COMMUNICATION AS A CRITERION FOR DEFINING REGIONS

by

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Signature of Author _____

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Head, Department of City and
Regional Planning

ABSTRACT OF THESIS

COMMUNICATION AS A CRITERION FOR DEFINING REGIONS

By Francis M. Dimond

Submitted to the Department of City and Regional Planning on January 18, 1954, in partial fulfillment of the requirements for the degree of Master in City Planning.

The political areas which exist are those which are most often planned for, although boundaries of towns, counties and states may be inconveniently placed for planning purposes. An alternative to planning for existing political areas is to find regions which will serve the requirements of comprehensive planning.

The thesis explores the possibilities of communication as the appropriate criterion for defining regions, composed of groups of towns, which are suitable for planning purposes. Arguments are presented in support of regions based on communication. Criteria are developed on the basis of which boundaries may be drawn. A method is outlined for the drawing of boundaries, and sets of resulting regions are demonstrated. Methods are suggested for checking the regions, and thereby the hypotheses, but these methods are not carried out.

The appendices contain calculations and certain subject matter which contributes to the background of the study.

Thesis Supervisor: Roland B. Greeley

Title: Associate Professor of Regional Planning

January 18, 1954

Professor Frederick J. Adams
Head, Department of City and Regional Planning
School of Architecture and Planning
Massachusetts Institute of Technology

Dear Sir:

In partial fulfillment of the requirements for the Degree of Master of City Planning from the Massachusetts Institute of Technology, I submit herewith this thesis entitled:

"Communication as a Criterion for Defining Regions"

Respectfully,

Francis M. Dimond

TABLE OF CONTENTS

Title Page

Summary Abstract

Letter of Transmittal

Table of Contents

Part I : Introduction, Setting Forth Certain Hypotheses 1

Part II : The Region Based on Communication 7

Part III : Measurement of Communication 12

Part IV : The Relationship of Certain Variables to the Volume of Communication 19

Part V : Alternative Hypotheses for the Delineation of Regions Based on Communication 24

Part VI : Delineation of Regions 30

Part VII : Conclusions 34

Appendix A : Data for Contiguous Relationships 36

Appendix B : Data for Non - Contiguous Relationships 52

Appendix C : Communication and the Social Organism 56

Appendix D : Communication in Small Groups - An Experiment 63

Appendix E : Telephone Terminals as an Index of Population 66

Bibliography 69

PART I

INTRODUCTION, SETTING FORTH CERTAIN HYPOTHESES

1.0 REGIONAL THEORY

There are many concepts suggested by the term "region", a region being an area in which some degree of homogeneity exists. Most regional delineations follow a typical procedure. (1) Criteria which serve as conditions for inclusion within a region are adopted. (2) Data are collected for the purpose of evaluation with respect to the criteria of inclusion. (3) The delineation is made to include the area evaluated at above (or below) the criterion level.

Many sets of "Special-purpose" regions have been created by the procedure of subdividing a broad area into regions on the basis of a single criterion. The social science of Geography is replete with examples of productive regions, climatic regions, cultural regions, and so forth. Within a single area, the geographer-analyst may develop innumerable sets of regions for various purposes.

The planner-synthesist, on the other hand, largely because of the comprehensive nature of planning, requires a "multi-purpose" region. The coordinated development of a region requires the interplay of many disciplines within the single geographical area. The planner seeks areal integration as opposed to functional integration. It is proposed in this paper to suggest a method for achieving the breakdown into regions within which areal integration could be achieved with the greatest probability of success. The method is that typically outlined above with the introduction of a hypothetical multi-purpose criterion, i.e. communication.

1.1 DIFFICULTIES BY THE EXISTENCE OF POLITICAL JURISDICTIONS

The most obvious arenas for planning exist within the existing political jurisdictions, such as states, counties, and municipalities.

The required distinct boundaries mark all political jurisdictions. However, there are numerous instances in which the boundaries may be in the "wrong" places, reflecting a societal situation which no longer exists.

Where boundaries have been in the "wrong" places it has been possible in certain cases to alter them by annexing additional territory (usually unincorporated) to the growing community. Eventually there is a limit at which the community is ringed by incorporated areas refusing to be annexed.

Another alternative has been organization on a federated basis of adjacent urban communities having common problems or requiring provision of common services. Such organization on a largely voluntary basis has been successful insofar as it deals with problems of mutual concern to all and suggests solutions beneficial to all. Where a program is not mutually beneficial, it is doubtful if the voluntary federation is effective. Where the federating areas appreciate their common problems and are willing to cooperate for the general welfare, the voluntary federation has a greater chance of success.

One may conceive of the "community" transcending political jurisdictions as a grouping of people who are markedly interdependent relative to their relations with other people, In the words of Hawley*, "interdependence among men cannot spread uniformly over an indefinite area." It is, "participation in a daily rhythm of collective life... which distinguishes and gives unity to the population of a locality." The phenomenon of interdependence may occur quite independently of political boundaries, as for instance Manhattan and Jersey City. It is the boundary of the organic community which must be found. Part

*Hawley, "Human Ecology"

and parcel of interdependence are the common problems and opportunities which are the basis of planning.

1.2 PLANNING FOR THE ORGANIC COMMUNITY OF INTEREST

The effectiveness of planning agencies lies in contributing to governmental decisions. On the whole, governmental decisions prior to which the planning has been adequate should be "better" than otherwise. Success in planning might be measured in terms of certain procedures being carried out prior to arrival at a decision, thus avoiding the difficulty of judging whether one decision is "better" than another.

Difficult as evaluation of decisions may be, it is perhaps as difficult to evaluate planning procedures. It would be quite difficult to measure the effectiveness of planning procedures except in terms of their results, without planning deteriorating to a rigid subjective ritual. Evidently those who may evaluate the efficacy of planning in a democracy are those to whom the government is responsible, namely the electorate. The attempt of this paper, to locate geographically that electorate which would be most capable of judging the decisions of its government and the adequacy of planning, has been based on the assumption that arriving at a consensus of opinion among any group of people requires communication. It follows that the grouping of people with the highest development of intracommunication, the organic community of interest, would probably be that electorate most capable of effective self-government.

The following hypotheses are directly relevant although it is not possible to test all of them in this paper:

1. That communities of interest may be observed. (That certain phenomena are observable which may be referred to as a community of interest. Note that observation is not sufficient to demonstrate existence).

2. That communities of interest are heterogeneous with respect to population density.

3. That the boundaries of such communities are relatively stable although subject to change with the passage of time. (That observations of the phenomena may yield modified results at a different time).

4. That communities of interest may be approximated by groupings of political jurisdictions.

5. That the entire inhabited land area might be divided into communities of interest. Translation of the community of interest to a geographical basis is dependent upon relative immobility of population.

6. That communities may be relatively more or less independent in both space and time.

1.3 OTHER ATTEMPTS TO ISOLATE THE ORGANIC COMMUNITY OF INTEREST

Several attempts have been made to divide the area of the United States into communities or regions. The multi-purpose region is a composite of numerous special-purpose regions. The multi-purpose region has quite a distinct center, usually a large city, but its boundaries are quite vague. By shifting the emphasis of various components it is possible to alter the boundaries. Since one of the requirements of planning is quite static boundaries, the multi-purpose region is not suitable except in a theoretical way.

Donald Bogue has developed a theory of metropolitan dominance and sub-dominance. It is a sector theory of the metropolis-dominated region. In order to set forth his theory, Mr. Bogue was required to divide the United States into regions. He did so by selecting all cities above a certain size of population (the critical size was lower west of the Mississippi River) and designating these as metropolitan centers.

All of the hinterland area was assigned to the nearest center. Mr. Bogue's method seems to be more an indication of the problem of where to draw boundaries than a solution.

A study of George Zipf is interesting in connection with Bogue's method. Zipf finds that upon ranking American cities, a smooth exponential curve relating the two variables results. Without speculating on why this phenomenon should be observed, one may conclude that any distinction based upon relative size among cities must be quite arbitrary. There do not exist large cities and medium-sized, and so on, but a continuous gradation in size. There is no clear line of demarcation.

Essentially, three problems emerge in delineating regions:

1. That of adopting criteria.
2. That of selecting regional centers (These centers might be more diffuse than the term implies).
3. That of drawing boundaries on the basis of criterion evaluation.

PART II

THE REGION BASED ON COMMUNICATION

2.0 CRITERIA ON WHICH REGIONS ARE BASED

To find suitable criteria for developing regions, it is necessary to decide what is to be included. If one makes the decision that the region is to include the central urban area and associated hinterland, it is already clear that an area heterogeneous in density is being considered. It is necessary to find a new element of homogeneity.

In the past, regionalists have chosen many criteria as bases for developing different kinds of regions. These are quite conveniently classified under four headings.

1. Geographical	river-valley watersheds areas of like soil areas of similar agricultural product areas of similar climate
2. Economic	areas of similar production areas of similar income
3. Social and Cultural	ethnic areas language areas areas of similar social customs areas of similar religion
4. Political	areas of political jurisdiction administrative areas

Each of these types of regions may be useful for specific purposes. The multi-purpose region is simply a composite of these special criteria. Although the multi-purpose region is theoretically sound, a formula would have to be chosen for arriving at the composite and, depending upon the formula chosen, the boundaries would vary. There is a fundamental soundness in the multi-purpose approach, in the attempt to find a single criterion for inclusion in a comprehensive region.

2.1 COMMUNICATION AS A CRITERION FOR THE REGION

One of the principal functions of the city has always been as a place of communication. It has likewise been called a place of production or trade. But increasingly today trade and production functions are removing to a more peripheral position. It is interesting, however, that those functions characterized by intensive communication have not decentralized. If the 19th Century saw the Industrial Revolution; the 20th is seeing a revolution in communication. Hardly have the radio and telephone become accepted when they are being replaced by other devices. There is an unprecedented traffic in ideas as all the nations of the World suddenly confront each other, no longer isolated by distance. Mankind as producer is gradually giving way to mankind as communicator, with increasing time today being devoted to the latter function, at least in the most highly developed nations.

Even if these assumptions are not accepted, it is desirable to consider the possibilities of communication as a criterion for the region. Many of the special-purpose criteria elaborated above involve communication. Government is essentially a system of communication. Business is completely dependent upon communication between businessman and client, as well as knowledge of the market. Social activities are built around some form of group communication. Culture, ideas, and political opinions, are all communicated from one person to the next. Education is communication par excellence.

All the World is in communication today. But on a smaller scale, there may be regions that are relatively self-sufficient with respect to communication. Such regions make possible cultural differentiation in a world where cultural isolation no longer exists. There may exist subregions within regions, a hierarchy similar to political elements - nations,

states, counties, towns.

The region is conceived as a combination of metropolis and hinterland, economically and socially interdependent. While it would be desirable that governmental jurisdiction should cover the area of interdependence, the problem of highest priority is to show that such regions of interdependence exist (can be observed). It is the principal hypothesis of this paper that communication is the criterion which distinguishes such regions most effectively. The center of the region exhibits maximum communication, attenuation increasing with distance from the center. This hypothesis does not differ from that of the multi-purpose region. The innovations lie in proposing communication as the composite criterion, proposing telephone communication as an index of total communication, and thus taking the concept of the comprehensive (multi-purpose) region from the realm of the theoretical to that of the practicable.

2.2 USEFULNESS OF THE COMMUNICATION REGION FOR PLANNING PURPOSES

It has been suggested that the communication region is the area of maximum interdependence, the area within which a maximum of common problems and opportunities exist. It follows that a comprehensive approach might yield optimum results within such an area. Unity is more probable. The advantages of the communication region may be listed:

1. Everyone participates in communication; it is thereby democratic.
2. Common problems and opportunities exist.
3. Social awareness exists to a maximum degree as a result of communication.
4. The very existence of the communication region implies that government is incipient. The need for planning follows (if all

political boundaries could suddenly disappear, it is most probable that they would be recrystallized on the basis of predominant communication relationships).

The neighborhood is an example. The school serves as the unifying element. It is the center of communication for the children. It is further conceived that it might serve as a center of communication for adults as well. The neighborhood is essentially a communication region on a minute scale.

PART III

MEASUREMENT OF COMMUNICATION

3.0 METHODS OF COMMUNICATION

There are many methods of communication in use. The total of communication between communities might be found by adding the individual amounts by all methods. A composite total of the communication realized through all channels would be difficult to achieve. An alternative would be a single medium of communication which might serve as an index of the total. Conceivably, the volume of communication between adjacent communities might be available for some medium.

Accordingly, communication is analyzed into its various components in the following table:

COMMUNICATION MEDIA

	One Way *	Two Way
Person to Person	Correspondence Telegraph	Telephone Personal conversation
Mass	Radio Television Newspaper Periodicals	Public meeting

The mass media of communication have the disadvantage that they are one-way and that they are usually commercial undertakings. People exercise choice in tuning in to one of several radio stations and by purchasing one of several newspapers. However, many communities have neither newspapers nor radio stations. It is possible to use data of the mass media only in a limited way and perhaps on a larger scale than the individual community. In addition, much of what is communicated over the mass media is produced on a nationwide basis, with all but the broadest regional differentiation cancelled out.

* One way communication is not really communication (See Appendix C) and this is its principal disadvantage as an index of communication. However, one-way communication is not ordinarily distinguished from communication as it has been defined in the Appendix.

Of the one-way, person-to-person methods, correspondence has the disadvantage that it is used principally over long distances. The telegraph has a similar disadvantage. Both of these means of communication might be more important between regions than within them relatively speaking. Other means of communication may be more convenient over short distances.

The two-way, person-to-person media have several advantages. If two people are separated by distance, they have the alternative of using remote communication by telephone, or overcoming the distance by travel to a point where intimate communication may occur. If good records were available of people's coming and going, then there might be an index of personal face-to-face communication in terms of an origin and destination study of transportation. Railroad and bus tickets, and automobile origin and destination studies are possibilities.

On the other hand, the telephone, besides its advantages as a two-way personal medium of communication, has the advantage of widespread use throughout the population and over a wide range of distance. It is also used for a variety of purposes, for all sorts of business, social and personal contacts. The chinching argument in favor of the telephone is its organization. The telephone companies annually require and ascertain the volume of calls throughout their systems.

