their subsequent relocation. In this paper, two distributions were noted. The first has been called the original pattern and the second the present distribution. With variations of the model, attempts have been made to simulate these distributions. Such models can have implications for regional planning. Indications are provided as to whom will benefit from the location of the decentralized industry and at what stage in the hiring process an individual from a particular district will benefit.

Subsequent research projects might examine the clustering of hired employees through time and thus gain a more realistic measure



Simulated Distribution of "Present" Worker Location Using Time-Distance, Parish Residence, and Employees' Attraction Index.

Figure 27.

of the neighbourhood effect for different stages in the hiring process. The Monte Carlo model and the tested model are capable of such simulations. However, the tested model is more suitable for simulating a distribution at a given point in time. Simulations of the clustering process were not attempted because of a lack of empirical data against which to compare them.

Our neighbourhood effect was applied as an equal value to all census subdistricts on each run. As mentioned some areas were benefiting from this when, in fact, they should not have been. Areas with a low relative attribute value benefited more from this neighbourhood effect than did the areas with greater attribute weightings. Another aspect of this research which should be examined more closely at a later time is the perception of the employment officer. Preliminary analysis revealed that he did have positive and negative feelings about different towns and districts in the study area, and his perception of the physical distances revealed considerable underestimation. However, incorporation of these two variables into the model did not prove as meaningful as hoped. Part of the problem undoubtedly stems from a shortage of detail concerning Mr. X's perception of the social and the physical environment around the plant.

6.8 Summary

This chapter has outlined the outcome of the many "runs" of the model to gain insights into the validity of the hypotheses put forward, and to examine the effects of different variables and combinations on the resultant levels of acceptance of the simulated distribution.

The use of the employees' attraction index along with the distance variable and parish of original residence produced the best model in terms of the test. For the present simulation, the highest level of acceptance was 88.1 percent. This high level of acceptance was obtained by combining the following variables; actual time-distance, parish residence and the employees' attraction index. For a closer examination of the exponent and constant values that were utilized see Table 6. The same variables were used in the simulation model of the original distribution of employees (see Table 4, Part B). One difference between the two was the greater relative distance decay rate in the present model than was the case for the original model.

Chapter VII: SUMMARY AND CONCLUSIONS

In the present investigation into the impact of the Reynolds Bauxite Company, a decentralized industry in north-central Jamaica, on the spatial pattern of employment in the surrounding area; the intention has been to construct and operationalize a probability model. This model, which was based on the Polya-Eggenberger distribution, was used to "test" the significance of a number of variables thought to influence the two resultant patterns under study and to simulate what the patterns should look like under various conditions. It was hoped that the model operationalized here, might be applied to the study of employment patterns of decentralized industries in different developing countries. One country where such a study could be carried out is Guyana, where bauxite extraction industries have been established.

The model proposed is very flexible and allows for data aggregated in different sized areal units. We are not forced to collect data for regular square areal units as some researchers have been. Also with this model, the author has a free choice in selecting those variables which he feels control the employee selection process.

The introductory chapter stressed the importance of the establishment of industries in low-income rural areas as one of the common methods of attempting to alleviate regional income disparities. The latter portion of the chapter dealt with a description of the study area and a brief history of Reynolds Jamaica Mines Limited.

The review of the literature was necessarily broad-ranging due to the nature of the hypotheses which were to be examined during the study. As a result of this review, the nature of the problem studied

and the data available, the Polya-Eggenberger distribution was utilized.

It is very difficult to prove rigorously any hypotheses "tested" in a simulation model. It had been hypothesized that the original location of the employees would be clustered around the plant for three reasons:

(a) the Company would be under political pressure;

(b) the Company would prefer to hire people living close to the industrial sites since the short journeys-to-work would help ensure that the workers were on-time and well-rested;

(c) people living nearest to the plant would have the greatest opportunity and motivation to seek work with the Company.

Preliminary analysis revealed that when the residence locations of the spatially random sample of hourly-paid workers were mapped, clustering did occur close to the plant. Under the above conditions, it was hypothesized that the number of people obtaining employment living at various time-distances from the plant should give rise to a concave decay function if the population distribution was assumed to be uniform. The plotting of scattergrams and the plotting of their least-squares regression lines revealed that despite the uneven population distribution concave decay functions existed for not only the original distribution but also for the present distribution.

The perceptual characteristics of the employment officer, who has been responsible for hiring all of the hourly-paid workers since the Company began mining operations in 1952, had been deemed very important to the particular pattern of employee locations. It was

hypothesized that from the standpoint of the employment officer attempting to hire local people, actual time-distance was not as relevant as his perception of time-distance. Simulation of the employment patterns using both forms of time-distance measure did not support the above hypothesis. The perceived distance values did not produce a higher level of correspondence than did the actual time-distances.

Population density, which had never been uniform in the study area due to the presence of towns, roads, a highly variable farming resource base, and varying land tenure conditions led the author to hypothesize that the pattern of original employee locations should reflect the original population distribution. Further, population density was not considered to be as important as the distribution of qualified persons who would be seeking bauxite employment. In attempting to simulate the original pattern and "test" the above hypothesis, "runs" were made using total population, the number of educated males, the number of males between 15-44 years of age, the number of experienced men seeking work and finally the number of inexperienced men looking for employment. Results of these "runs" actually showed that of the above, total population figures were the most meaningful for simulating the original distribution. Due to the movement of individuals in the parishes, the 1960 census figures may be non-applicable to this problem. This data was the most recent that was available however.

Two personal or psychological variables considered to be important in accounting for the original distribution of employees

were the employment officer's impressions of specific areas around the Belmont plant and an inter-employee neighbourhood effect. It had been recognized during the field research that Jamaicans normally have strong value judgements about the quality of people living in specific towns or districts, and that these impressions were long lasting and thus should be reflected in the hiring policy of the Company. With regard to the neighbourhood effect, it was hypothesized that the friends and/or relatives of existing employees would have a better chance of obtaining employment than those with no such contact or "pull". Aside from pure favoritism, it was felt that the Company would be reducing its risk by hiring individuals known and recommended by existing employees.

The existence of a neighbourhood effect in the simulation model did not lead to any improvement in the level of acceptance, and, in fact, results were poorer as the level of the bias was increased. Questionnaires revealed that social contacts are of considerable importance, but this study has been unsuccessful in meaningfully incorporating this neighbourhood effect.

It had been proposed that the actual distribution of employees at any given time would reflect both their location just prior to obtaining employment and the tendency for some of them to relocate themselves. The relocation process should have occurred so that workers could live in areas regarded as more attractive for residence and/or more accessible to the plant. The increased income from bauxite employment would facilitate their moving. It was felt that the relocation patterns should tend to centre on towns regarded as preferred

residential sites, and should reflect an adjustment to accessibility measured in terms of actual time-distance. The latter process should give rise to a concave decay function, as this distribution would reflect a saturation of employees in available housing proximous to the Belmont plant. The use of the employees' attraction index did provide a high level of acceptance of the simulation model of the present distribution; and combined with this index was a negative exponent for the actual time-distance of -1.4.

Generally speaking, the use of the simulation model is sufficient to provide knowledge of the existence of certain relationships between the variables and the two distribution patterns, but it is inadequate for the successful "testing" of the hypotheses. Whether or not the proposed model is utilized for other employment simulations in future work, it is hoped that this study has provided some insight into the potentials of the simulation model described, for predicting the areas that will benefit in employment opportunities from the location of a particular decentralized industry in Jamaica or similar areas.

APPENDIX A

A COPY OF THE LIST OF EMPLOYEES RECEIVED FROM REYNOLDS JAMAICA MINES IN MAY 1968

Name of Employee	Address Given by Mr. X
John Ashman	Kingston, Jamaica
Roland Williams	Crescent Park, Lydford P.O.
Teddy V. Llewellyn	Discovery Bay P.O.
Reginald Williams	Crescent Park, Lydford P.O.
Ermine Fletcher	St. Ann's Bay P.O.
Valerie McIntosh	Crescent Park, Lydford P.O.
Soren Zetterman	Beulah Park, Lydford P.O.
Joyce Christie	Crescent Park, Lydford P.O.
Hilma Williams	Crescent Park, Lydford P.O.
John Wilson	Moneague P.O.
Cecil Hamilton	Lydford P.O. (Crescent Park)
Robin Ashton	Retreat P.O., St. Mary Parish
Joyce Murray	Moneague
James Broven	Beulah Park, Lydford P.O.
Vertl Lebert	Kingston, Jamaica
Rupert Dickenson	St. Ann's Bay P.O.
Olga Demercado	Crescent Park, Lydford P.O.
Euel Slack	Claremont P.O.
Franklin Owens	Crescent Park, Lydford P.O.
Theodore Brown	Claremont P.O.
Caleb DaCosta	Ocho Rios P.O.
Oliver Sheppard	Lydford P.O.
Bruce Cargill	Soho, Moneague P.O.