The New England Telephone System in particular is engaged in converting its toll systems to dial systems in order to economize on operative personnel. The Company has found that service can be maximized by connecting into the same dial system those exchanges exhibiting a high "community of interest". The community of interest is greatest where the number of calls per telephone terminal is greatest, this situation occurring most typically in the suburban-central city relationship. The Com-

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pany has found that wherever the community of interest factor between two exchanges exceeds a certain value, it is economical to connect the two exchanges into a common dial system into a common dial system. In connection with this study, the Telephone Company makes an annual ten-day tabulation of the volume of calls between every pair of exchanges in its system, entering this information upon IBM cards.

3.1 AREA OF STUDY

Before the collection of data could begin, it was necessary to select an area for study and outline some hypotheses to be tested with the data. Western Massachusetts was selected as the area of study, since it is believed to contain a variety of communication both as regards size and other factors. It has the advantage that no state boundaries cross it, nor does it contain many communities not served directly by the New England Telephone System. Use of this area excludes from consideration the more complicated Boston Metropolitan Area, within which comparable data are not available by the same methods.

The data available for Western Massachusetts include the results of a 1952 ten-day study of the origin and destination of all calls. There are about 100 exchanges within the study area, and hence the number of items of data is on the order of 100 x 99 / 2 or 5000 entries. While many of the items of data are small enough to escape consideration, there remains the problem of dealing with a large volume of data, especially considering the number of munipulations of data involved.

3.2 PRINCIPAL VARIABLES RELATED TO VOLUME OF COMMUNICATION

Numerous variables suggest themselves as plausibly related to the volume of communication. Almost all of the variables may be divided into two categories; depending upon whether their relation to volume of

communication is positive or negative. These variables may be assumed positive or negative in most cases without the necessity of testing the assumptions.

Positive Variables (Those cases in which an increase of the variable is assumed to be related to an increase in communication).

1. Geographic
   shared resources
   shared transport

2. Economic
   shared employment
   shared distribution facilities

3. Social
   shared services
   shared institutions
   shared media of mass communication
   shared recreational facilities

4. Size of population

Negative Variables (Those cases in which an increase of the variable is assumed to be related to a decrease in communication).

1. Geographic
   distance
   intervening topographic barriers

2. Economic
   self-sufficiency
   differences of economic level
   cost of communication (rates charged)

3. Social
   political boundaries
   ethnic, linguistic or cultural differences

It would be virtually impossible to find the effect of each of these variables individually upon the volume of communication. The aggregate effects of these and other possible variables may be assumed to be related to the observation of communication regions, probably explaining

departure from a standard volume of communication relative to population. In the vernacular, it is these variables which "cause" the region to exist*.

The relationships with the volume of communication, of distance, population, and rates charged are particularly interesting. In the first place, rates charged vary directly with distance, and so part of the relationship of distance to volume of communication may be attributed to the rate structure. Population is assumed a positive variable with respect to communication. Testing of hypotheses relative to the variables of population and distance**, while not strictly necessary to the arguments of this thesis, are an indication of the method which may be used to test other of the variables.

3.3 SOURCES OF DATA

The following data are available for the purposes of this study:

1. Tabulation of the number of calls between every pair of exchanges in the New England Telephone System over a ten-day period in 1952.
2. A map showing boundaries of all exchanges and all political boundaries as well.
3. Population figures for 1950 individually by community.
4. Number of telephone terminals in each exchange.
5. Rates charged by the Telephone Company as a function of distance.
6. Distances between all pairs of exchanges in the system.

* The region has no existence, but rather certain observations may be called manifestations of the hypothetical region (See Appendix C).

** Note that the distance between exchanges is rather a loose idea, based upon the assumption that each exchange may be represented as a point on the map instead of an area. The Telephone Company has designated scaling centers resembling centroids of population. The distance between exchanges is the distance between scaling centers.

3.4 A METHOD OF ESTIMATING THE POPULATION OF EXCHANGES

The size of population of each community in Western Massachusetts is available most recently in the Census of 1950. Since the boundaries of telephone exchanges do not correspond exactly to the boundaries of individual communities, it is necessary to estimate the population of the exchanges. Data are available for the number of telephone terminals in each exchange.

HYPOTHESIS The population of an exchange is directly proportional to the number of telephone terminals.

By examining those cases in which exchange boundaries are contiguous with community boundaries, it is possible to test the hypothesis, and a constant of proportionality may be derived. The population is given for 1950 and the number of terminals for 1952. Changes of population in the two-year period are probably minor considering the overall accuracy of the data in this study.

A sample is tested and the average population per terminal found to be 3.8. In the majority of cases the deviation from the mean is less than 10%. It may therefore be concluded that the number of telephone terminals is a satisfactory index of population within the relative accuracy of this study.

* See Data and Method (Appendix E)

PART IV

THE RELATIONSHIP OF CERTAIN VARIABLES TO THE VOLUME OF COMMUNICATION

4.0 THE RELATIONSHIP BETWEEN VOLUME OF COMMUNICATION AND DISTANCE BETWEEN CONTIGUOUS EXCHANGES

The following hypothesis is proposed:

HYPOTHESIS That the volume of communication is inversely proportional to the intervening distance.

The volume of communication in thousands of calls monthly is available for each contiguous relationship as well as the distance between scaling centers as listed in Appendix A. All of these items were tabulated according to distance with volume of communication, the dependent variable. Only the median values of the tabulations for each distance are included in the report. The median was used rather than the average to avoid the considerable influence of large values upon the average.

Relationship of Median Volume of Communication to Distance

Distance (miles)	Median value of volume of communication (thousands of calls monthly)
3	6
4	2.5
5	1
6	1.5
7	2.25
8	1.75
9	.5
10	.5
11	.25
12 - 15	.75

4.1 THE RELATIONSHIP BETWEEN VOLUME OF COMMUNICATION AND SIZE OF POPULATION

The following hypothesis is proposed:

HYPOTHESIS That the volume of communication is directly proportional to the size of population.

The volume of communication in thousands of calls monthly is available for each contiguous relationship as well as the number of telephone terminals in each exchange (an index of population) as listed in Appendix A. For each communication relationship there are two values of the index of population, which is the independent variable. Only the median values of the tabulations for each range of the population index are included in this report. The median was used rather than the average to avoid the considerable influence of large values upon the average.

The Relationship of Median Volume of Communication to Population

Number of Telephone Terminals (Index of Population)	Median Volume of Communication (Thousands of calls monthly)
1 - 250	.25
251 - 500	.50
501 - 750	.75
751 - 1000	1.0
1001 - 1500	2.0
1501 - 2000	2.5
2001 - 3000	2.5
3001 - 4000	2.0
4001 - 6000	3.0
6001 - 10000	5.5
10001 - 15000	8.0
15001 - 25000	14.5
25001 and up	36.

4.2 RELATIONSHIP BETWEEN VOLUME OF COMMUNICATION AND OPPORTUNITY TO COMMUNICATE

Assuming that every person is able to communicate with every other person, the number of possibilities for communication between two exchanges is represented by the cross product of the population divided by two. This is the opportunity to communicate, and may be represented by the index of opportunity (the product of numbers of terminals). The following hypothesis is proposed:

HYPOTHESIS The volume of communication is directly proportional to the opportunity to communicate.

The volume of communication in thousands of calls monthly is available for each contiguous relationship as well as the product of terminals for each relationship (an index of opportunity to communicate) as listed in Appendix A. The items are tabulated according to range of opportunity which is the independent variable. The average volume of communication is the dependent variable.

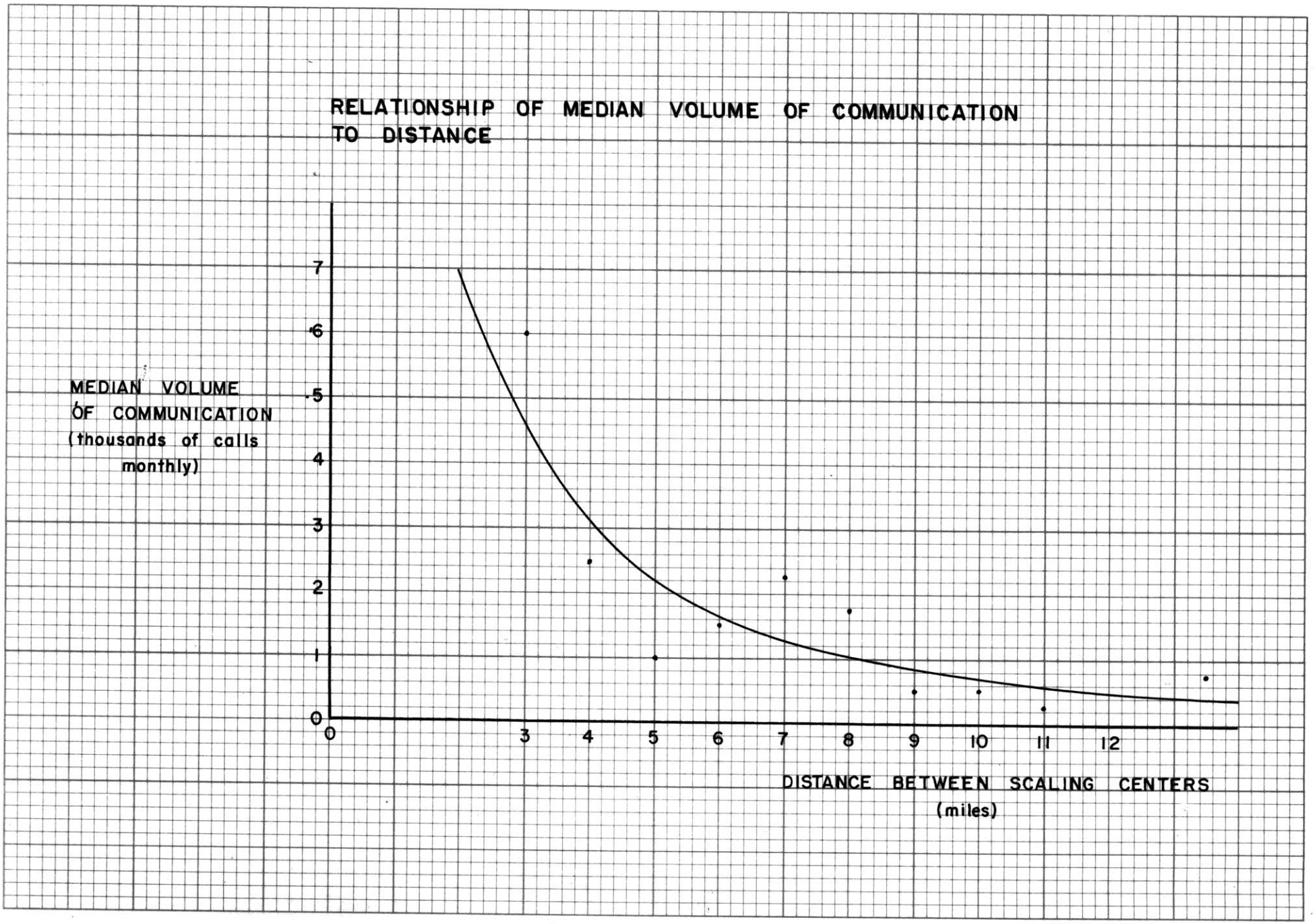
Relationship of Average Volume of Communication to Opportunity to Communicate.

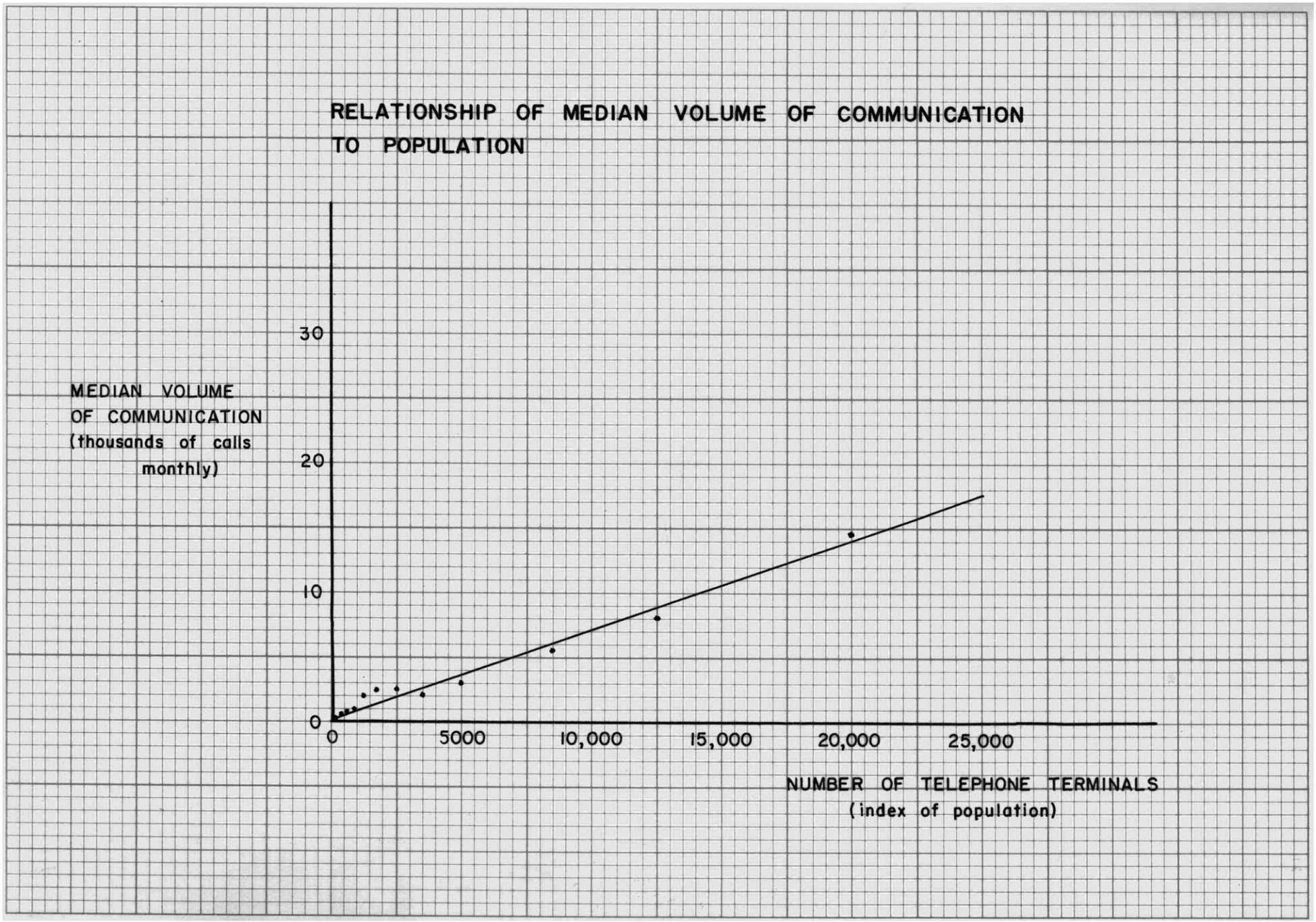
Range of Opportunity (millions)	Average Opportunity	Average Volume of Communication (thousands of calls monthly)
0 - .1	.05	.27
.11 - .5	.35	.79
.51 - 1.0	.8	1.81
1.1 - 2.0	1.55	2.76
2.1 - 4.0	3.05	3.12
4.1 - 8.0	6.5	7.85
8.1 -16.0	12.5	11.7
16.1 -32.0	24.5	15.8
32.1 and up		48

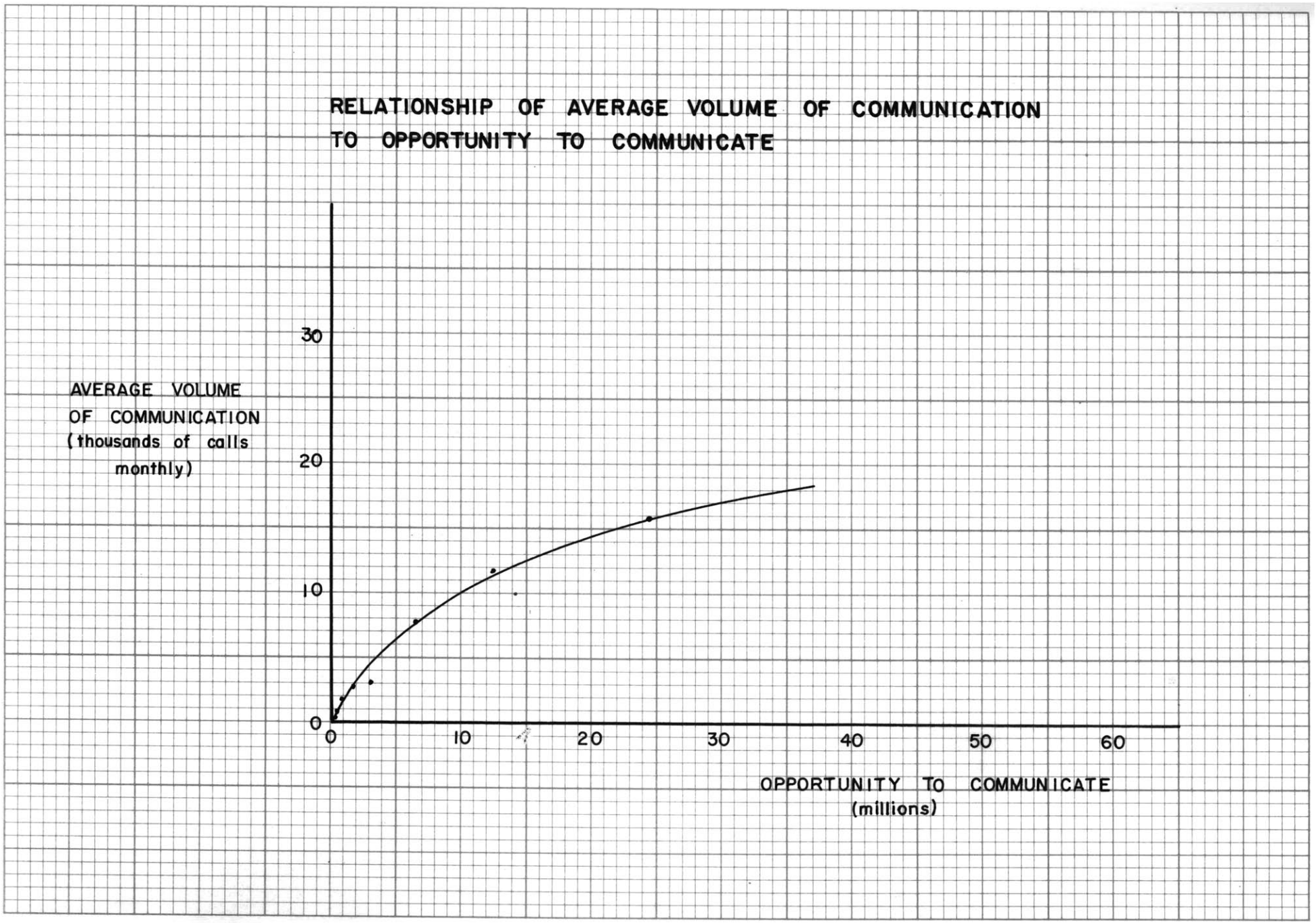
4.3 SUMMARY OF RELATIONSHIPS

The relationship of volume of communication with distance, population and opportunity to communicate are shown in the following graphs. Generally speaking, volume of communication varies inversely with distance raised to a power greater than one. Volume of communication varies directly with the size of population to a power of approximately one, and directly with the opportunity to communicate lowered to a power of less than one.

(See graphs following).


RELATIONSHIP OF MEDIAN VOLUME OF COMMUNICATION TO DISTANCE
MEDIAN VOLUME OF COMMUNICATION (thousands of calls monthly)
7
6
5
4
3
2
1
0
0
3
4
5
6
7
8
9
10
11
12
DISTANCE BETWEEN SCALING CENTERS (miles)


RELATIONSHIP OF MEDIAN VOLUME OF COMMUNICATION TO POPULATION
MEDIAN VOLUME OF COMMUNICATION (thousands of calls monthly)
30
20
10
0
0
5000
10,000
15,000
20,000
25,000
NUMBER OF TELEPHONE TERMINALS (index of population)


RELATIONSHIP OF AVERAGE VOLUME OF COMMUNICATION TO OPPORTUNITY TO COMMUNICATE
AVERAGE VOLUME OF COMMUNICATION (thousands of calls monthly)
30
20
10
0
0
10
20
30
40
50
60
OPPORTUNITY TO COMMUNICATE (millions)

PART V

ALTERNATIVE HYPOTHESES FOR THE DELINEATION OF REGIONS BASED ON COMMUNICATION

5.0 TOTAL VOLUME OF COMMUNICATION AS THE INDEX OF COMMUNITY OF INTEREST

The measurement of total volume of communication in order to define the communities of interest is the most obvious method. It is based upon the assumption that where volume of communication is the greatest, there will be the maximum community of interest.

HYPOTHESIS A criterion of total volume of communication enables observations to be made which completely and critically divide an area into regions.

An examination of the hypothesis in the light of available knowledge about the variables leads to the expectation that the relationships between the large exchanges are emphasized by the adoption of this criterion, since volume of communication is roughly proportional to population. It is sought to avoid bias in favor of the heavily populated exchanges and the criterion may be disqualified on that ground alone.

The data consists of the volume of calls monthly in thousands between each pair of contiguous exchanges as listed in Appendix A. The results are plotted graphically on Map 1.

The results indicate strong relationships in terms of this criterion around the more heavily populated centers. Where the intervening distance is small, these centers tend to string together. Relationships in sparsely populated areas exhibit low volumes throughout, rendering delineation quite difficult. The regional groupings which emerge resemble metropolitan areas based on density of population. The rural areas are left out and the total area is not included in one or another region. Reasoning against the criterion of population density has been set forth earlier in the paper.

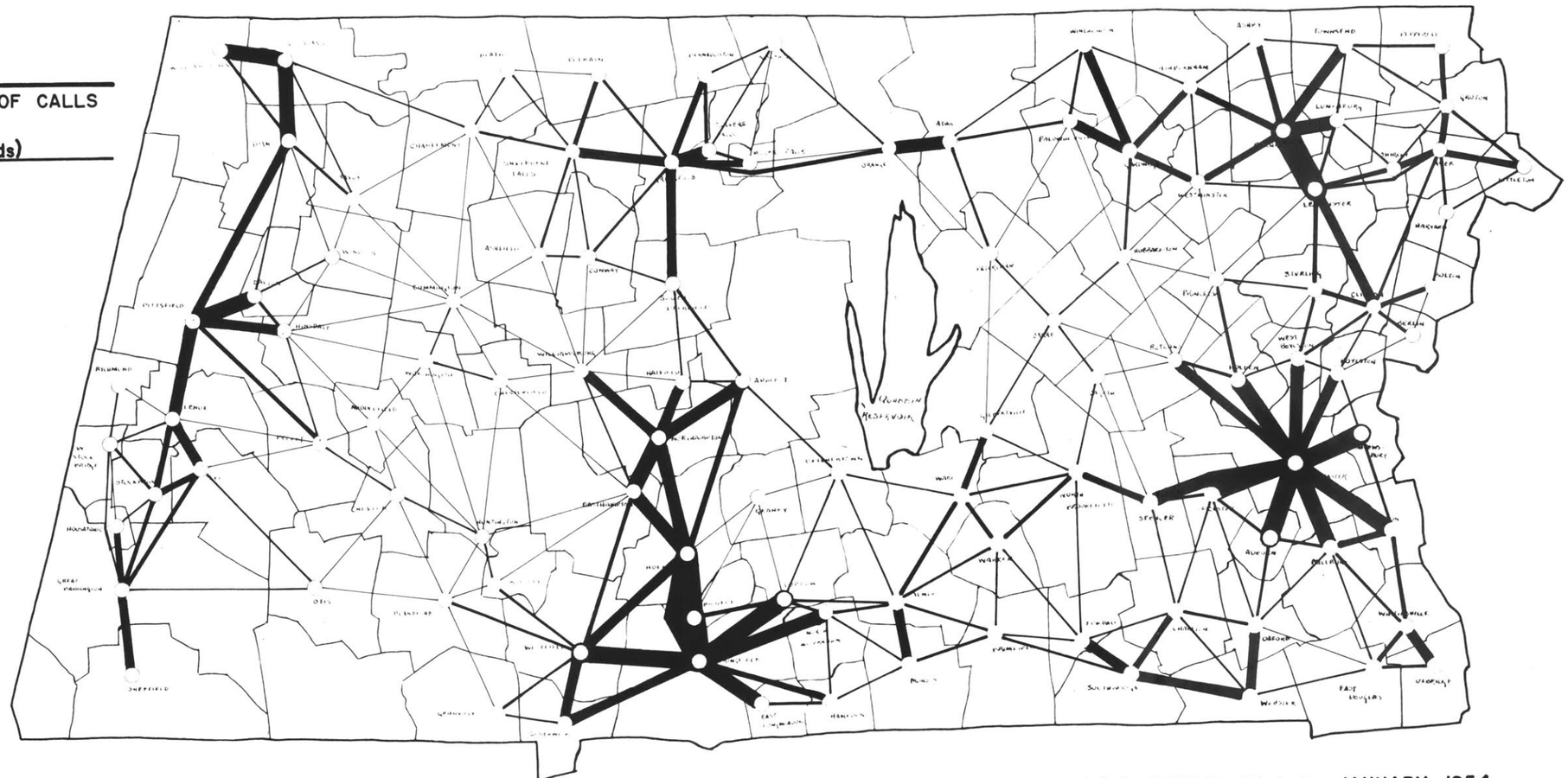
MAP 1

TOTAL VOLUME OF COMMUNICATION BETWEEN CONTIGUOUS EXCHANGES

WESTERN MASSACHUSETTS

LEGEND

TOTAL NUMBER OF CALLS MONTHLY (Thousands)
0.0- 0.4
0.5- 1.4
1.5- 2.9
3.0- 4.9
5.0- 7.9
8.0- 13.9
14.0- 24.9
25.0- 49.9
50.0- 99.9
100.0-200.0



SOURCE: NEW ENGLAND TELEPHONE COMPANY DATA.

F. M. DIMOND, M.C.P. THESIS, M. I. T., JANUARY, 1954

To summarize, volume of communication is not a satisfactory criterion for dividing the area into regions because of its bias in favor of the larger exchanges and because it is insufficiently critical in sparsely populated areas.

5.1 TOTAL VOLUME OF COMMUNICATION RELATIVE TO OPPORTUNITY TO COMMUNICATE AS THE INDEX OF COMMUNITY OF INTEREST

The measurement of total volume of communication relative to opportunity to communicate, in order to define the community of interest, is sound from a theoretical point of view. Communication increases as opportunity to communicate increases, although less than in proportion. The bias in favor of the large exchange does not exist under this criterion. In fact, those relationships in areas of minimum opportunity (sparse population) have the relative advantage.

HYPOTHESIS A criterion of total volume of communication relative to opportunity to communicate enables observations to be made which completely and critically divide an area into regions.

An examination of the hypothesis in the light of available knowledge about the variables leads to the expectation that the relationships between the small exchanges are emphasized by the adoption of this criterion, since communication relative to opportunity is greatest where the opportunity is small. Bias in favor of sparsely populated exchanges is just as undesirable as bias in favor of heavily populated exchanges, and this criterion may be disqualified on that ground alone.

The data consists of the volume of calls monthly in thousands divided by the product of population indices in millions which is an index of opportunity. The quotients are derived for each pair of contiguous exchanges in Appendix A. The results are plotted graphically on Map 2.