Carlisle D. Gill	Retirement
Donald Keith Johnson	Malvern P.O., Torrington Property
Winston Ashley	Lydford P.O.
Dennis Dundas	Bradfield, Claremont P.O.
Oswald Goldsmith	Hopeton, Spur Tree P.O.
Frederick Green	Reading P.O., Montego Bay
Donald Dwyer	Ocho Rios P.O.
Donald Chinsue	Moneague P.O.
Lynford McNeill	Kingston, Jamaica
Cecille Kameka	Kingston, Jamaica
Sandra Cooke	Kingston, Jamaica
Oswald Nembhard	Epworth P.O.
Dalphy Levermore	Golden Grove, Lydford P.O.
Colbert King	Ocho Rios P.O.
Steadman Nicholson	Pimento Walk, Ocho Rios P.O.
Lloyd Cole	Higgin Town, Lime Hall P.O.
Cleveland James	Golden Grove, Lydford P.O.
Ewart Morris	Golden Grove, Lydford P.O.
Winston Preston	Ocho Rios P.O.
Lloyd Neil	Lucky Hill P.O.
Clinton Ricketts	Epworth P.O.
Melvin Henry	Pimento Walk, Ocho Rios P.O.
Ivy Wilmott	Castle Daley, Walkerswood P.O.
Gertrude Blackwood	Mt. Forest, Newport P.O.
Joseph Peart	Mt. Forest, Newport P.O., Manchester

William Montrose	Moneague P.O.
Fred Clarke	Golden Grove, Lydford P.O.
Jepthah Bailey	Davis Town, Chalky Hill P.O.
Howard Paul	Orange Park, Lydford P.O.
Noel Christie	Claremont P.O.
Teron Irons	Lydford P.O.
Joscelyn Stephenson	Claremont P.O.
Clifton Lobbon	Claremont P.O.
Israel Blake	Golden Grove, Lydford P.O.
Reuban Bryan	Irons Mountain
Vivian L. Black	Claremont P.O.
Joslyn Franklyn	Salisbury P.O.
David Grandison	Steerfield, Lydford P.O.
Gustavus Grant	Retreat P.O.
Alfred Brown	Walkerswood P.O.
Alvin Simms	Orange Park, Lydford P.O.
Clarence Steele	Orange Park, Lydford P.O.
Lambert A. Tucker	Golden Grove, Lydford P.O.
Leon G. Hudson	Pimento Walk
Errol Wisdom	Wellington - Rose Hall P.A.
Headly Henry	Lime Hall P.O.
Albert A. Levers	Ocho Rios P.O.
Leonard Brown	Irons Mountain, Lydford P.O.
Herman Brown	Claremont P.O.
Victor Williams	Claremont P.O.

Lester J. Wright	Ocho Rios P.O.
Clement H. Lawrence	Irons Mountain, Lydford P.O.
Envoy A. Brown	Lime Hall
Lloyd Livermore	Claremont P.O.
John Gordon Jr.	Claremont P.O.
Wilton George Webb	Brittonville, Lumsden P.A.
Kenneth Archer	Claremont P.O.
Dudley Simpson	Claremont P.O.
Donald Johnson	Golden Grove, Lydford P.O.
Kenneth Osbourne	Moneague P.O.
Clifford Goulbourne	Walkerswood P.O.
Leopold Morris	Golden Grove, Lydford P.O.
Osmond Hall	Golden Grove, Lydford P.O.
Lester Hall	Irons Mountain, Lydford P.O.
Lester Forbes	Ocho Rios P.O.
Percival Harrison	Riverhead, Moneague P.O.
Stewart J. Rose	Claremont P.O.
Baldie Brown	Claremont P.O.
Vincent Grant	Golden Grove, Lydford P.O.
Ralph Gordon	Claremont P.O.
Harold Wilson	Golden Grove, Lydford P.O.
Cleveland Johnson	Orange Park, Lydford P.O.
Keith Morris	Claremont P.O.
Eric G. Williams	Ocho Rios P.O.
Calvin L. Clarke	Ocho Rios P.O.
Isiah McDermott	Ocho Rios P.O.

John Mitchell	Alderton P.O.
Henry Harrison	St. Ann's Bay P.O.
Alexander Thomas	St. Elizabeth
Alfred G. Wilmot	Colegate P.O.
Leslie Isaacs	Claremont P.O.
Lodrick Hutchinson	Golden Grove, Lydford P.O.
Henry Black	Golden Grove, Lydford P.O.
Nedley Boland	Lime Hall P.O.
Walter Thomas	Linstead P.O.
John Arlington Hind	Walkerswood P.O.
Erwin Sterling	Beechertown P.A.
Everick Osbourne	Orange Park, Lydford P.O.
George Cunningham	Brown's Town P.O.
Samuel Pottinger	Claremont P.O.
Glenford Walters	Linstead P.O.
Roy Brown	Moneague P.O.
Wilfar Hall	Goden Grove, Lydford P.O.
Richardo Marshall	St. Ann's Bay P.O.
Dillion Johnson	Golden Grove, Lydford P.O.
Gladstone S. Gordon	Walkerswood P.O.
Hubert Mitchell	Friendship - Mt. Waddy P.A.
Alcon G. Williams	Steertown, P.O.
Austin Sinclair	Barrett Hall, Lydford P.O.
Reginald Martin	Ocho Rios P.O.
Wilbert Smith	Alexandria P.O.

Samuel Brown	St. Elizabeth
Alfred Somers	Claremont P.O.
Aston James	Golden Grove, Lydford P.O.
Roy Kelly	Claremont P.O.
Gilbert S. Archer	Claremont P.O.
Vivian Sterling	Beechertown P.A.
Hubert James	Golden Grove, Lydford P.O.
Adolphus Wilson	St. Ann's Bay
Ransford Reid	St. Elizabeth
Gladstone Jacobs	Ocho Rios P.O.
Adonijah Spencer	Laughlands P.O.
James Briscoe	Claremont P.O.
Lloyd Roache	Ocho Rios P.O.
Lloyd W. Moncrieffe	Brown's Town P.O.
Alpheus Lewis	Golen Grove, Lydford P.O.
Luke Barnett	St. Ann's Bay P.O.
Nigel Kelly	Prior P.O.
Albert Boswell	St. Ann's Bay P.O.
Winston Riley	Claremont P.O.
Harold E. Johnson	Orange Park, Lydford P.O.
Ashman Barnett	Golden Grove, Lydford P.O.
Richard Crooks	St. Ann's Bay P.O.
Clinton Christie	Ocho Rios P.O.
Louis Marsh	Walkerswood P.O.
Anetta Morstan	Orange Park, Lydford P.O.

Delroy Simmonds	Claremont P.O.
Stewart Green	Claremont P.O.
Ezekiel Sinclair	Barrett Hall, Lydford P.O.
Gladstone G. Johnson	Golden Grove, Lydford P.O.
Lenworth Gowie	Priory P.A.
Ronald Espeut	Kingston
Derrick Whiteman	Moneague P.O.
Kenneth Shaw	St. Elizabeth
Sydney Clacken	St. Elizabeth
Daniel Braham	Malvern P.O.
Spencer Ellis	Joyland
Ceford Burnett	Golden Grove, Lydford P.O.
Leroy Sparks	St. Elizabeth
Vincent Davis	Golden Grove, Lydford P.O.
Donald Bowen	Bamboo P.O.
Kesert Mullings	Golden Grove, Lydford P.O.
George Wadsworth	Linstead P.O.
Armon Llewellyn	Ocho Rios P.O.
Lorna Nembhard	Epworth P.O.
Ivy G. Ramsaran	Crescent Park, Lydford P.O.
Nathan Walker	Bamboo P.O.
Glenroy Smith	Bamboo P.O.
Sybil MacMillan	Crescent Park, Lydford P.O.
Steadman Bailey	Golden Grove, Lydford P.O.
Douglas Lynch	Golden Grove, Lydford P.O.

Osmond Lyons	Philadelphia P.O.
Kenneth Caldwell	Lydford Park, Lydford P.O.
Barbara Llewellyn	Discovery Bay, P.O.
Monica Lawrence	Claremont P.O.
Rudolph Jobson	Lydford Park, Lydford P.O.
Paul Smith	Bamboo P.O.
Vhara Duncan	Moneague P.O.
Anthony Moyston	St. Ann's Bay P.O.
Lloyd Brown	Lime Hall P.O.
Alty Nunes	Crescent Park, Lydford P.O.
Geoffrey Chong	Ocho Rios P.O.
Horace Davis	Auckland, Lydford P.O.
Roy G. McFarlane	Bogg, Ocho Rios P.O.
Donald Meikle	Long Hill, Santa Cruz P.O.
Edward Redshaw	Lydford Park, Lydford P.O.
Kingsley Payne	Orange Park, Lydford P.O.
Genville White	Bradfield, Lydford P.O.
Ivan Lloyd	Claremont P.O.
Rudolph Sullivan	Crescent Park, Lydford P.O.
Maxwell Edwards	Ocho Rios P.O.
Edward Grant	St. Ann's Bay P.O.
Vilma Trewick	Kingston
Phyllis Wallace	Kingston
Kenneth Fulton	Lumsden P.O.
Winston Roxburgh	Ocho Rios P.O.
Gilbert Grant	Golden Grove, Lydford P.O.