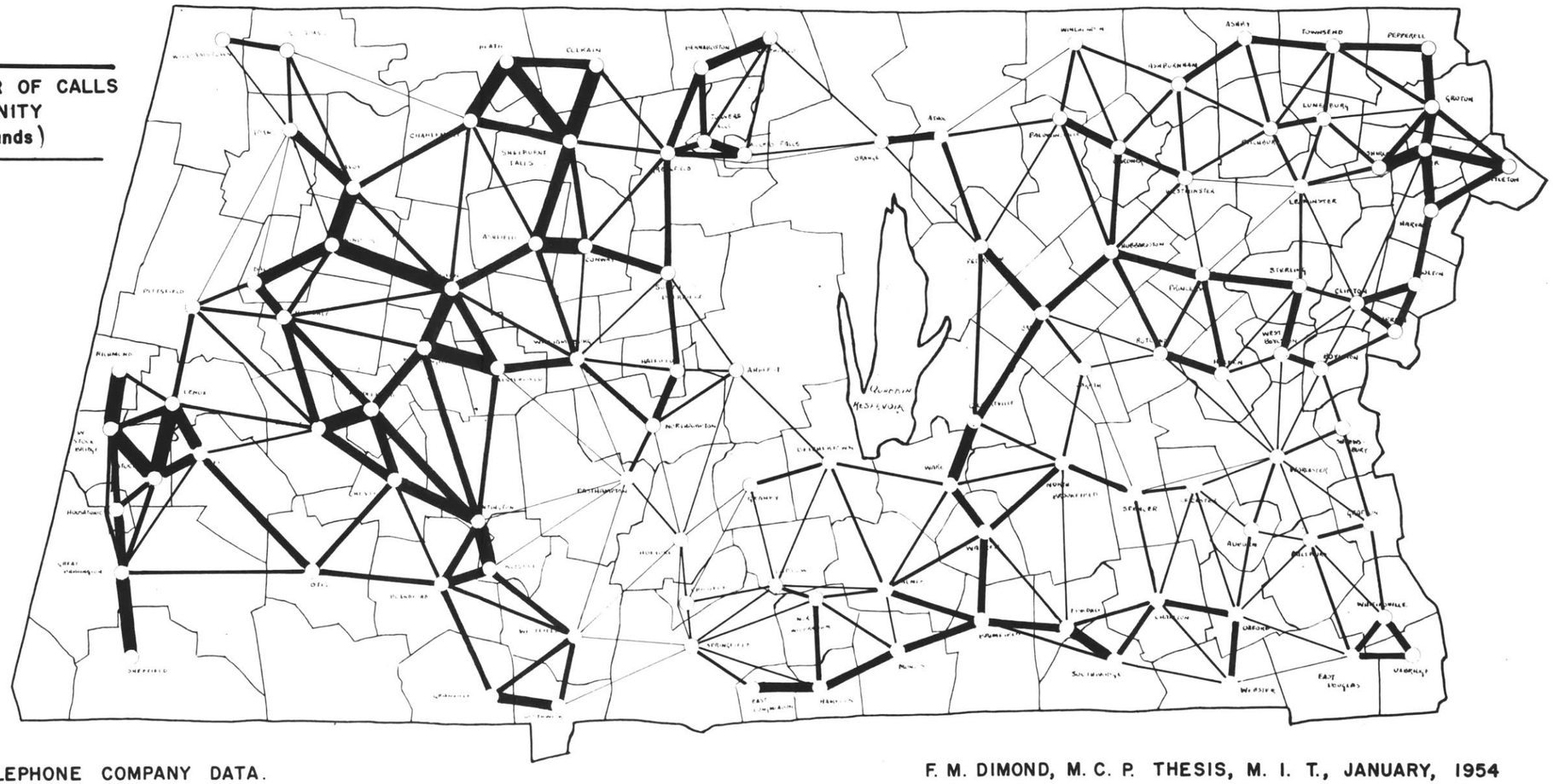
MAP 2

TOTAL VOLUME OF COMMUNICATION RELATIVE TO OPPORTUNITY TO COMMUNICATE, BETWEEN CONTIGUOUS EXCHANGES

WESTERN MASSACHUSETTS

LEGEND

TOTAL NUMBER OF CALLS OPPORTUNITY (1/Thousands)
0.0- 0.2
0.3- 0.5
0.6- 0.9
1.0- 1.5
1.6- 2.4
2.5- 3.6
3.7- 5.0
5.1- 7.0
7.1- 15.0



SOURCE: NEW ENGLAND TELEPHONE COMPANY DATA.

F. M. DIMOND, M. C. P. THESIS, M. I. T., JANUARY, 1954

The graphic results show clearly the difficulty of drawing regional boundaries under this alternative. The sparsely populated centers are like islands. The results are almost the converse of those under the first alternative. In general, the density of communication relative to opportunity is greatest where density of population is least. It may be speculated that as opportunity increases, the level of communication which a person can sustain imposes limits upon the degree to which opportunity can be utilized.

To summarize, volume of communication relative to opportunity is not a satisfactory criterion for dividing the area into regions, because of its bias in favor of the smaller exchanges and because it does not result in coherent groupings of exchanges.

5.2 TOTAL VOLUME OF COMMUNICATION RELATIVE TO POPULATION AS THE INDEX OF COMMUNITY OF INTEREST

The measurement of total volume of communication relative to population in order to define the community of interest represents a reasonable compromise between the previously tested alternatives, in one of which larger exchange relationships were emphasized, and in the other of which small exchange relationships were emphasized.

HYPOTHESIS A criterion of total volume of communication relative to population enables observations to be made which completely and critically divide an area into regions.

There are two values of population for each communication relationship and there is the problem of combining these two values into one value of population. A simple addition results in the distortion shown below in the table.

Standard Opportunity Factor

Relationship of p1 and p2 assuming constant (p1 + p2)	(Assuming p1 + p2 = 200) p1 x p2	Relative Opportunity	Standard Opportunity Factor (Reciprocal of Relative Opportunity)
p1 = p2	10,000	1.00	1.00
p1 = 3p2	7,500	.75	1.3
p1 = 5p2	5,600	.56	1.8
p1 = 7p2	4,400	.44	2.3
p1 = 9p2	3,600	.36	2.8
p1 = 11p2	3,100	.31	3.3
p1 = 15p2	2,300	.23	4.3
p1 = 19p2	1,900	.19	5.3
p1 = 39p2	980	.098	10.3

The formula for the Standard Opportunity Factor may be represented by $0.25\ r + 0.55$ (for all r except $r = 1$) where r is the ratio of p1 to p2. In other words, for a constant population sum, the opportunity decreases as the ratio of the populations increases. A compensating multiplier called the Standard Opportunity Factor, effectively raises the volume in proportion as opportunity would be increased were the populations equal rather than unequal. The distortions of unequal opportunity for an identical sum of two populations may be corrected with this factor.

The data consists of the total volume of communication divided by the sum of the population indices for each pair of contiguous exchanges. The quotients derived are multiplied by the appropriate Standard Opportunity Factor values and the results listed in Appendix A. The results are plotted graphically on Map 3.

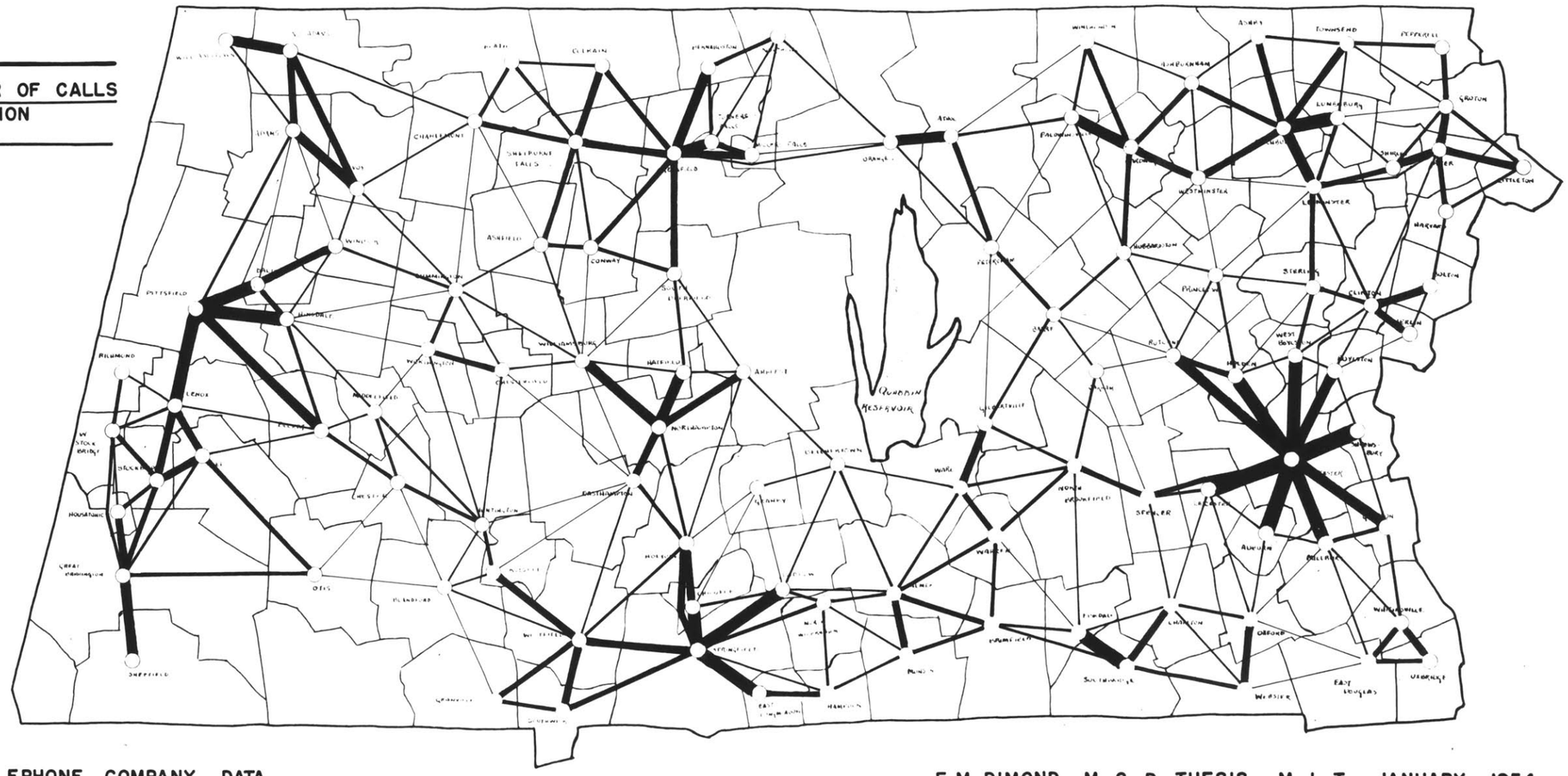
MAP 2

TOTAL VOLUME OF COMMUNICATION RELATIVE TO SIZE OF POPULATION, BETWEEN CONTIGUOUS EXCHANGES

WESTERN MASSACHUSETTS

LEGEND

TOTAL NUMBER OF CALLS / POPULATION	
	0.0– 0.2
	0.3– 0.5
	0.6– 0.9
	1.0– 1.5
	1.6– 2.4
	2.5– 3.6
	3.7– 5.0
	5.1– 7.0
	7.1– 15.0



SOURCE: NEW ENGLAND TELEPHONE COMPANY DATA.

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The results show a clear compromise between the first two alternatives. Concentration around the population centers exists but to a lesser extent than under the first alternative. The sparsely populated areas are emphasized more than under the first alternative and less than under the second. The graphic results appear to be quite critical. Cleavage between closely contiguous urban areas is also much clearer.

To summarize, volume of communication appears to be a satisfactory criterion for dividing the area into regions. It appears possible to draw boundaries quite critically which will divide the entire area into regions.

PART VI

DELINEATION OF REGIONS

6.0 INTRODUCTION OF NON-CONTIGUOUS RELATIONSHIPS

All data presented in Appendix A represent the contiguous relationships between exchanges. The more numerous non-contiguous relationships were omitted with the knowledge that most of them would be negligible by comparison. To complete the picture, however, it is necessary to include non-contiguous relationships, the most important of which are tabulated in Appendix B. The volume of communication relative to population, including the non-contiguous relationships is graphically presented as Map 4.

6.1 ESTABLISHMENT OF PRINCIPAL RELATED GROUPINGS AS REGIONAL CENTERS

The assumption has been made that the region based on the criterion of communication would demonstrate the most dense communication at the center, with gradually diminishing communication toward the periphery. A critical level of communication may be set as the basis for discovering the groupings which will be called regional centers. All those exchanges interrelated at higher than the critical level would compose the central grouping.

If a critical level of 2.5 is selected, the regional central groupings are as shown on Map 5. Heavy black lines distinguish between groupings.

6.2 ASSIGNMENT OF PERIPHERAL AREAS TO APPROPRIATE CENTERS

If the boundary of any regional center is traced, it may be found that many communication relationships are severed by the boundary. It is desirable to minimize the severed relationships and it is assumed that if the sum of the severed relationships is a minimum then the boundary is optimally placed. If, by extending the area of the region

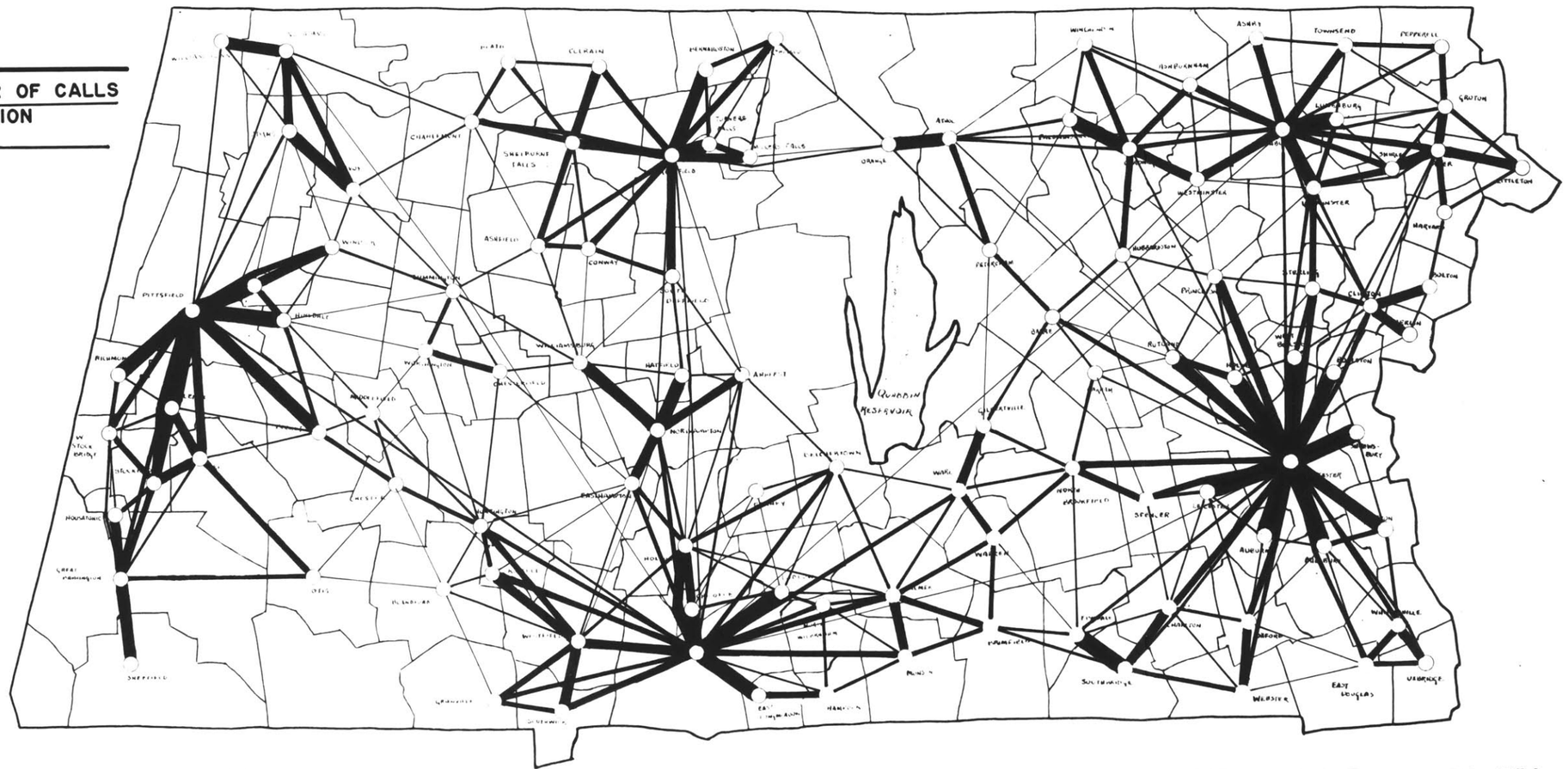
MAP 4

TOTAL VOLUME OF COMMUNICATION RELATIVE TO SIZE OF POPULATION, BETWEEN CONTIGUOUS AND NON-CONTIGUOUS EXCHANGES

WESTERN MASSACHUSETTS

LEGEND

TOTAL NUMBER OF CALLS / POPULATION
0.0- 0.2
0.3- 0.5
0.6- 0.9
1.0- 1.5
1.6- 2.4
2.5- 3.6
3.7- 5.0
5.1- 7.0
7.1- 15.0



SOURCE: NEW ENGLAND TELEPHONE COMPANY DATA.

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beyond the center to include additional exchanges, the sum of the severed relationships can be reduced, then these additional exchanges may be added to the regions. All of the peripheral exchanges are assigned in this manner excepting Barre, Warren, Otis and the group of Worthington, Cummington, and Chesterfield. The assignments of peripheral areas are shown on Map 5.

6.3 DISPOSITION OF REMAINING DOUBTFUL AREAS

Barre, Warren and Otis exchanges are so small in extent that they cannot be left as isolated independent regions, and so a basis of assignment is worked out for them. Barre is assigned to the Worcester Region because of the preponderant relationship with that region, compared with any of the other contiguous regions. Similarly, Warren is assigned to Palmer. Otis, although most strongly connected to the Pittsfield Region, is assigned to the Great Barrington Region. The area south of Otis has its scaling center in Connecticut. Presumably, if the relationship between Otis and that area were included in the study it would swing the preponderance from Pittsfield to Great Barrington.

The group of Worthington, Commington, and Chesterfield, since it exhibits no strong relationship with any of the contiguous regions, may be established as an independent region.

The results of this method of assignment are shown as the heavy line boundaries of Map 5. The results are not inevitable. Other assumptions would result in other sets of regions.

MAP 5

DELINEATION OF REGIONS

WESTERN MASSACHUSETTS

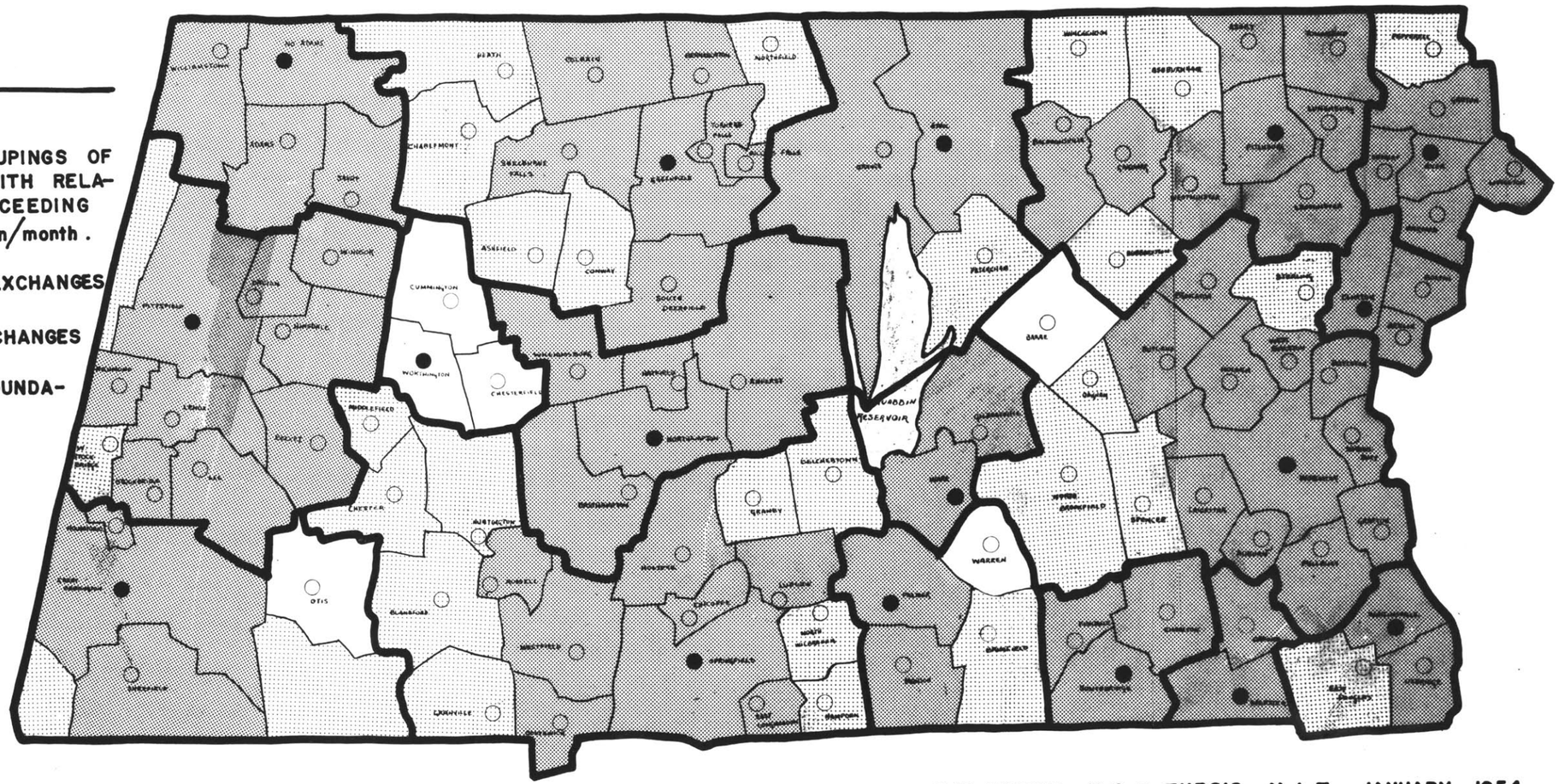
LEGEND

CENTRAL GROUPINGS OF EXCHANGES WITH RELATIONSHIPS EXCEEDING 2.5 calls/person/month.

PERIPHERAL EXCHANGES

DOUBTFUL EXCHANGES

REGIONAL BOUNDARIES



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6.4 THE RESULTING REGIONS

As a result of carrying out the above procedures, seventeen regions are formed as shown on Map 6. There are the further possibilities of dividing the Fitchburg-Gardner Region and the Springfield-Westfield Region into two regions each. Approximately twenty regions is the maximum into which Western Massachusetts can be divided by using these procedures. Adoption of a higher critical level of the criterion results in fewer eligible central groupings. Adoption of a lower level results in coalescence of central groupings and fewer independent units.

On the other hand, if fewer than seventeen regions are desired, it is possible to combine some of them to form fewer and, on the average, larger regions. In doing so, the following objectives should be considered:

1. To combine those regions the boundary between which severs a large sum of relationships.
2. To equalize the extent in area or population of the regions if this is desirable.
3. To consolidate regional areas.

Reductions to eleven and to five regions are indicated on Map 6.

6.5 A REGION COMPOSED OF INTEGRAL POLITICAL JURISDICTIONS

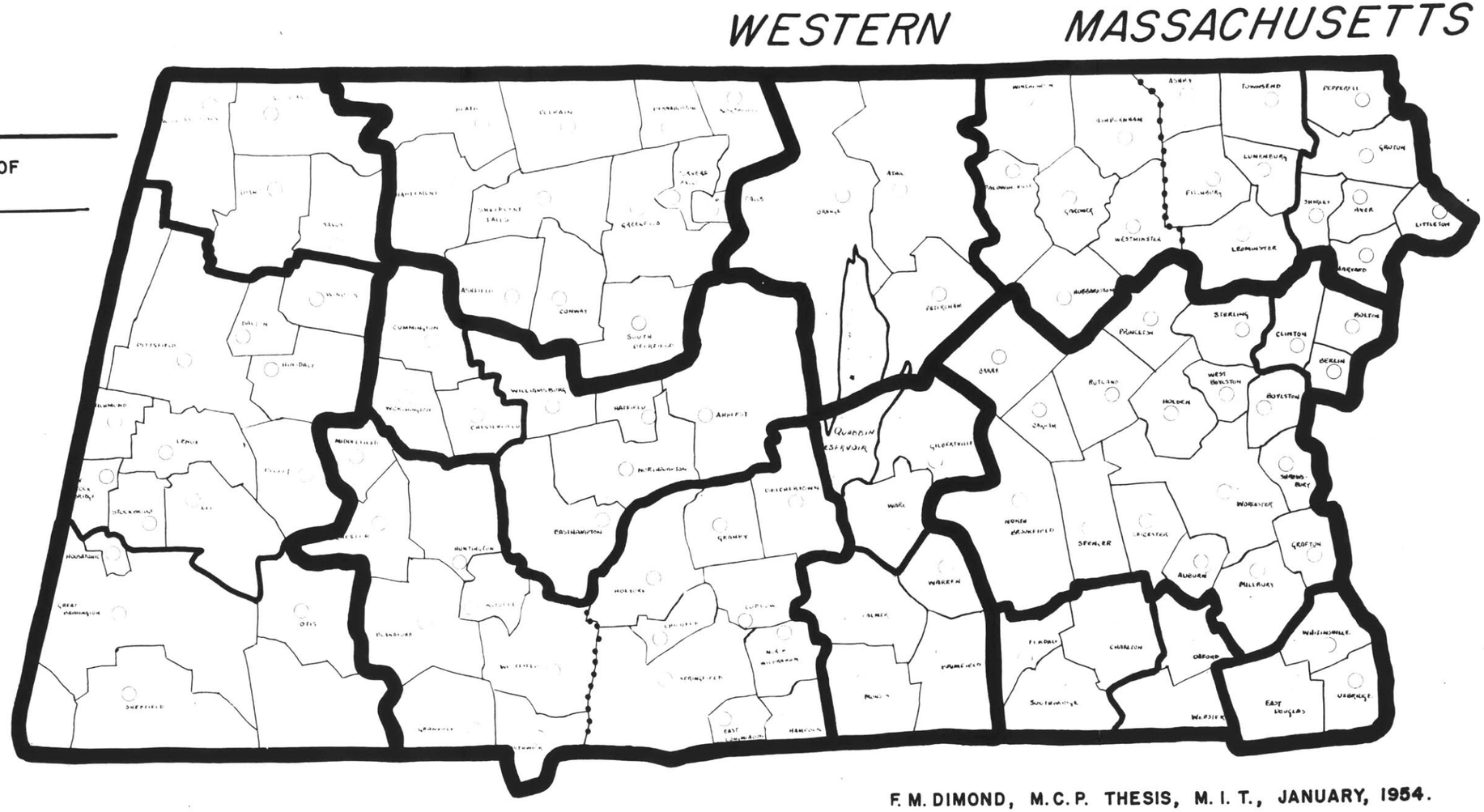
Hitherto, the regions shown have been groupings of telephone exchanges which do not necessarily contain integral communities. Certain relatively minor boundary shifts result in transformation of the seventeen regions into groupings of political jurisdictions. The regions in an alternative final form are shown on Map 7.