Henry S. Hall	Irons Mountain, Lydford P.O.
Clement Henriques	Beecher Town P.O.
Hylton Byles	Golden Grove, Lydford P.O.
Victor Riley	Golden Grove, Lydford P.O.
Easton Innis	Golden Grove, Lydford P.O.
Curtiss Levers	Ocho Rios P.O.
Henry Coxe	Lime Hall, P.O.
Ransford Morris	Golden Grove, Lydford P.O.
Vincent Harvey	Golden Grove, Lydford P.O.
Harold Scarlett	Brittonville, Claremont P.O.
Joseph Garrick	Golden Grove, Lydford P.O.
Daniel Bryan	Golden Grove, Lydford P.O.
Reid Harry Lewis	Long Hill Prop. Santa Cruz P.O.
Winston Vanhorn	Golden Grove, Lydford P.O.
Joseph Forbes	Steerfield, Lydford P.O.
Leslie Morris	Orange Park, Lydford P.O.
George Grandison	Walkerswood P.O.
Roland Rose	St. Ann's Bay P.O.
Jonathan Johnson	Orange Park, Lydford P.O.
Percival Hall	Irons Mountain, Lydford P.O.
Ryland N. Clarke	----------
Reuban Hay	Brittonville, Claremont P.O.
Leslie Ellis	Walkerswood P.O.
Ewart Hyde	Kingston
Albert Hardware	Golden Grove, Lydford P.O.

Reginald White	St. Ann's Bay P.O.
Hezekiah Johnson	Orange Park, Lydford P.O.
Solomon Smith	Epworth P.O.
McCready Officer	Ocho Rios P.O.
Franke Sharpe	Moneague P.O.
Fredrick Henry	Ocho Rios P.O.
Wilbert Kelly	Orange Park, Lydford P.O.
Laska Johnson	Colegate P.O.
Henry Francis	Golden Grove, Lydford P.O.
Ira Bailey	Golden Grove, Lydford P.O.
Irving James	Golden Grove, Lydford P.O.
Harold Guest	Brittonville, Claremont P.O.
Wilfred C. Stephenson	St. Ann's Bay P.O.
Vincent Bromfield	Claremont P.O.
Charles James	Barrett Hall, Lydford P.O.
Melford Reid	Claremont P.O.
Percival Simmonds	Gibralter, Moneague P.O.
Vincent G. Marsh	Barrett Hall, Lydford P.O.
Ralph Bingham	St. Ann's Bay P.O.
James Hall	Irons Mountain, Lydford P.O.
Clinton Harvey	Brittonville, Lumsden P.A.
Claude Ingram	St. Ann's Bay P.O.
John Lloyd	Walkerswood P.O.
Neville Dacosta	Ocho Rios P.O.
Austin Watson	Orange Park, Lydford P.O.

Charles Lewton	Ocho Rios P.O.
Adam Green	Steertown P.O.
Roy McGrath	Moneague P.O.
Alexander Roberts	Ocho Rios P.O.
Adolphus White	Claremont P.O.
Cecil Thorney	Lydford P.O.
Robert Samuel Webb	Ocho Rios P.O.
Astil Boreland	Ocho Rios P.O.
Colbert Garrick	Golden Grobe, Lydford P.O.
Stanley Ormsby	Lydford P.O.
Dorrel Buchanan	Claremont P.O.
Aston G. Mannings	Ocho Rios P.O.
Roy Elliot	Lydford P.O.
Astley Ramsay	Ocho Rios P.O.
Leslie Thompson	Golden Grove, Lydford P.O.
Huklyn Lamm	St. Ann's Bay P.O.
Norris C. Williams	Lime Hall P.O.
Clifton Stewart	Lucky Hill P.O.
Samuel Meredith	St. Ann's Bay P.O.
Percival Sewell	Kingston
Roy Morris	Lydford P.O.
Canal N. Brown	Riverhead, Moneague P.O.
Wesley Dixon	Annotto Bay P.O.
George Campbell	Lydford P.O.
Astley G. Woodburn	Ocho Rios P.O.
Albert Daley	Lydford P.O.

Hugh Nembhard	Claremont P.O.
Lloyd A. Smith	Spanish Town P.O.
Reginald James	Beechertown P.O.
Namon Clarke	Golden Grove, Lydford P.O.
Bernard Lewis	Lydford P.O.
Joshua Tulloch	Kingston
Linton P. Church	Ocho Rios P.O.
Lester Lewis	Lydford P.O.
Wytcliffe Weir	----------
Jeffrey Walters	Lydford P.O.
Derick Lemon	Claremont P.O.
Kenneth Anderson	Claremont P.O.
Vernal Graham	Epworth P.O.
Oscar Wildman	Anotto Bay P.O.
Ridley Saint	Epworth P.O.
Herbert Grant	Golden Grove, Lydford P.O.
Eulem Lewis	Golden Grove, Lydford P.O.
Arthur Ricketts	Epworth P.O.
Shirley Robinson	Claremont P.O.
Kaestner H. Shirley	Alderton P.O.
Charles Holman	Lydford P.O.
Reginald Brown	Claremont P.O.
Percy Robinson	Pimento Walk, Ocho Rios P.O.
Dave Harvey	Claremont P.O.
Vincent Sadler	Ocho Rios P.O.
Thomas McDonald	Claremont P.O.
Cleveland Hinds	Orange Park, Lydford P.O.

Verman Campbell	Golden Grove, Lydford P.O.
Rudolph Young	Manchester
Edward Miller	Golden Grove, Lydford P.O.
Locksley Smith	Moneague P.O.
Basil Peart	Manchester
Charles Woollery	St. Ann's Bay P.O.
Elisha Dakers	Steerfield, Lydford P.O.
Gaston Hamil	Kingston
Winston Jones	Lydford P.O.
Sydney A. Tracey	St. Ann's Bay P.O.
Patrick Kelly	Golden Grove, Lydford P.O.
Danzil Mendez	Chalky Hill, P.O.
Herman Magnus	Linstead P.O.
Cecil John Wright	Lumsden, P.O.
Wollyoung Sinclair	Kingston
Moodie Lodge	St. Elizabeth
Frederick Gordon	St. Elizabeth
Vincent Thompson	St. Elizabeth
Kermit Smalling	St. Elizabeth
Leaford Dennis	St. Elizabeth
Delroy Waite	Kingston
Barrington Delon	St. Elizabeth
Roy Coote	Golden Grove, Lydford P.O.

APPENDIX B

A COPY OF THE SECOND LIST OF EMPLOYEES WHICH WAS PRESENTED TO MR. X TO SEE IF WE COULD GET MORE COMPLETE ADDRESSES

Name of Employee	Address Given by Mr. X
John Ashman	Ocho Rios P.O.
Teddy V. Llewellyn	Discovery Bay P.O.
Cecil Hamilton	----------
Robin Ashton	Retreat P.O.
Vertl Lebert	----------
Carlisle D. Gill	----------
Donald Keith Johnson	----------
Oswald Goldsmith	----------
Frederick Green	----------
Lynford McNeill	----------
Cecille Kameka	----------
Sandra Cooke	----------
Dalphy Levermore	Golden Grove, Lydford P.O.
Ewart Morris	Golden Grove, Lydford P.O.
Gertrude Blackwood	Mt. Forest, Cross Keys P.O. Manchester
Joseph Peart	Mt. Forest, Cross Keys P.O. Manchester
Teron Irons	Irons Mountain, Lydford P.O.
Gustavus Grant	Retreat P.O.
Alvin Simms	----------
Errol Wisdom	----------
Lester Forbes	Chalky Hill P.O.
John Mitchell	Alderton P.O.

Alexander Thomas	----------
Alfred G. Wilmot	Colegate P.O.
Lodrick Hutchinson	Golden Grove, Lydford P.O.
Walter Thomas	Linstead P.O.
George Cunningham	----------
Glenford Walters	Linstead P.O.
Wilfar Hall	Golden Grove, Lydford P.O.
Hubert Mitchell	----------
Wilbert Smith	----------
Samuel Brown	----------
Alfred Somers	Beechamville, Claremont P.O.
Hubert James	----------
Ransford Reid	----------
Gladstone Jacobs	Ocho Rios P.O.
Adonijah Spencer	Mt. Zion
Nigel Kelly	Laughlands P.A.
Ashman Barnett	Golden Grove, Lydford P.O.
Delroy Simmonds	----------
Stewart Green	Claremont P.O.
Gladstone G. Johnson	Golden Grove, Lydford P.O.
Ronald Espeut	----------
Kenneth Shaw	----------
Sydney Clacken	----------
Daniel Braham	----------
Spencer Ellis	----------
Leroy Sparks	----------

Vincent Davis	----------
George Wadsworth	Haddon, Moneague P.O.
Barbara Llewellyn	Discovery Bay P.O.
Roy G. McFarlane	----------
Donald Meikle	Long Hill, Santa Cruz
Vilma Trewick	----------
Phyllis Wallace	----------
Reid Harry Lewis	----------
Ryland N. Clark	----------
Reuban Hay	----------
Ewart Hyde	----------
Laska Johnson	----------
Charles Lewton	Ocho Rios P.O.
Aston G. Mannings	Ocho Rios P.O.
Roy Elliot	Crescent Park, Lydford P.O.
Leslie Thompson	Golden Grove, Lydford P.O.
Norris C. Williams	----------
Percival Sewell	----------
Wesley Dixon	----------
Albert Daley	----------
Lloyd A. Smith	----------
Joshua Tullock	----------
Lester Lewis	Golden Grove, Lydford P.O.
Jeffrey Walters	----------
Oscar Wildman	----------
Reginald Brown	----------

Rudolph Young	----------
Basil Peart	----------
Gaston Hamil	----------
Herman Magnus	----------
Sydney A. Tracey	----------
Wollyoung Sinclair	Claremont P.O.
Moodie Lodge	----------
Frederick Gordon	----------
Vincent Thompson	----------
Kermit Smalling	----------
Leaford Dennis	----------
Leaford Dennis	----------
Delroy Waite	----------
Barrington Delon	----------

APPENDIX C

A COPY OF THE QUESTIONNAIRE ADMINISTERED TO A SELECTED SAMPLE OF THE PREVIOUSLY LOCATED COMPANY EMPLOYEES

Sample No._____ Present Location_____

Employee's Name_____ Department_____

Hourly-Paid/ yes_____ no_____

Question 1.

1. Did you live here, in your present residence, prior to obtaining your job with the bauxite company?

   Yes_____ No_____

If not, where did you live; please describe in enough detail that I can locate your previous place of residence as slosely as possible on my map.

Question 2.

2. I would like to briefly obtain some idea of what type or types of schools you attended prior to working for Reynolds, for example when you were a boy.

Type of School	Yes or No	Highest Grade Attained
Prinary School		
Secondary School		

Technical High School		
Commercial School		
Vocational School		
College of Arts, Science and Techn.		
Technical Institute		
University		

Question 3.

3. How many years have you been working for Reynolds?

Question 4.

4. How old are you now?

Question 5.

5. Was it necessary for you to pass (at the mine) or to have recently passed a medical examination when you applied for the job with Reynolds?

Question 6.

6. Have you had always the same job with the Company since you started with Reynolds? If not, please relate any changes.

Question 7.

7. What was your job with the Company when you started to work with them?

Question 8.

8. Where do you work? ex. (Belmont, on a property, or in Kingston)

Question 9.

9. How do you get to work each day? ex. (car, walk, etc.)

Question 10.

10. What prior experience did you have for the job which you originally obtained with Reynolds?

Question 11.

11. Did you have any relatives who worked for Reynolds before you got your job?

Question 12.

12. What was his or her position? What did he or she do?

Question 13.

13. Do you have any relatives now working with the Company? (If yes state his or her name and position)

Yes_____ No_____

Name	Position	Employment Location

Question 14.

14. Did you know anyone else who worked for the Company before?

Yes_____ No_____

Name	Position	Employment Location

Question 15.

15. Did you know Mr. Jobson or a mutual friend of his before you got your job?

Question 16.

16. Have you assisted anyone, friend or relative in getting a job with the Company?

Yes_____ No_____

Name	Position	Employment Location

Question 17.

17. Do you belong to any of the following groups or organizations:

Name	Yes	No
Chamber of Commerce		
Kiwanis Club		
Church Men's Group		
Barrel's Scheme		
Other		

Question 18.

18. Did you belong to any of these clubs or organizations before getting your job with Reynolds?

Yes_____ No_____

Explain. . . . . .

APPENDIX D

A COPY OF THE QUESTIONNAIRE ADMINISTERED TO MR. RUDOLPH JOBSON WHICH IS TO PROVIDE DATA ON THE WAY IN WHICH HE PERCEIVES THE ENVIRONMENT AROUND THE PLANT.

Name MR. RUDOLPH JOBSON

Position CHIEF PERSONNEL OFFICER & PUBLIC RELATIONS OFFICER -

Place of Employment BELMONT-ST. ANN PARISH, JAMAICA, W.I.

Salaried X Hourly-Paid

Mr. Jobson I am interested in the fact that you stated in a previous discussion that proximity was an important factor in the hiring of employees and therefore I would like to ask you a few questions about it.

Question 1.

1. What do you think of when you refer to distance? Is it

   (a) Actual straight-line distance from point to point

   (b) Travel-time by road

   (c) Actual road-distance

   (d) Or do ;you have something else in mind? If so please explain.

It is actually a combination of travel-time and actual road-distances. The time required to travel from one point to another over the Jamaican roads is the most important. He says that he is very concerned with the length of time that it takes an employee to drive from his home to work.

Question 2.

2. Secondly I would like you to list certain towns in terms of their distance (straight-line distance _____, time-distance _____, road-distance_____), from the mine site. I will give to you a sheet of paper with a number of groups of five towns and districts ;which I would like you to rank by putting a number '1' in the bracket opposite the closest town and so on to a number '5' opposite that town or district, which in your opinion is the furthest from Belmont.

Note: Offer Mr. Jobson the sheet with the groups of districts on it.

THIS SHEET IS TO BE GIVEN TO MR. JOBSON TO WORK ON AND COMPLETE

Note: If you feel two places are of equal distance from the plant, you can place the same number in both brackets.

(1)
(4) St. Ann's Bay
(2) Hopewell
(3) Ocho Rios
(1) Golden Grove
(5) Alderton

(2)
(1) Orange Park
(3) Moneague
(2) Claremont
(5) Steertown
(4) Pimento Walk

(3)
(3) Ocho Rios
(4) Pimento Walk
(1) Davis Town
(2) Bread Nut Hill
(3) Steertown
(2) Epworth

(4)
(1) Moneague
(3) Lumsden
(4) St. Ann's Bay
(3) Steertown
(2) Epworth

(5)
(2) Colegate
(1) Walkerswood
(5) Labyrinth - St. Mary
(4) Lodge
(3) Exchange

(6)
(2) Barrett Hall
(4) Meself
(5) Irons Mountain
(1) Steerfield
(3) Hopewell

(7)
(4) White River
(3) Greenwich Park
(1) Higgin Town
(5) York Castle
(2) Clapham

(8)
(3) Bamboo
(2) Priory
(4) Clay Ground
(1) Cedar Valley
(5) Lucky Hill - St. Mary

(9)
(2) Bonham Spring
(4) Industry
(3) Exchange
(1) Fergis
( ) Cum See

(10)
(2) Salisbury
(3) Beecher Town
(4) Spicy Hill
(1) Pheonix Park
(5) Bonneville

* You will be provided with a pencil and eraser and are allowed to make any changes if you feel them necessary.

Question 3.

3. Mr. Jobson, would you please mark on this outline map the following things: (mark towns with a small 'x' and the area of the mine site with a circle and label each point that you locate).

(a) the mind-site (near Belmont

(b) White River

(c) St. Ann's Bay

(d) the north coast road from Ocho Rios to St. Ann's Bay

(e) Claremont

(f) Golden Grove

(g) Moneague

(h) Alexandria

(i) mark on the main road that you would take if driving from Ocho Rios to Belmont. (If he says there are more than one route ask him to mark both of them.)

(j) mark on the main road from Moneague to St. Ann's Bay

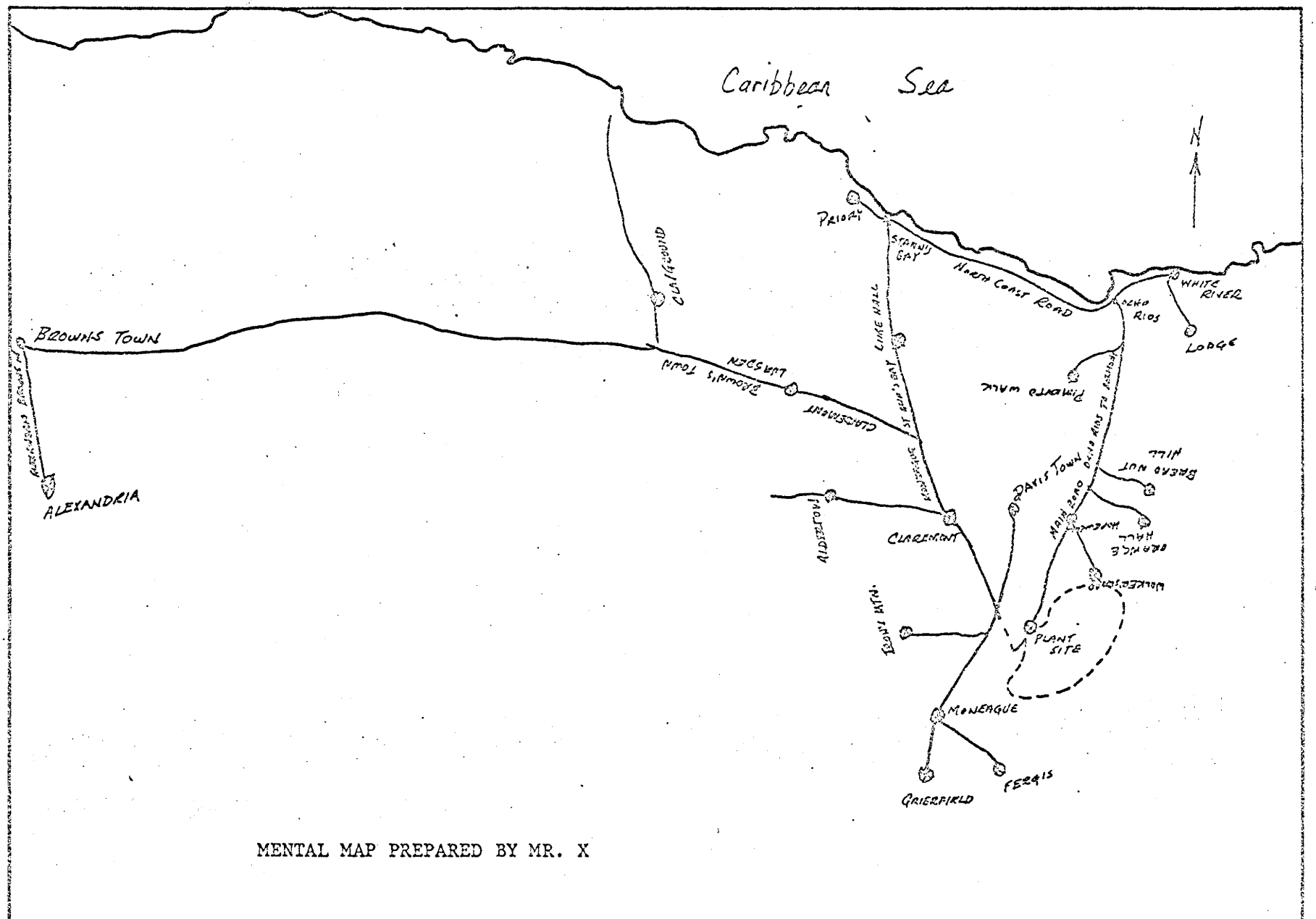
(k) mark on the main road from Claremont to Brown's Town