MAP

ALTERNATIVE SETS OF REGIONS

LEGEND

	BOUNDARIES OF REGIONS
▬▬	5 REGIONS
▬▬	11 REGIONS
——	17 REGIONS
.....	19 REGIONS



F. M. DIMOND, M.C.P. THESIS, M. I. T., JANUARY, 1954.

MAP 7

REGIONS AS GROUPINGS OF INTEGRAL POLITICAL JURISDICTIONS

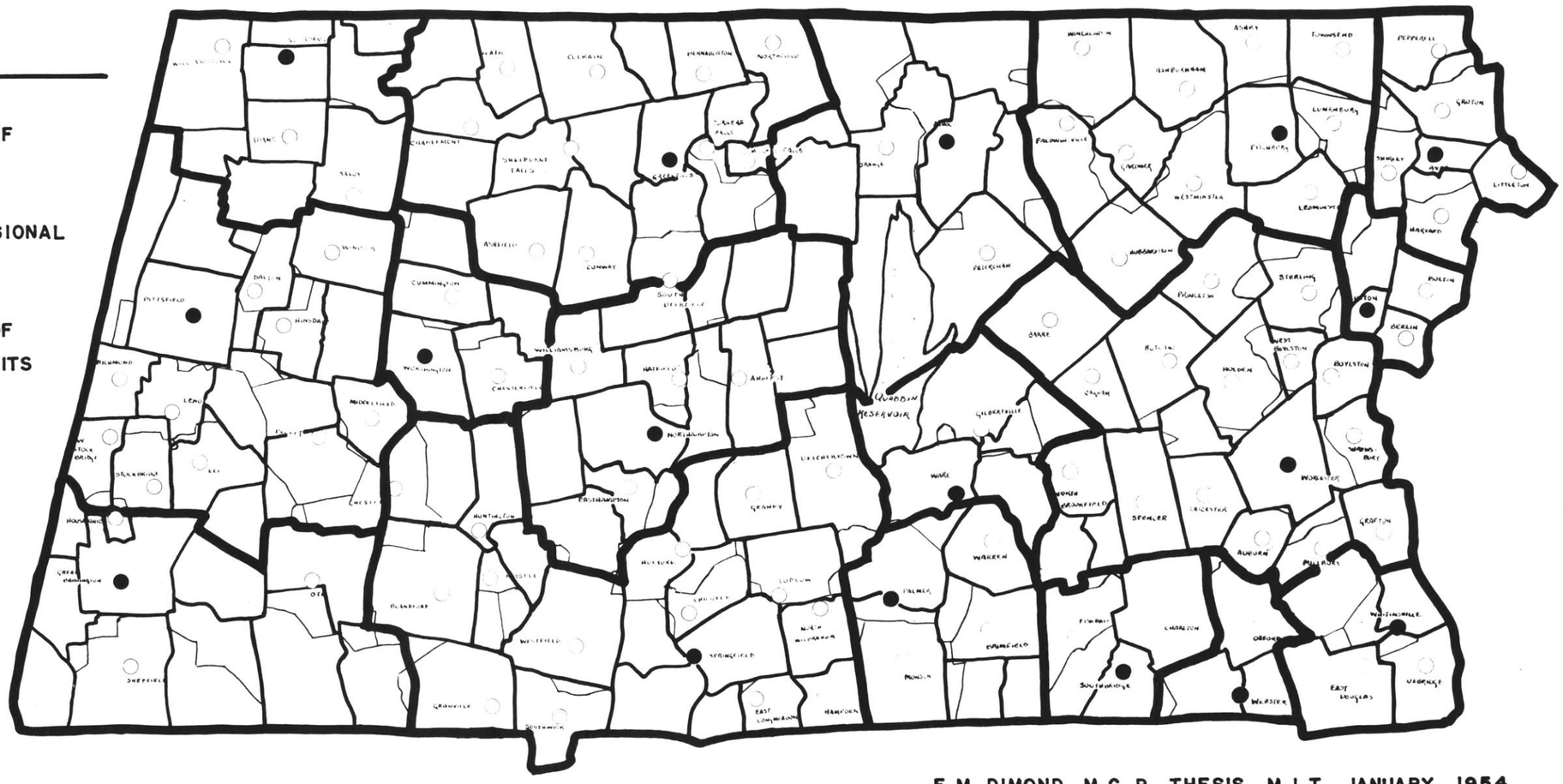
WESTERN MASSACHUSETTS

LEGEND

BOUNDARIES OF 17 REGIONS

LARGEST REGIONAL COMMUNITY

BOUNDARIES OF POLITICAL UNITS



F. M. DIMOND, M. C. P. THESIS, M. I. T., JANUARY, 1954.

6.6 POSSIBLE METHODS FOR CHECKING THE REGIONS DEFINED

The regions mapped by the methods of this study should not be accepted uncritically. There still remains the problem of checking their validity, as the criterion of communication was adopted by reason rather than experience. It is proposed to suggest the methods by which these hypotheses might be checked.

Groupings of communities may be shown to exist in several ways. If the existing regional groupings show a tendency to correspond to those suggested by this study, then the evidence may be counted in support of the defined regions. Otherwise, reason must reject the criterion of communication as established in this study, or at least suggest a modification of hypotheses.

1. Communities may be grouped by an agency to form an administrative subdivision, of convenience for the peculiar purposes of the agency. Such groupings may be made by any organization whether governmental, economic, or social.

2. Communities may be spontaneously self-grouped to perform a service, solve a problem, or use a resource in common. Groupings of this type are probably more reliable as indicating a community of interest since they are not made by an "outside" agency seeking its own convenience.

3. Communities may be observed to be inter-related according to the flow of traffic, in a similar manner to the pattern of communication. Traffic surveys of an origin-and-destination type would probably show groupings of communities among which transportation was maximized

relative to population. Traffic counts would be less useful since they fail to distinguish through traffic from local traffic.

There are undoubtedly other variables that might be measured and applied as tests of the hypotheses presented in this study.

PART VII

CONCLUSIONS

7.0 EVALUATION OF REGIONS DELINEATED

Throughout the study, relatively crude methods have been used. Figures have been ruthlessly rounded off to make the work simpler. Data have been missing in several instances with the necessity of making estimates. Such steps were unavoidable in view of the large area being covered in the limited time available.

A superior method might start with the establishment of a central grouping and showing all communication relationships with that grouping no matter how small the value. The boundary could then be extended until the minimum point of communication is reached. By attempting to delineate a single region, far more careful work could be undertaken with better results.

7.1 THE DIRECTION OF FURTHER RESEARCH

This thesis has been directed toward the establishment of a method for delineating regions rather than toward the establishment of any particular set of regions. It is proposed that a similar method might be used for finding natural population groupings at other levels of the social structure, as for instance the neighborhood level or the national level. There is the further possibility of study over time, to indicate how the patterns of communication change with various developments and population shifts.

A P P E N D I X A

DATA FOR CONTIGUOUS RELATIONSHIPS

Column Headings on Data Sheets for Contiguous Relationships

(1) Relationships Between Contiguous Exchanges

(2) Volume of Communication (Thousands of Calls Monthly)

(3) Distance Between Scaling Centers

(4) Number of Terminals in First Listed Exchange

(5) Number of Terminals in Second Listed Exchange

(6) Product of Numbers of Terminals (4) x (5) (Millions)

(7) Volume of Communication Relative to Opportunity to Communicate (2) ÷ (6) (1/Thousands)

(8) Sum of Numbers of Terminals in Both Listed Exchanges (4) + (5)

(9) Ratio of Numbers of Terminals of Both Listed Exchanges Such that the Ratio is Greater Than One (4) ÷ (5) or (5) ÷ (4)

(10) Standard Opportunity Factor (1/4 (9) + .55)

(11) Volume of Communication Relative to Population (2) x (10) ÷ (8)

(1)		(2)	(3)	(4)	(5)	(6)
ATHOL						
Athol	- Baldwinsville	2	8	3900	910	3.5
	Orange	22	4	3900	2000	8
	Petersham	2	8	3900	240	.9
	Winchendon	1	11	3900	1600	6
Orange	- Petersham	.25	10	2000	240	.5
AYER						
Ayer	- Clinton	1.5	12	1310	4100	5
	Groton	6	3	1310	890	1.2
	Harvard	2	5	1310	380	.5
	Leominster	1.5	9	1310	6700	9
	Littleton	5	5	1310	770	1
	Shirley	5	4	1310	510	.7
Groton	- Littleton	1.5	6	890	770	.7
	Lunenburg	.25	8	890	640	.6
	Pepperell	3.5	4	890	820	.7
	Shirley	1	4	890	510	.5
	Townsend	.75	8	890	790	.7
Harvard	- Littleton	.75	5	380	770	.3
Pepperell	- Townsend	1.5	7	820	790	.6
CLINTON						
Clinton	- Leominster	8	8	4100	6700	27
	Sterling	3	4	4100	580	2.5
	W. Boylston	1.5	6	4100	780	3
Berlin	- Bolton	.25	4	300	250	.1
	Boylston	.1	5	300	430	.1
	Clinton	2.5	4	300	4100	1.2
Bolton	- Clinton	3	4	250	4100	1
	Harvard	.5	5	250	770	.2
Sterling	- W. Boylston	1.5	6	580	780	.5
FITCHBURG						
Fitchburg	- Leominster	100	5	12,400	6700	83
	Lunenburg	17	4	12,400	640	8
	Townsend	9	8	12,400	790	10
	Westminster	7	7	12,400	660	8
Ashby	- Fitchburg	6	7	380	12,400	5
	Townsend	.75	6	380	790	.3
Leominster	- Lunenburg	2.5	6	6,700	640	4
	Princeton	.25	8	6,700	310	2
	Shirley	4	6	6,700	510	3.5
	Sterling	3.5	6	6,700	580	4

(7)	(8)	(9)	(10)	(11)
.6	5	4	1.55	.6
2.8	6	2	1.05	4
2.2	4	16	4.55	2.3
.2	6	2	1.05	.2
.5	2	8	2.55	.3
.3	5	3	1.3	.4
5	2	1	1	3
4	1.5	3	1.3	1.7
.2	8	5	1.8	.3
5	2	2	1.05	2.6
7	2	3	1.3	3.2
2.1	1.5	1	1	1.0
.4	1.5	1	1	.2
5	1.5	1	1	2.3
2	1.5	2	1.05	.7
1.1	1.5	1	1	.5
2.5	1.0	2	1.05	.8
2.5	1.5	1	1	1.0
.3	10	2	1.05	.8
1.2	5	7	2.3	1.4
.5	5	5	1.8	.5
2.5	.5	1	1	.5
1	.75	1	1	.1
2.1	4	14	4.05	2.5
3	4	16	4.55	3.4
2.5	1	3	1.3	.7
3	1.5	1	1	1.0
1.2	20	2	1.05	5
2.1	15	19	5.3	6
.9	15	16	4.55	2.7
.9	15	19	5.3	2.5
1.2	15	33	8.8	3.5
2.5	1	2	1.05	.8
.6	7	10	3.05	1.1
.1	7	22	6.05	.2
1.1	7	13	3.8	2.2
.9	7	12	3.55	1.8

(1)		(2)	(3)	(4)	(5)	(6)
Leominster-	Westminster	.5	9	6700	660	4
Lunenburg -	Shirley	.5	5	640	510	.4
	Townsend	.75	5	640	790	.5
GARDNER						
Gardner -	Hubbardston	2.5	7	5600	250	1.4
	Westminster	6	5	5600	660	3.5
	Winchendon	8	8	5600	1600	9
Ashburnham-	Ashby	.5	6	750	380	.3
	Fitchburg	7	7	750	12,400	9
	Gardner	6	6	750	5600	4
	Westminster	.75	7	750	660	.5
	Winchendon	1	8	750	1600	1.2
Baldwinsville-	Gardner	14	6	910	5600	5
	Hubbardston	.25	10	910	250	.2
	Petersham	.1	10	910	240	.2
	Winchendon	2	6	910	1600	1.5
Hubbardston-	Princeton	.25	7	250	310	.1
	Rutland	.25	8	250	540	.15
	Westminster	.1	7	250	660	.15
GREAT BARRINGTON						
Gt.Barrington-	Housatonic	6	5	2500	510	1.3
	Lee	3	10	2500	1500	4
	Otis	.75	14	2500	190	.5
	Sheffield	11	6	2500	750	1.9
	Stockbridge	4	7	2500	700	1.8
	W.Stockbridge	1	9	2500	270	.7
Housatonic -	Stockbridge	1	3	510	700	.4
	W.Stockbridge	.25	5	510	270	.15
GREENFIELD						
Greenfield -	Millers Falls	5	6	6600	420	3
	Orange	3	15	6600	2000	13
	Shelburne Falls	10	8	6600	1200	8
	So. Deerfield	11	7	6600	970	6
	Turners Falls	23	3	6600	1500	10
Ashfield -	Charlemont	.1	9	260	330	.1
	Conway	.75	6	260	200	.05
	Cummington	.25	8	260	280	.05
	Shelburne Fall	2	7	260	1200	.3
	Williamsburg	.25	9	260	650	.15
Bernardston -	Greenfield	6	6	310	6600	2

(7)	(8)	(9)	(10)	(11)
.1	7	10	3.05	.2
1.3	1.0	1	1	.5
1.5	1.5	1	1	.5
1.8	6	20	5.55	2.3
1.7	6	8	2.55	2.6
.9	7	4	1.55	1.8
1.7	1.0	2	1.05	.5
.8	15	15	4.3	2.0
1.5	6	7	2.3	2.3
1.5	1.5	1	1	.5
.8	2.5	2	1.05	.4
2.8	7	6	2.05	4
1.3	1.0	4	1.55	.4
.5	1.0	4	1.55	.2
1.3	2.5	2	1.05	.8
2.5	.5	1	1	.5
1.7	.75	2	1.05	.4
.7	1.0	3	1.3	.1
5	3	5	1.8	3.5
.8	4	2	1.05	.8
1.5	2.5	15	4.3	1.3
6	3.5	3	1.3	4
2.2	3	4	1.55	2.1
1.4	3	9	2.8	.9
2.5	1.0	1	1	1.0
1.7	1.0	2	1.05	.3
1.7	7	15	4.3	3.1
.2	9	3	1.3	.4
1.3	8	6	2.05	2.6
1.8	8	7	2.3	3.2
2.3	8	4	1.55	4
1.	.5	1	1	.2
15	.5	1	1	1.5
5	.5	1	1	.5
7	1.5	5	1.8	2.4
1.7	1.0	3	1.3	.3
3	7	20	5.55	5

(1)		(2)	(3)	(4)	(5)	(6)
Bernardston	- Northfield	1	6	310	730	.25
	Turners Falls	1	5	310	1500	.5
Charlemont	- Cummington	.1	12	330	280	.1
	Heath	.5	5	330	100	.05
	No. Adams	.5	13	330	7000	2.5
	Savoy	.1	9	330	100	.05
	Shelburne Falls	2	8	330	1200	.4
Colrain	- Greenfield	2.5	8	350	6600	2.5
	Heath	.25	6	350	100	.05
	Shelburne Falls	3.5	5	350	1200	.4
Conway	- Greenfield	1.5	8	200	6600	1.3
	Shelburne Falls	.5	7	200	1200	.25
	So. Deerfield	.75	5	200	970	.2
	Williamsburg	.1	8	200	650	.15
Heath	- Shelburne Falls	.75	7	100	1200	.1
Millers Falls	- Northfield	.25	9	420	730	.3
	Orange	.25	10	420	2000	.8
	Turners Falls	2.5	4	420	1500	.6
Northfield	- Orange	.5	11	730	2000	1.5
	Turners Falls	.75	9	730	1500	1.1
So.Deerfield	- Williamsburg	.25	10	970	650	.6