(l) mark on the main road from Alexandria to Brown's Town

(m) mark on the main road from Alexandria to Claremont

(n) please locate the following towns and districts on the map as accurately as possible

(1) Lumsden	(2) Clay Ground	(3) Priory
(4) Alderton	(5) Grierfield	(6) Irons Mountain
(7) Walkerswood	(8) Lodge	(9) Hopewell
(10) Bread Nut Hill	(11) Davis Town	(12) Pimento Walk
(13) Lime Hall	(14) Orange Hall	(15) Fergis



MENTAL MAP PREPARED BY MR. X

Question 4.

4. Mr. Jobson, now I will read to you a list of towns or districts and I would like you to state, very quickly, your general impression of the place. (Just a few words).

(1) Steertown. . . . (if he doesn't say anything about the reputation of Steertown as being a rough place ask him why he didn't say so)

A troublesome, dirty little town. It has a bad reputation. People from there are regarded as troublesome types. Some of the people are better and good people. It was a stronghold for some time. Mainly cleared up but still some are left. It was a stronghold for 5-6 years.

(2) Retreat-Content, in St. Mary

He thinks it is a pleasant residential spot. Quite productive agriculturally.

(3) Brown's Town

One of the better towns. Lovely residential, progressive town. Good place to live. Plenty of schools, good schools.

(4) Claremont

A quiet little town, pleasant quiet country town.

(5) St. Ann's Bay

Hot, a miserable but capital town, main business centre.

(6) Ocho Rios

Tourists, bauxite economy. Plenty of future and potential.

(7) Walkerswood

A lazy little town. Seems an unproductive area, little activity goes on over there except for one lady who lives in a house on hill, Mrs. Simpson, who did a lot of work for the people.

(8) Bamboo

A very nondescript place. Nothing comes to mind at all.

(9) Alderton

Nothing particular either, centre of many little villages up on the hills there.

(10) Lumsden

A new village, isn't very much. Isn't developed yet. Just got a postal agency.

(11) Industry

He doesn't know the place. Knows the name but never been there.

(12) Riverhead

Got name from stream that rises there. Crossroads of many villages, converge onto that district.

(13) Colegate

Normally associated with Fern Gully.

Question 5.

5. I am now going to present you with a list of factors which might have some bearing on the chances of an individual receiving employment.

(a) Do you consider educational background?

Note: Here as in the following cases I would like to determine the extent to which you consider education for different types of work. Please provide the details.

Certainly in Supervisory levels (General foremen, clerical accountant, top skills - yes). Operatives not the major consideration although important. For unskilled (all those working as labourers on farms or at mines) it is only of secondary importance. He tries to get the best he can, the best that is available. Certainly if the man is illiterate you wouldn't want him for any mechanical job or for any job which requires that he reads instructions and carries them out.

(b) Do you consider previous experience of a prospective employee?

It is in Supervisory positions that experience is most important (the most important factor) but certain basic education and personality, (his ability to attain respect and influence people). This includes supervisor in office and field but more important, in the field. For foremen in general, basic education not as important as job knowledge and experience. His experience is the most important factor considered by Mr. Jobson.

For the labourer, experience is not important, his physical considerations are important, on the other hand, if chance he might advance then it is important he has basic education.

(c) Do you consider age, and if so, for what jobs is it most important?

Since he does a lot of training, people whom he develops, he prefers to get them young. ex, for technicians he prefers to get them in late teens or early 20's and train them. As far as labourers are concerned he doesn't want a man too young. He is looking for maturity and a man in 20's and early thirties. For the people applying for highest jobs, experience overshadows age consideration.

(d) Do you consider employee reliability, and if so, how do you determine this?

I do consider this the best way to do it is by exploring his past work record. If he is a stable fellow. There are areas which can indicate to you if he is unstable or a good solid fellow. For example (1) length of time in respective jobs, (2) areas of responsibility, (3) how successfully he would have carried out these responsibilities - determined by talking to him and his previous company. He never checks back on labourers. If local people, he doesn't check back.

(e) Why do you prefer to hire local people?

Reasons are:

(1) You create a better good-will in your community
(2) They are more stable
(3) Their roots are here, not as likely to go wandering off
(4) It helps the economy of the locality
(5) You end up with a more satisfied work force

(20-30 employees drive from Kingston each day. For the most part these people have some form of skill which was not available in the local area. Usually man lived in Golden Grove, married Kingston girl and moved there.)

(f) Is there any form of pressure brought to bear on you from the parish council or from the local member of the house of representatives to hire local residents?

Originally the Parish Council approached him and friendly asked what Reynolds policies were. Reynolds said at the time that they would hire all unskilled help and whatever else could be found in St. Ann. Above this they would hire them wherever they could find them. Now, they can take all young fellows who can get technical education and then train them. Company has no formal hiring policy and the policy they have was determined by the Jamaican management when they first started here.

(g) Do you consider the fact that a local person will be more likely to get to work on time than someone who lives at a greater distance from the minesite? (assuming that both work at the mine-site)

It is an important factor. He must come fit to do a day's work. If they drive great distances they are tired before they start to work. In some cases men from Kingston have been found to not be doing their job. These people are talked to and told. One person lost his job because he did make it on time but did very little work on the job. He developed a bad stomach and his health suffered from the long trip.

(h) Do you consider the state of health of the prospective employee and how do you determine this?

Yes you do consider. The salaried people must first pass the physical at the clinic. The medical is a little more intensive for the salaried employee than for the hourly-paid worker. Hourly-paid worker is inter-

viewed and starts to work. He is usually called in to the clinic within the 60 day period. When less than 40 years old a man has a checkup every two years, after this, every year.

(i) Do you particularly try to hire people who you know or who have friends or relatives to recommend them?

It is important that someone recommends them. It is a form of screening. If a reliable person recommends him then you know he is not going to recommend someone who is a bum. This recommendation applies at all levels of the labour force. Given that two men are equally equiped, he would strongly consider the recommendation from a person whom he knows.

(j) Do you consider social class in selecting employees?

Examples: (i) family background
(ii) colour
(iii) personal appearance

*Please elaborate as to the extent to which these are important as far as different jobs are concerned.

(i) Family background is considered. It is important. It is more important for certain kinds of jobs. A man who comes from a home of better education, economic, and social background. People might have known his father, grandfather. Therefore people would respect him. In some cases this might outweigh the educational qualifications of another individual for a supervisory position.

(ii) Colour - it depends on the position. If fellow has to be with the public, dealing with people - it would be rather his personality than colour. If a black fellow has better personality than a white person he would get the job. In past, those with fairer complexion have been better educated.

(iii) This is important because it gives the impression of orderliness of personal habits. An orderliness of mind. This is the impression it conveys. This includes overall appearance. Very strong indications of good personal habits.

<u>The Following Questions Relate more directly to Mr. Jobson</u>

<u>Question 6.</u>

6. How many years have you worked with Reynolds here at Belmont?

18 years - ever since Reynolds came to Belmont, St. Ann.

Question 7.

7. Did you work for Reynolds prior to this at all, at some other location?

No, he did not work for Reynolds prior to this at all.

Question 8.

8. Have you always held the position of Chief of personnel since you started working with Reynolds here at Belmont?

When he started, he began in a clerical position in the engineering office. At one time he was intending to become a chemist. When they set up personnel, he asked to go there. From the beginning he headed it, at first a one-man operation, and he developed the personnel office into what it is today. There is no pressure for the worker to offer his address.

Question 9.

9. Who had the job of hiring before yourself? Was he also a Jamaican?

There was no one else before. The case where Captain Ryder, Port Superintendent, interviews somebody would be very rare.

Question 10.

10. Have any changes in the hiring policy been initiated by Reynolds since you took over as the Personnel Officer at Belmont?

The policy as developed was arranged between Mr. Cole and Mr. Jobson. This would have been Mr. Jobson's policy. Mr. Jobson doesn't interview everyone. Jobson would never impose a man on those in a department who did not want him. Jobs being difficult to have, masons and carpenters would be glad to come and work as labourers.

Question 11.

11. What was your employment prior to working with Reynolds in Jamaica?

He was in the Jamaican Regiment for four years and then in the British Honduras Battalion for one year. Before this he was an officer training school and reached the level of Lieutenant.