NORTH ADAMS

North Adams	- Savoy	1	7	7000	100	.7
	Williamstown	27	5	7000	1800	13
Adams	- Dalton	.75	11	3700	1400	5
	No. Adams	33	5	3700	7000	26
	Pittsfield	9	15	3700	16,000	60
	Savoy	2	4	3700	100	.4
	Williamstown	2.5	8	3700	1800	7
	Windsor	.1	9	3700	110	.4
Savoy	- Windsor	.1	7	100	110	.01

NORTHAMPTON

Northampton	- Williamsburg	10	8	7600	650	5
Amherst	- Belchertown	.75	9	3000	550	1.7
	Hatfield	.5	5	3000	500	1.5
	Holyoke	5	13	3000	20,000	60
	Northampton	21	7	3000	7600	23
	So.Deerfield	1.5	9	3000	970	3
Chesterfield	- Cummington	.25	7	150	280	.05
	Easthampton	.1	12	150	3200	.5
	Huntington	.1	11	150	460	.05
	Williamsburg	.25	5	150	650	.1

(7)	(8)	(9)	(10)	(11)
4	1	2	1.05	1.1
2	2	5	1.8	.9
1	.5	1	1	.2
10	.5	3	1.3	1.3
.2	7	20	5.55	.4
2	.5	3	1.3	.3
5	1.5	4	1.55	2.0
1	7	20	5.55	2.0
5	.5	4	1.55	.8
9	1.5	3	1.3	3.0
1.2	7	35	9.3	2.0
2	1.5	6	2.05	.7
4	1.0	5	1.8	1.4
.7	.75	3	1.3	.2
8	1.5	10	3.05	1.5
.8	1.0	2	1.05	.3
.3	2.5	5	1.8	.2
4	2.0	4	1.55	1.9
.3	2.5	3	1.3	.3
.7	2.0	2	1.05	.4
.4	1.5	1	1	.2
1.4	7	70	18.05	2.6
2.1	9	4	1.55	5
.2	5	3	1.3	.2
1.3	10	2	1.05	3.5
.2	20	4	1.55	.7
5	4	35	9.3	5
.4	6	2	1.05	.4
.3	4	35	9.3	.2
10	.25	1	1	.4
2	8	10	3.05	4
.4	3.5	5	1.8	.4
.3	3.5	6	2.05	.3
.1	25	7	2.3	.5
.9	10	3	1.3	2.7
.5	4	3	1.3	.5
5	.5	2	1.05	.5
.2	3.5	20	5.55	.2
2	.5	3	1.3	.3
2.5	.75	4	1.55	.5

	(1)	(2)	(3)	(4)	(5)	(6)
Chesterfield	- Worthington	.5	5	150	200	.05
Easthampton	- Holyoke	16	6	3200	20,000	64
	Huntington	.25	11	3200	460	1.5
	Northampton	29	4	3200	7600	24
	Russell	.1	11	3200	220	.7
	Williamsburg	.5	10	3200	650	2.1
	Westfield	4	11	3200	6300	20
Hatfield	- Northampton	10	4	500	7600	4
	So. Deerfield	1	8	500	970	.5
	Williamsburg	.25	8	500	650	.3

PITTSFIELD

Becket	- Chester	.5	7	240	330	.1
	Hinsdale	.5	8	240	380	.1
	Lee	.25	9	240	1500	.4
	Lenox	.25	11	240	930	.2
	Middlefield	.1	5	240	90	.01
	Pittsfield	4	12	240	16,000	4
Chester	- Huntington	1	6	330	460	.15
	Middlefield	.25	6	330	90	.05
	Otis	.1	9	330	190	.05
Cummington	- Hinsdale	.1	12	280	380	.1
	Savoy	.1	10	280	100	.05
	Williamsburg	.25	10	280	650	.2
	Windsor	.25	9	280	110	.03
	Worthington	.5	5	280	200	.05
Dalton	- Hinsdale	2.5	3	1400	380	.5
	Pittsfield	31	6	1400	16,000	22
	Windsor	1	6	1400	110	.15
Hindsdale	- Middlefield	.1	9	380	90	.03
	Pittsfield	8	7	380	16,000	6
	Windsor	.1	6	380	110	.05
	Worthington	.1	11	380	200	.1
Lee	- Lenox	8	5	1500	930	1.4
	Otis	1	11	1500	190	.3
	Stockbridge	6	5	1500	700	1.1
Lenox	- Pittsfield	24	7	930	16,000	15
	Richmond	.25	5	930	200	.2
	Stockbridge	5	6	930	700	.7
	W.Stockbridge	.5	5	930	270	.25
Middlefield	- Worthington	.05	5	90	200	.01
Richmond	- W.Stockbridge	.75	4	200	270	.05
Stockbridge	- W.Stockbridge	1.5	4	700	270	.2

(7)	(8)	(9)	(10)	(11)
10	.25	1	1	2
.3	25	6	2.05	1.3
.2	3.5	7	2.3	.2
1.2	10	2	1.05	3
.1	3.5	15	4.3	.1
.2	4	5	1.8	.2
.2	10	2	1.05	.4
2.5	8	15	4.3	5
2.	1.5	2	1.05	.7
.8	1	1	1	.3
5	.5	1	1	1
5	.5	2	1.05	1.1
.6	1.5	6	2.05	.3
1.3	1	4	1.55	.4
10	.25	3	1.3	.5
1	15	70	18.05	5
7	.75	1	1	1.3
5	.5	4	1.55	.8
2	.5	2	1.05	.2
1	.75	1	1	.1
2	.5	3	1.3	.3
1.3	1	2	1.05	.3
8	.5	3	1.3	.7
10	.5	1	1	1
5	2	4	1.55	1.9
1.4	15	10	3.05	6
7	1.5	15	4.3	2.9
3	.5	4	1.55	.3
1.3	15	40	10.55	6
2	.5	3	1.3	.3
1	.5	2	1.05	.2
6	2.5	2	1.05	3.4
3.3	1.5	8	2.55	1.7
5	2.0	2	1.05	3.2
1.6	15	15	4.3	7
1.3	1	5	1.8	.5
7	1.5	1	1	3.3
2	1	3	1.3	.7
5	.25	2	1.05	.2
15	.5	1	1	1.5
8.	1	3	1.3	2.0

(1)		(2)	(3)	(4)	(5)	(6)
SPRINGFIELD						
Springfield	- Westfield	75	8	59,000	6300	370
Belchertown	- Granby	.25	6	550	450	.25
	Ludlow	.5	10	550	2000	1.1
	Palmer	1	10	550	2600	1.4
	Ware	.75	9	550	1800	1.0
Blandford	- Chester	.1	7	280	330	.1
	Granville	.1	9	280	240	.05
	Huntington	.25	5	280	460	.1
	Otis	.1	9	280	190	.05
	Russell	.25	5	280	220	.05
	Westfield	2	10	280	6300	1.8
Brimfield	- Fiskdale	.75	5	470	600	.3
	Monson	1.5	7	470	1000	.5
	Palmer	2.5	7	470	2600	1.2
	Southbridge	1.5	9	470	5300	2.5
	Warren	1	6	470	700	.3
Chicopee	- Granby	.25	6	6900	450	3
	Holyoke	62	5	6900	20,000	140
	Ludlow	4	6	6900	2000	14
	Springfield	173	3	6900	59,000	400
Granby	- Holyoke	.25	6	450	20,000	9
	Ludlow	.25	8	450	2000	.9
Granville	- Southwick	.75	4	240	870	.2
	Westfield	2.5	8	240	6300	1.5
Hampden	- E. Longmeadow	1.5	6	330	1200	.4
	Monson	.75	6	330	1000	.3
	No.Wilbraham	.75	6	330	1200	.4
	Springfield	5	10	330	59,000	20
Holyoke	- Northampton	20	9	20,000	7600	150
	Springfield	160	7	20,000	59,000	1200
	Westfield	13	8	20,000	6300	125
Huntington	- Middlefield	.25	11	460	90	.05
	Russell	1	4	460	220	.1
	Worthington	.25	12	460	200	.1
Ludlow	- No. Wilbraham	2.5	4	2000	1200	2.4
	Palmer	2.5	8	2000	2600	5
	Springfield	42	7	2000	59,000	120
Monson	- No. Wilbraham	.75	6	1000	1200	1.2
	Palmer	9	4	1000	2600	2.6
No.Wilbraham	- Palmer	2.5	4	1200	2600	3
	Springfield	20	10	1200	59,000	70
Palmer	- Ware	3.5	9	2600	1800	5
	Warren	2.5	9	2600	700	1.8
Russell	- Westfield	2.5	7	220	6300	1.4
Southwick	- Springfield	8	10	870	59,000	51
	Westfield	11	6	870	6300	5

(7)	(8)	(9)	(10)	(11)
.2	65	10	3.05	3.5
1.	1	1	1	.3
.5	2.5	4	1.55	.3
.7	3	5	1.8	.6
.8	2.5	3	1.3	.4
1	.5	1	1	.2
2	.5	1	1	.2
2.5	.75	2	1.05	.4
2	.5	1	1	.2
5	.5	1	1	.5
1.1	25	25	6.8	.5
2.5	1	1	1	.8
3	1.5	2	1.05	1.1
2.1	3	6	2.05	1.7
.6	6	11	3.3	.8
3.3	1	1	1	1
.1	7	15	4.3	.2
.4	25	3	1.3	3.2
.3	9	3	1.3	.6
.4	65	9	2.8	7
.05	20	45	11.8	.2
.3	2.5	4	1.55	.2
4	1	4	1.55	1.2
1.7	7	25	6.8	2.4
4	1.5	4	1.55	1.6
2.5	1.5	3	1.3	.7
1.9	1.5	4	1.55	.8
.3	60	20	5.55	.5
.1	30	3	1.3	.9
.1	80	3	1.3	2.6
.1	25	3	1.3	.7
5	.5	5	1.8	.9
10	.75	2	1.05	1.4
2.5	.75	2	1.05	.4
1	3	2	1.05	.9
.5	5	1	1	.5
.4	60	30	8.05	6
.6	2	1	1	.4
.3	3.5	3	1.3	3.4
.8	4	2	1.05	.7
.3	60	50	13.05	1
.7	4	1	1	.9
1.4	3.5	4	1.55	1.1
1.8	7	30	8.05	2.9
.2	60	70	18.05	2.4
2.2	7	7	2.3	3.6

(1)		(2)	(3)	(4)	(5)	(6)
WARE						
Ware	- Warren	4	5	1800	700	1.3
Gilbertville	-No. Brookfield	1	7	520	2200	1.1
	Petersham	.1	12	520	240	.1
	Ware	6	5	520	1800	.9
WORCESTER						
Auburn	- Millbury	2	4	1900	2100	4
	Leicester	1.5	6	1900	1500	2.9
	Oxford	1.5	6	1900	1320	2.5
	Worcester	63	6	1900	58,000	110
Barre	- Gilbertville	1	9	850	520	.4
	Hubbardston	.5	6	850	250	.2
	Oakham	.5	6	850	500	.4
	Petersham	1	6	850	240	.2
	Rutland	.25	9	850	540	.5
Boylston	- Clinton	.75	6	430	4100	1.8
	Shrewsbury	.5	4	430	1550	.7
	W. Boylston	.5	3	430	780	.3
	Worcester	8	7	430	58,000	25
Charlton	- Fiskdale	.5	8	670	600	.4
	Leicester	.5	9	670	1500	1
	Oxford	1.5	6	670	1320	.9
	Southbridge	7	6	670	5300	3.5
	Spencer	.75	8	670	2000	1.3
	Webster	.75	8	670	4700	3
E. Douglas	- Millbury	1	9	730	2100	1.5
	Oxford	.25	9	730	1320	1
	Uxbridge	2	5	730	1300	.9
	Webster	.5	9	730	4700	3.5
	Whitinsville	4	4	730	2600	1.9
Fiskdale	- No. Brookfield	.5	11	600	2200	1.3
	Southbridge	13	5	600	5300	3.2
	Warren	.25	8	600	700	.4
Grafton	- Millbury	5	4	1600	2100	3.5
	Shrewsbury	1.5	6	1600	1550	2.5
	Whitinsville	3	7	1600	2600	4
	Worcester	30	7	1600	58,000	90
Holden	- Princeton	1	7	1500	310	.5
	Rutland	2.5	5	1500	540	.8
	Sterling	.25	9	1500	580	.9
	W. Boylston	1	5	1500	780	1.2
	Worcester	30	7	1500	58,000	90
Leicester	- Oxford	1	10	1500	1320	2
	Spencer	2.5	5	1500	2000	3
	Worcester	44	6	1500	58,000	90

(7)	(8)	(9)	(10)	(11)
3.1	2.5	3	1.3	2.1
.9	2.5	4	1.55	.6
1	.75	2	1.05	.1
7	2.5	3	1.3	3.1
.5	4	1	1	.5
.5	3.5	1	1	.4
.6	3	1	1	.5
.6	60	30	8.05	8.5
2.5	1.5	2	1.05	.7
2.5	1	3	1.3	.7
1.3	1.5	2	1.05	.4
5	1	3	1.3	1.3
.5	1.5	2	1.05	.2
.4	5	10	3.05	.5
.7	2	4	1.55	.4
1.7	1	2	1.05	.5
.3	60	130	33.05	4.5
1.3	1.5	1	1	.3
.5	2	2	1.05	.3
1.7	2	2	1.05	.8
2	6	8	2.55	3.0
.6	2.5	3	1.3	.4
.3	5	7	2.3	.4
.7	3	3	1.3	.4
.3	2	2	1.05	.1
2.2	2	2	1.05	1.1
.1	5	6	2.05	.2
2.1	3.5	4	1.55	1.8
.4	3	4	1.55	.3
4	6	9	2.8	6
.6	1.5	1	1	.2
1.4	3.5	1	1	1.4
.6	3	1	1	.5
.8	4	2	1.05	.8
.3	60	35	9.3	4.7
2	2	5	1.8	.9
3.1	2	3	1.3	1.6
.3	2	3	1.3	.2
.8	2.5	2	1.05	.4
.3	60	40	10.55	5.5
.5	3	1	1	.3
.8	3.5	1	1	.7
.5	60	40	10.55	7.5