Question 12.

12. Would you please give me a brief account of your educational background? Where did you go to school, and what types of schools were they?

	Name of School	Duration
Prep School	Near Geddes	1 year
Elementary School	Brittonville	5th class
Secondary School	Middlesex	3rd form (3 years)
Secondary School	Kingston College	6th form

APPENDIX E

NAME	CODE NO.	ORIG. NO. EMPL.	PRES. NO. EMPL.	VAR. 1 TIME DISTANCE (MINUTES)	VAR. 2 TOTAL POPU-LATION	VAR. 3 PARISH: IN = 2 OUT = 1	VAR. 4 NO. MALES 15-44	VAR. 5 NO. MALES w.> 4 YRS EDUCATION	VAR. 6 NO. IN-EXPERIEN-CED MALES	VAR. 7 NO. EX-PERIENCED MALES	VAR. 8 JOBSON'S ATTRACTION INDEX	VAR. 9 EMPLOYEE'S ATTRACTION INDEX	VAR. 10 JOBSON'S PERCEIVED TIME DISTANCE
ST. ANN'S BAY T9	1019	11	10	34.5	5087	2	1105	1426	55	23	5	4787	20
OCHO RIOS 1	1024	0	0	26.0	725	2	166	204	2	2	5	310	20
OCHO RIOS 2	1025	1	1	24.5	1210	2	267	355	9	6	5	510	20
OCHO RIOS 3	1026	1	1	23.5	876	2	136	201	18	0	5	676	15
OCHO RIOS 4	1027	0	0	21.5	257	2	73	88	7	3	5	190	15
OCHO RIOS 5	1028	0	0	26.0	280	2	80	86	4	3	5	230	15
OCHO RIOS 6	1029	0	1	23.5	355	2	92	95	3	5	5	355	15
OCHO RIOS 7	1030	0	1	26.0	867	2	198	257	5	36	5	210	15
SANDY BAY	1004	0	0	39.0	209	2	41	52	1	0	0	90	20
LEWIS AREA	1005	0	0	38.5	597	2	104	132	7	0	0	477	25
ROADSIDE	1006	1	1	36.0	313	2	34	38	1	0	0	197	20
PRIORY 1	1007	0	0	35.5	311	2	59	81	1	8	0	231	20
PRIORY 2	1008	3	3	35.5	516	2	116	145	8	1	0	516	20
BLOWFIRE HILL	1009	1	1	25.5	370	2	58	83	2	5	0	140	15
SEVILLE HOUSE	1010	0	1	35.5	800	2	170	173	3	1	0	340	20
DRAX HALL	1020	0	0	43.0	306	2	66	94	3	0	0	60	15
STEER TOWN 1	1021	1	1	32.5	822	2	166	228	5	32	1	622	15
STEER TOWN 2	1022	0	0	32.5	578	2	116	158	26	5	1	578	15
DUNNS RIVER	1023	3	3	24.0	371	2	69	109	2	0	0	300	15
EXCHANGE	1031	0	0	31.5	696	2	144	136	1	43	0	280	20
BENHAM SPRING	1032	0	0	33.0	473	2	95	120	2	21	0	70	20
ELTHAM	1033	0	1	32.5	374	2	67	99	4	6	0	130	20
UPTON	1034	0	0	39.5	182	2	32	53	4	2	0	50	20
HIATTSFIELD	1035	1	2	12.5	430	2	74	126	7	8	3	220	15
BREADNUT HILL	1036	0	0	15.0	280	2	47	70	7	11	3	40	10
HARRISON TOWN	1037	1	1	22.5	554	2	102	146	1	20	0	110	10
HOPEWELL	1038	0	0	12.5	484	2	94	122	2	19	3	240	10
COLEGATE	1039	1	3	21.0	368	2	63	92	1	0	0	100	10
SPICY HILL	1040	0	1	23.0	379	2	71	106	8	25	0	160	15
BEECHER TOWN	1041	0	0	30.5	451	2	81	108	2	0	0	160	15
SALISBURY	1042	3	2	22.0	555	2	93	150	2	5	0	220	10
DAVIS TOWN	1043	1	1	20.5	453	2	94	141	0	0	0	270	10
CHALKY HILL	1044	0	0	25.5	600	2	120	144	13	0	0	280	10
EPWORTH	1045	0	0	16.0	45	2	10	15	0	0	0	20	10
HIGGIN TOWN 1	1046	0	0	18.5	320	2	54	95	0	0	0	80	10
LUMSDEN	1047	2	0	19.5	384	2	46	93	3	2	4	60	15
CONTENT	1048	0	0	19.0	646	2	116	160	5	6	0	100	10
HIGGIN TOWN 2	1049	3	4	21.5	704	2	117	139	3	0	0	150	15
ARTHUR MOUNT	1050	0	0	25.0	160	2	19	39	2	1	0	140	15
LIME HALL	1051	0	0	25.0	483	2	78	112	3	3	0	130	15
INDUSTRY	1052	0	0	24.5	118	2	14	30	1	0	3	50	20
BAMBOO	1053	0	0	29.0	552	2	91	109	2	0	3	210	20
PILOT	1054	1	1	24.0	256	2	57	70	1	0	3	50	15
CLAY GROUND	1056	0	0	31.5	230	2	37	61	0	2	0	60	15
JOHNSON AREA 1	1058	0	0	28.0	712	2	93	165	4	0	3	390	15
JOHNSON AREA 2	1059	0	0	37.5	233	2	46	77	0	2	0	160	25
LODGE	1092	0	0	25.5	431	2	74	94	1	0	0	379	20
CANNON HILL	1074	0	0	23.0	487	2	86	122	3	8	3	407	20
MAMMEE HILL	1077	3	2	18.0	315	2	50	74	0	5	4	100	15
INDUSTRY	1078	0	0	23.0	447	2	77	102	0	0	3	317	20
CLAREMONT 4	1079	6	9	11.0	577	2	110	152	6	13	4	507	5
RURAL RETREAT	1080	3	2	15.5	651	2	121	166	7	11	0	90	10
BELMONT 2	1081	2	2	3.0	557	2	111	115	12	7	0	230	5
CLAREMONT 3	1082	5	7	9.0	415	2	87	133	2	3	4	270	10
GOLDEN GROVE 2	1083	11	13	4.0	713	2	147	164	3	0	0	633	5

TABLE OF DATA

CLAREMONT	2	1084	5	8	12.5	713	2	129	212	11	0	4	443	10
CLAREMONT	1	1085	3	1	10.0	341	2	84	106	3	6	4	261	5
BEECHAMVILLE		1086	2	3	8.5	224	2	46	59	2	2	4	164	5
GOLDEN GROVE	1	1087	13	24	5.0	806	2	156	202	5	11	0	776	5
PHOENIX PARK		1088	0	3	10.5	262	2	58	82	1	3	0	182	5
BELMONT PLANT	1	1089	8	11	9.0	110	2	28	33	2	2	2	50	5
UNION PEN	3	1090	0	0	13.5	511	2	90	119	4	6	3	240	15
UNION PEN	2	1091	0	0	27.0	466	2	72	115	3	1	0	226	15
UNION PEN	1	1093	0	0	25.0	500	2	86	152	4	1	0	300	20
HOPEWELL		1094	1	3	11.5	432	2	86	117	5	0	2	272	10
CLAPHAM		1095	2	1	20.5	629	2	114	166	14	2	2	589	10
CROWLE PEN		1096	0	0	33.0	36	2	8	8	0	0	0	10	10
MONEAGUE	3	1097	1	1	11.0	461	2	81	122	1	0	0	341	5
IRONS MOUNTAIN	2	1098	3	4	24.0	396	2	72	92	6	0	0	240	10
IRONS MOUNTAIN	1	1099	8	5	22.0	669	2	141	154	4	1	0	180	5
BIGAMS MOUNTAIN		1100	0	0	24.5	407	2	84	112	12	5	0	290	10
BONNEVILLE		1101	1	1	16.5	204	2	45	58	3	0	0	100	10
ALDERTON	2	1102	0	0	26.0	137	2	30	51	5	0	3	80	15
SHOW MESELF		1103	0	0	25.5	618	2	114	138	21	1	3	280	15
ALDERTON	1	1104	0	0	21.5	350	2	60	81	5	0	3	350	15
SYMS RUN		1105	0	0	32.0	780	2	129	147	20	0	0	100	25
STEPNEY		1106	0	0	40.0	403	2	57	53	10	0	0	190	25
P.P.(2)(7,8) T2		1108	0	0	29.0	541	2	63	103	2	0	0	120	25
PRICKLY POLE	1	1109	0	0	28.0	200	2	44	62	0	0	0	70	25
EDINBURGH CASTLE		1113	1	0	40.0	328	2	65	79	5	0	0	90	25
BENSONTAN	1	1114	0	0	40.0	280	2	49	94	6	0	0	130	25
BENSONTAN	2	1115	0	0	40.0	463	2	79	137	12	0	0	290	25
PEDRO		1116	0	0	32.0	673	2	99	116	6	1	0	393	20
HARMONY VALE		1117	0	0	33.0	327	2	53	99	13	1	0	130	20
TYDIXTON		1118	0	0	29.0	287	2	46	75	6	6	0	170	15
LINCOLN		1119	0	0	19.0	259	2	43	72	9	0	0	160	15
FRIENDSHIP		1120	0	0	26.0	548	2	90	163	8	0	0	270	10
GRIER PARK		1121	0	0	37.5	209	2	38	45	5	1	0	160	15
MONEAGUE	2	1122	1	1	21.0	515	2	98	127	14	11	0	110	15
MONEAGUE	1	1123	0	1	19.5	333	2	66	93	3	1	3	50	15
RIO HOE		1124	0	0	17.0	710	2	129	221	3	0	3	200	10
FERGIS, CUM SEE		1125	0	0	21.5	667	2	150	194	8	17	3	170	10
VILLAGE		1133	0	0	25.5	565	2	93	173	9	0	0	140	10
FAITHS PEN		1134	0	0	22.5	222	2	50	62	10	0	0	80	10
CALDERWOOD	1	2076	0	0	40.0	751	2	106	151	2	0	0	351	10
LUCKY HILL PEN	2	2092	0	0	40.0	242	1	41	61	6	7	0	90	20
LUCKY HILL PEN	1	2091	0	0	25.0	388	1	70	120	12	0	0	288	20
LABYRINTH		2090	0	0	24.0	353	1	64	90	11	1	0	70	20
THREE HILLS		2130	0	0	39.0	275	1	55	63	4	10	0	60	25
CHARLES TOWN	2	2089	0	0	40.0	553	1	100	131	3	17	0	150	25
CHARLES TOWN	1	2002	0	0	39.5	500	1	113	110	4	3	0	120	25
WHITE RIVER		2001	0	0	35.0	178	1	55	69	1	1	0	90	20
WORTHY PARK		3002	0	0	38.0	410	1	69	86	7	0	0	10	15
RESCURCE		3005	0	0	40.0	401	1	82	70	12	0	0	60	25
EWARTON	1	1002	0	0	40.0	223	1	45	73	8	8	0	100	25
EWARTON	2	1148	0	0	40.0	419	1	66	86	1	16	0	271	25
EWARTON	3	1009	0	0	40.0	197	1	24	45	1	0	0	30	25
MOUNT ROSSER		1001	0	0	39.0	574	1	69	89	5	8	0	314	20
MOUNT DIABLO		1010	0	0	39.0	411	1	74	122	14	10	0	381	20

NUMBER OF DISTRICTS = 109

APPENDIX F (PART A)

TRIAL 3 TIME PERIOD 1

CUMULATIVE NUMBER CHOSEN = 114

DISTRICT NAME		CODE NUMBER	OBSERVED EMPLOYEE DISTRIBUTION	CUMULATIVE SIMULATED DISTRIBUTION	EMPLOYEES FROM THIS TIME PERIOD
ST. ANN'S BAY	T9	1019	11	7	7
OCHO RIOS	1	1024	0	1	1
OCHO RIOS	2	1025	1	6	6
OCHO RIOS	3	1026	1	4	4
OCHO RIOS	4	1027	0	0	0
OCHO RIOS	5	1028	0	0	0
OCHO RIOS	6	1029	0	0	0
OCHO RIOS	7	1030	0	1	1
SANDY BAY		1004	0	1	1
LEWIS AREA		1005	0	2	2
ROADSIDE		1006	1	1	1
PRIORY	1	1007	0	2	2
PRIORY	2	1008	3	2	2
BLOWFIRE HILL		1009	1	0	0
SEVILLE HOUSE		1010	0	0	0
DRAX HALL		1020	0	0	0
STEER TOWN	1	1021	1	1	1
STEER TOWN	2	1022	0	2	2
DUNNS RIVER		1023	3	2	2
EXCHANGE		1031	0	1	1
BENHAM SPRING		1032	0	0	0
ELTHAM		1033	0	1	1
UPTON		1034	0	0	0
HIATTSFIELD		1035	1	1	1
BREADNUT HILL		1036	0	0	0
HARRISON TOWN		1037	1	0	0
HOPEWELL		1038	0	2	2
COLEGATE		1039	1	0	0
SPICY HILL		1040	0	1	1
BEECHER TOWN		1041	0	0	0
SALISBURY		1042	3	3	3
DAVIS TOWN		1043	1	1	1
CHALKY HILL		1044	0	0	0
EPWORTH		1045	0	0	0
HIGGIN TOWN	1	1046	0	2	2
LUMSDEN		1047	2	2	2
CONTENT		1048	0	0	0
HIGGIN TOWN	2	1049	3	1	1
ARTHUR MOUNT		1050	0	0	0
LIME HALL		1051	0	0	0
INDUSTRY		1052	0	0	0
BAMBOO		1053	0	1	1

PILOT		1054	1	1	1
CLAY GROUND		1056	0	1	1
JOHNSON AREA	1	1058	0	1	1
JOHNSON AREA	2	1059	0	1	1
LODGE		1092	0	0	0
CANNON HILL		1074	0	0	0
MAMMEE HILL		1077	3	2	2
INDUSTRY		1078	0	1	1
CLAREMONT	4	1079	6	4	4
RURAL RETREAT		1080	3	1	1
BELMONT	2	1081	2	5	5
CLAREMONT	3	1082	5	0	0
GOLDEN GROVE	2	1083	11	2	2
CLAREMONT	2	1084	5	0	0
CLAREMONT	1	1085	3	1	1
BEECHAMVILLE		1086	2	0	0
GOLDEN GROVE	1	1087	13	4	4
PHOENIX PARK		1088	0	1	1
BELMONT PLANT	1	1089	8	1	1
UNION PEN	3	1090	0	1	1
UNION PEN	2	1091	0	0	0
UNION PEN	1	1093	0	1	1
HOPEWELL		1094	1	1	1
CLAPHAM		1095	2	3	3
CROWLE PEN		1096	0	0	0
MONEAGUE	3	1097	1	0	0
IRONS MOUNTAIN	2	1098	3	4	4
IRONS MOUNTAIN	1	1099	8	0	0
BIGAMS MOUNTAIN		1100	0	1	1
BONNEVILLE		1101	1	0	0
ALDERTON	2	1102	0	1	1
SHOW MESELF		1103	0	4	4
ALDERTON	1	1104	0	2	2
SYMS RUN		1105	0	0	0
STEPNEY		1106	0	1	1
P.P.(2)(7,8) T2		1108	0	0	0
PRICKLY PELE	1	1109	0	1	1
EDINBURGH CASTLE		1113	1	0	0
BENSONTAN	1	1114	0	0	0
BENSONTAN	2	1115	0	2	2
PEORO		1116	0	2	2
HARMONY VALE		1117	0	2	2
TYDIXTON		1118	0	1	1
LINCOLN		1119	0	0	0
FRIENDSHIP		1120	0	0	0
GRIER PARK		1121	0	0	0
MONEAGUE	2	1122	1	2	2
MONEAGUE	1	1123	0	0	0
RIO HUE		1124	0	3	3
FERGIS, CUM SEE		1125	0	0	0
VILLAGE		1133	0	1	1
FAITHS PEN		1134	0	0	0
CALDERWOOD	1	2076	0	1	1
LUCKY HILL PEN	2	2092	0	0	0
LUCKY HILL PEN	1	2091	0	1	1
LABYRINTH		2090	0	2	2
THREE HILLS		2130	0	0	0
CHARLES TOWN	2	2089	0	1	1
CHARLES TOWN	1	2002	0	0	0
WHITE RIVER		2001	0	0	0
WORTHY PARK		3002	0	0	0
RESOURCE		3005	0	0	0
EWARTON	1	1002	0	0	0
EWARTON	2	1148	0	0	0
EWARTON	3	1009	0	0	0
MOUNT ROSSER		1001	0	1	1
MOUNT DIABLO		1010	0	1	1

APPENDIX F (PART B)

TEST OF THIS MODEL AGAINST OBSERVED DISTRIBUTION

CUTOFF POINT IS 0.50 OF POINT OF MAXIMUM PROBABILITY IN EACH DISTRICT

DISTRICT NAME	CODE NUMBER	OBSERVED DISTRIBUTION	EXPECTED (HYPOTHETICAL) DISTRIBUTION	ACCEPT HYPOTHESIS?
ST. ANN'S BAY T9	1019	11	7.81	NO
OCHO RIOS 1	1024	0	0.98	YES
OCHO RIOS 2	1025	1	1.31	YES
OCHO RIOS 3	1026	1	1.89	YES
OCHO RIOS 4	1027	0	0.87	YES
OCHO RIOS 5	1028	0	0.85	YES
OCHO RIOS 6	1029	0	1.08	YES
OCHO RIOS 7	1030	0	0.82	YES
SANDY BAY	1004	0	0.53	YES
LEWIS AREA	1005	0	1.13	YES
ROADSIDE	1006	1	0.71	YES
PRIORY 1	1007	0	0.77	YES
PRIORY 2	1008	3	1.21	NO
BLOWFIRE HILL	1009	1	0.72	YES
SEVILLE HOUSE	1010	0	0.94	YES
DRAX HALL	1020	0	0.47	YES
STEER TOWN 1	1021	1	1.70	YES
STEER TOWN 2	1022	0	1.33	YES
DUNNS RIVER	1023	3	0.99	NO
EXCHANGE	1031	0	0.87	YES
BONHAM SPRING	1032	0	0.54	YES
ELTHAM	1033	0	0.63	YES
UPTON	1034	0	0.47	YES
HIATTSFIELD	1035	1	1.27	YES
BREADNUT HILL	1036	0	0.84	YES
HARRISON TOWN	1037	1	0.72	YES
HOPEWELL	1038	0	1.30	YES
COLEGATE	1039	1	0.74	YES
SPICY HILL	1040	0	0.79	YES
BEECHER TOWN	1041	0	0.70	YES
SALISBURY	1042	3	0.90	NO
DAVIS TOWN	1043	1	1.01	YES
CHALKY HILL	1044	0	0.94	YES
EPWORTH	1045	0	0.77	YES
HIGGIN TOWN 1	1046	0	0.77	YES
LUMSDEN	1047	2	0.71	NO
CONTENT	1048	0	0.79	YES
HIGGIN TOWN 2	1049	3	0.80	NO
ARTHUR MOUNT	1050	0	0.73	YES
LIME HALL	1051	0	0.71	YES
INDUSTRY	1052	0	0.60	YES
BAMBOO	1053	0	0.79	YES
PILOT	1054	1	0.60	YES
CLAY GROUND	1056	0	0.53	YES
JOHNSON AREA 1	1058	0	1.08	YES
JOHNSON AREA 2	1059	0	0.65	YES
LODGE	1092	0	1.09	YES
CANNON HILL	1074	0	1.17	YES
MAMMEE HILL	1077	3	0.82	NO
INDUSTRY	1078	0	1.05	YES

TESTED MODEL "RUN"

CLAREMONT	4	1079	6	1.85	NO
RURAL RETREAT		1080	3	0.89	NO
BELMONT	2	1081	2	5.58	NO
CLAREMONT	3	1082	5	1.74	NO
GOLDEN GROVE	2	1083	11	4.56	NO
CLAREMONT	2	1084	5	1.62	NO
CLAREMONT	1	1085	3	1.58	NO
BEECHAMVILLE		1086	2	1.67	YES
GOLDEN GROVE	1	1087	13	3.89	NO
PHOENIX PARK		1088	0	1.40	YES
BELMONT PLANT	1	1089	8	1.40	NO
UNION PEN	3	1090	0	1.23	YES
UNION PEN	2	1091	0	0.84	YES
UNION PEN	1	1093	0	0.98	YES
HOPEWELL		1094	1	1.43	YES
CLAPHAM		1095	2	1.50	YES
CROWLE PEN		1096	0	0.45	YES
MONEAGUE	3	1097	1	1.59	YES
IRONS MOUNTAIN	2	1098	3	0.90	NO
IRONS MOUNTAIN	1	1099	8	0.84	NO
BIGAMS MOUNTAIN		1100	0	0.97	YES
BONNEVILLE		1101	1	0.87	YES
ALDERTON	2	1102	0	0.62	YES
SHOW MESELF		1103	0	0.94	YES
ALDERTON	1	1104	0	1.11	YES
SYMS RUN		1105	0	0.59	YES
STEPNEY		1106	0	0.68	YES
P.P.(2)(7,8)	T2	1108	0	0.65	YES
PRICKLY POLE	1	1109	0	0.58	YES
EDINBURGH CASTLE		1113	1	0.53	YES
BENSONTAN	1	1114	0	0.59	YES
BENSONTAN	2	1115	0	0.84	YES
PEDRO		1116	0	1.05	YES
HARMONY VALE		1117	0	0.63	YES
TYDIXTON		1118	0	0.73	YES
LINCOLN		1119	0	0.88	YES
FRIENDSHIP		1120	0	0.92	YES
GRIER PARK		1121	0	0.65	YES
MONEAGUE	2	1122	1	0.75	YES
MONEAGUE	1	1123	0	0.70	YES
RIO HOE		1124	0	1.00	YES
FERGIS, CUM SEE		1125	0	0.84	YES
VILLAGE		1133	0	0.72	YES
FAITHS PEN		1134	0	0.68	YES
CALDERWOOD	1	2076	0	0.93	YES
LUCKY HILL PEN	2	2092	0	0.40	YES
LUCKY HILL PEN	1	2091	0	0.83	YES
LABYRINTH		2090	0	0.51	YES
THREE HILLS		2130	0	0.36	YES
CHARLES TOWN	2	2089	0	0.49	YES
CHARLES TOWN	1	2002	0	0.45	YES
WHITE RIVER		2001	0	0.43	YES
WORTHY PARK		3002	0	0.29	YES
RESOURCE		3005	0	0.35	YES
EWARTON	1	1002	0	0.42	YES
EWARTON	2	1148	0	0.68	YES
EWARTON	3	1009	0	0.31	YES
MOUNT ROSSER		1001	0	0.75	YES
MOUNT DIABLO		1010	0	0.85	YES
			114	114.00	

HYPOTHESIS ACCEPTED IN 83.49 PERCENT OF DISTRICTS

LITERATURE CITED

1. Gerald A. P. Carrothers; "Discussion: Gravity and Potential Concepts of Human Interaction", Journal of the American Institute of Planners, Volume 22, 1956a.

2. Lawrence A. Brown; Models for Spatial Diffusion Research, A Review, Technical Report No. 3, Spatial Diffusion Study, Department of Geography, Northwestern University, June, 1965.

3. Robert L. Colenutt; "Linear Diffusion in an Urban Setting: An Example", Geographical Analysis, Volume 1, No. 1, 1969, pp. 106-114.

4. Michael Dacey; Location Processes Described by the Ordinary and Compound Polya-Eggenberger Probability Distributions, Unpublished Paper, Department of Geography, Northwestern University.

5. Leon W. Ellwood; "Estimating Potential Volume of Proposed Shopping Centres", The Appraisal Journal, Volume 22, 1954, pp. 581-589.

6. William L. Garrison; "Toward Simulation Models of Urban Growth and Development", Symposium of I.G.U., Lund, K. Norberg (eds.), 1962, pp. 91-108.

7. --------; "The Spatial Impact of Transport Media: Studies of Rural Roads", PPRSA, Volume 1, 1955, pp. T1-T14.

8. Torsten Hagerstrand; "A Monte Carlo Approach to Diffusion", Archiv. Europ. Sociol., Volume 6, 1965, pp. 43-67.

9. Chauncy D. Harris; "The Market as a Factor in the Localization of Industry in the United States", AAAG, Volume 44, 1954, pp. 315-348.

10. R.N.S. Harris and E.S. Steer; "Demographic-Resource Push in Rural Migration: A Jamaican Case Study", Social and Economic Studies, December 1968, pp. 398-406.

11. Fred Charles Iklé; "Sociological Relationships of Traffic to Population and Distance", Traffic Quarterly, Volume 8, 1954.

12. Zvi Grliches; "Hybrid Corn: An Explanation in the Economics of Technological Change", Econometrica, Volume 25, 1957, pp. 501-522.

13. Richard L. Morrill; "Simulation of Central Place Patterns over Time", Symposium of I.G.U., Lund, K. Norberg (eds.), 1962.

14. Leatrice D, MacDonald and John S. MacDonald; "Motives and Objectives of Migration: Selective Migration and Preferences Toward Rural and Urban Life", Social and Economic Studies, December 1968, pp. 417-434.

15. Gunnar Olsson; Distance and Human Interaction, Regional Science Research Institute, Bibliography Series, No. 2, Philadelphia, 1965.

16. R. Porter; "Approach to Migration through its Mechanism", Geografiska Annaler, Volume 38, 1956, pp. 317-343.

17. Waldo R. Tobler; "Of Maps and Matrices", Journal of Regional Science, Volume 7, No. 2, 1967.

18. Roy L. Wolfe; "Recreational Travel: The New Migration", Canadian Geographer, Volume 10, No. 1, 1966.

19. Julian Wolpert; "The Decision Process in Spatial Context", AAAG, Volume 54, 1964, pp. 537-558.

20. "Reynolds Jamaica Mines Limited: Its Origin and Development 1943-1953", Reynolds Metals Company, Economic Research Department, August 1956.

21. Kalman Tekse; Internal Migration in Jamaica, Demography and Vital Statistics Section, Department of Statistics, April 1967.

OTHER REFERENCES

Emelio Casetti; "Why do Diffusion Processes Conform to Logistic Trends": Geographical Analysis, Volume 1, No. 1, pp. 101-105, 1969.

Duane F. Marble, John D. Nystuen; "An Approach to the Direct Measurement of Community Mean Information Fields", PPRSA, Volume 11, pp. 99-109, 1963.

Everett M. Rogers; Diffusion of Innovation, New York, The Free Press of Glencoe, 1962.

Richard L. Morrill; "Simulation of Central Place Patterns over Time", Symposium of I.G.U., Lund, K. Norberg (eds.), 1962.

John D. Nystuen; "A Theory and Simulation of Intraurban Travel", in Quantitative Geography Part 1, Economic and Cultural Topics, Number 13, 1967, Northwestern University, pp. 54-83.

Torsten Hagerstrand; "On Monte Carlo Simulation of Diffusion", University of Lund, in Quantitative Geography, Part 1, No. 13, pp. 1-32, 1967.

Forest Pitts; "Problems in Computer Simulation of Diffusion", PPRSA, Volume 11, pp. 111-119, 1963.

John Nystuen; "Boundary Shapes and Boundary Problems", PPRSA, 1967.