(1)		(2)	(3)	(4)	(5)	(6)
Millbury	- Oxford	.75	8	2100	1320	2.8
	Whitinsville	2.5	8	2100	2600	5
	Worcester	44	6	2100	58,000	120
No.Brookfield	- Oakham	1	7	2200	500	1.1
	Spencer	7	5	2200	2000	4
	Ware	2.5	9	2200	1800	4
	Warren	3.5	7	2200	700	1.5
Oakham	- Rutland	.1	5	500	540	.3
	Spencer	.1	9	500	2000	1
Oxford	- Webster	11	5	1320	4700	6
Princeton	- Rutland	.25	7	310	540	.2
	Sterling	.5	6	310	580	.2
	Westminster	.1	7	310	660	.2
Rutland	- Worcester	8	12	540	58,000	31
Shrewsbury	- Worcester	51	5	1550	58,000	90
Southbridge	- Webster	11	9	5300	4700	25
Spencer	- Worcester	15	10	2000	58,000	115
W. Boylston	- Worcester	19	8	780	58,000	45
Whitinsville	- Uxbridge	10	3	2600	1300	3.5

(7)	(8)	(9)	(10)	(11)
.3	3.5	2	1.05	.2
.5	5	1	1	.5
.4	60	30	8.05	6
.9	2.5	4	1.55	.6
1.8	4	1	1	1.8
.6	4	1	1	.6
2.3	3	3	1.3	1.5
.3	1	1	1	.1
.1	2.5	4	1.55	.1
1.8	6	4	1.55	2.8
1.3	.75	2	1.05	.4
2.5	1	2	1.05	.5
.5	1	2	1.05	.1
.3	60	110	28.05	3.8
.6	60	35	9.3	8
.4	10	1	1	1.1
.1	60	30	8.05	2
.4	60	75	19.3	6
2.9	4	2	1.05	2.7

APPENDIX B

DATA FOR NON-CONTIGUOUS RELATIONSHIPS

COLUMN HEADINGS ON DATA SHEETS FOR NON-CONTIGUOUS RELATIONSHIPS

(1) Relationships Between Non-Contiguous Exchanges

(2) Volume of Communication (1/2 Calls Daily)

(3) Volume of Communication (Thousands of Calls Monthly)

(4) Number of Terminals in First Listed Exchange

(5) Number of Terminals in Second Listed Exchange

(6) Sum of Numbers of Terminals in Both Listed Exchanges (4) + (5)

(7) Ratio of Numbers of Terminals of Both Listed Exchanges Such That the Ratio is Greater Than One. (4) ÷ (5) or (5) ÷ (4)

(8) Standard Opportunity Factor (1/4 (7) + .55)

(9) Volume of Communication Relative to Population (2) x (8) ÷ (6)

(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Athol	- Fitchburg	47	2.8	3900	12,400	16	4	1.55	.3
	Gardner	127	7.6	3900	5,600	10	1	1	.8
	Worcester	58	3.6	3900	58,000	65	15	4.3	.2
Ayer	- Fitchburg	175	10.5	1310	12,400	14	9	2.8	2.1
	Worcester	38	2.3	1310	58,000	60	45	11.8	.5
Clinton	- Fitchburg	152	9.1	4100	12,400	17	3	1.3	.7
	Worcester	347	21.0	4100	58,000	65	14	4.05	1.3
Fitchburg	- Gardner	291	17.4	12,400	5,600	18	2	1.05	1.0
	Groton	42	2.5	12,400	890	13	14	4.05	.8
	Pepperell	39	2.3	12,400	820	13	15	4.3	.8
	Shirley	62	3.7	12,400	510	13	25	6.8	1.9
	Springfield	61	3.6	12,400	59,000	70	5	1.8	.1
	Winchendon	58	3.5	12,400	1,600	14	8	2.55	.6
	Worcester	365	22.0	12,400	58,000	70	5	1.8	.6
Gardner	- Worcester	146	9.0	5,600	58,000	65	10	3.05	.4
Great Barrington	- Pittsfield	189	11.4	2,500	16,000	19	6	2.05	1.2
Greenfield	- Amherst	37	2.2	6,600	3,000	10	2	1.05	.2
	Ashfield	16	1.0	6,600	260	7	25	6.8	1.0
	Charlemont	24	1.4	6,600	330	7	20	5.55	1.1
	Holyoke	40	2.4	6,600	20,000	25	3	1.3	.1
	Northampton	70	4.2	6,600	7,600	14	1	1	.3
	Northfield	86	5.2	6,600	730	7	9	2.8	2.1
	Springfield	203	12.2	6,600	59,000	65	9	2.8	.5
North Adams	- Pittsfield	210	12.6	7,000	16,000	25	2	1.05	.5
	Springfield	54	3.2	7,000	59,000	65	8	2.55	.1
Northampton	- Springfield	470	28.2	7,600	59,000	65	8	2.55	1.1
	Westfield	40	2.4	7,600	6,300	14	1	1	.2
Pittsfield	- Lee	270	16.2	16,000	1,500	18	11	3.3	3.0
	Richmond	81	4.9	16,000	200	16	80	20.55	6.3
	Springfield	204	12.2	16,000	59,000	75	4	1.55	.3
	Stockbridge	130	7.8	16,000	700	17	25	6.8	3.1

(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Pittsfield	- West Stockbridge	41	2.4	16,000	270	16	60	15.55	2.3
	Williamstown	56	3.3	16,000	1,800	18	9	2.8	.5
	Windsor	14	.8	16,000	110	16	150	38.05	1.9
Springfield	- Amherst	107	6.4	59,000	3,000	60	20	5.55	.6
	Belchertown	55	3.3	59,000	550	60	110	28.05	1.5
	Easthampton	190	11.4	59,000	3,000	60	18	5.05	1.0
	Granville	17	1.0	59,000	240	60	250	63.05	1.1
	Huntington	35	2.0	59,000	460	60	130	33.05	1.1
	Monson	112	6.7	59,000	1,000	60	60	15.55	1.7
	Palmer	345	21.0	59,000	2,600	60	25	6.8	2.4
	Russell	30	1.8	59,000	220	60	270	68.05	2.3
	Ware	112	6.7	59,000	1,800	60	35	9.3	1.0
	Worcester	352	21.0	59,000	58,000	120	1	1	.2
Holyoke	- Belchertown	43	2.6	20,000	550	20	35	9.3	1.2
	Ludlow	42	2.5	20,000	2,000	20	10	3.05	.4
	Palmer	43	2.6	20,000	2,600	25	8	2.55	.3
Westfield	- Huntington	45	2.7	6,300	460	7	14	4.05	1.6
Worcester	- Barre	76	4.5	58,000	850	60	70	18.05	1.4
	Charlton	77	4.5	58,000	670	60	85	21.8	1.6
	E. Douglas	64	3.8	58,000	730	60	80	20.55	1.3
	Fiskdale	30	1.8	58,000	600	60	100	25.55	.8
	Leominster	217	13.0	58,000	6,700	65	9	2.8	.6
	Oakham	14	.8	58,000	500	60	115	29.3	.4
	Oxford	203	12.0	58,000	1,320	60	45	11.8	2.4
	N.Brookfield	267	16.0	58,000	2,200	60	25	6.8	1.8
	Princeton	66	4.0	58,000	310	60	190	48.05	3.2
	Southeridge	273	16.2	58,000	5,300	65	11	3.3	.8
	Sterling	91	5.4	58,000	580	60	100	25.55	2.3
	Uxbridge	73	4.5	58,000	1,300	60	35	9.3	.7
	Webster	323	19.5	58,000	4,700	65	12	3.55	1.1
	Whitinsville	222	13.2	58,000	2,600	60	22	6.05	1.3

APPENDIX C

COMMUNICATION AND THE SOCIAL ORGANISM

C.0 A HYPOTHETICAL EVOLUTION OF COMMUNICATION

In its broadest sense, communication assumes the existence of at least two sentient beings. It is true that one sentient being may receive stimuli from non-sentient sources, but such a phenomenon cannot be classified as communication. A person may feel the coldness of snow, but there is no way to communicate the feeling to the inert snow.

There can be no proof that communication has occurred unless there are both stimulus and response. Two sentient beings are required to establish the fact that stimulus and response have occurred. One sentient being may provide a stimulus to another, but will have communicated only if there is an observable event in the behavior of the latter, by which the former knows that his message has been understood. In other words, feedback is a necessary condition for communication.

The environment of any being is essentially composed of an enormous number of stimuli from sentient and non-sentient sources. It is possible for a sentient being to respond to some of these stimuli, but this is not possible for the non-sentient being. Certain theories of evolution are based upon the hypothesis that life on Earth has developed out of an environment in which there was no life. Communication would therefore have been impossible at a time when only non-sentient beings existed, although there were many stimuli in the environment of each non-sentient being. Gradually, states one theory, life arose from non-life. Sentient beings developed from non-sentient beings. Alternatively, God created the animals and the vegetation.

Evidently, sentient beings, capable of responding to various stimuli of their environment possessed a survival advantage over non-sentient beings. This is not to say that non-sentient beings have died, but

rather they have been relatively consumed in the creation of sentient beings. Sentient beings have multiplied through their ability to respond to their environments and to render a statistically increasingly superior performance. This is a hypothesis.

Without being much concerned about the "Creation", one may state the hypothesis that the development of communication between sentient beings possessed survival value. Sentient beings able to communicate might be termed social beings, by their peculiar ability to organize into a hypothetical social organism. Mankind is not only a sentient being, capable of responding to his environment, but also a social being able to communicate. The hypothetical path of evolution is traced from non-sentient being to sentient being, to social being; and from inorganism, to organism, to social organism.

C.1 THE BEE-HIVE

The social organism is not purely a human contrivance (or response). The bee-hive includes specialists - queens, workers, drones, and the effective operation of the hive requires considerable communication. When a bee discovers a source of nectar, it returns to the hive and dances on the interior wall. The on-lookers learn the distance, direction, quality of the source, its odor and taste, by following the dance of the discoverer-bee. That the bees are able to reach the source of nectar as in following a map, indicates that this method of communication is successful.

Herbert Spencer imagines a universal evolutionary process from a state of incoherent homogeneity to a state of coherent heterogeneity, with each unit so specialized that no other can perform its function correctly at all. While this may now appear inhuman or impossible, further developments await humanity in the future. For coherent heterogeneity to increase will require a further development of communication.

C.2 THE SOCIAL ORGANISM - CITY

A city may be viewed in many different lights. One may immediately visualize a map; others, an important landmark; still others, an event of personal importance or perhaps an historical event. A city may be a group of buildings. But a city may be thought of not as buildings, but as relationships among people. These are not alternative viewpoints. Clearly, the "life" of the city is reflected in its architecture. Its integrity is its accuracy in portraying urban life.

Emil Durkheim distinguishes physical from social density. Social density is the frequency of contacts and interchanges among members of a population. Organization develops as social density increases. The social organism is built of communication. "Organization... expansion of idea of organism, is used to describe a variety of phenomena in which numbers of differentiated and more or less discrete objects exist together in such a way as to constitute larger units or wholes".

Hawley expands this idea with the hypothesis that the collective life of man revolves about two axes which he calls symbiotic and commensalistic. The symbiotic (corporate) groups embark on elaborate and aggressive programs of action producing a characteristic response of reactive rigidity outside of the group. The family, associational unit and territorial unit are examples of corporate groups, the merger of which forms the community. Commensalistic (categoric) groups emerge only when a challenge is presented by the aggression of some corporate group. Categoric groups are characteristically protective and conservative. Hawley concludes that the corporate groups are intermittently categoric and vice-versa. Probably the distinction is characteristic of aspects of group organization rather than of the groups themselves as groups probably alter their character periodically or according to circumstance.

The social organism evidently exists in two senses, a sense of greater convenience or capacity to produce desirable results within the organism and a sense of protection against agressive developments outside of the organism. Cities of the Middle Ages developed primarily as defensive arrangements. Commercial cities are examples of organization with quite another end in view.

The social organism or community is composed of corporate and categoric groups which alike depend upon communication for their existence. It is by means of these groups that the localized population provides its necessary daily requirements. The ecological community may embrace many categoric and corporate groups within it. To quote Park, "...The limits of the urban community are not likely to be identified with the city as an administrative unit but rather with the metropolitan region, the boundaries of which are not arbitrarily fixed, but coextensive with the area within which the city, as a natural phenomenon, actually functions...". And so, the social organism is not something inert, boundaries of which may be drawn static and inflexible in terms of land area, but rather it is a living thing capable of growth and decline.

C.3 THEORIES OF STRUCTURE OF THE SOCIAL ORGANISM

Weber observed concentric zones of agricultural production about the city. Burgess found concentric zones of land use within the city. Hoyt conceived of the city as sectored, with different groups occupying each sector. While there is undoubtedly some truth in each of these concepts, and each may be valuable for analysis, it would be surprising to find the social organism adhering rigidly to any simple geometrical pattern as does the inert snowflake.

The neighborhood concept is yet another theoretical construct which has been useful in studying urban structure. This construct was an advance over the others in that it was based more on relationships among people than upon any particular geometrical form. There have been various attempts to find the locations of users of urban services. For instance, the clientele of a bank, the circulation of a newspaper, church and high school attendance, use of the public library, have all been studied and plotted. It is this effort to explore the relationships of people to one another or to a community facility, which would appear to be most fruitful. With this thought in mind, the writer has investigated the pattern of communication relationships between telephone exchanges with the intention of defining and delineating social regions (or isolating social organisms). Presumably a parallel investigation on a different level would disclose the existence of neighborhoods if there is reality in the concept. Regions, or neighborhoods, or any other sub-units of humanity exist only if interdependence varies in such a way that there are peaks and valleys in its topography. The peaks are centers and the valleys boundaries.

Norbert Wiener in "Cybernetics" states that, "Any organism is held together... by the possession of means for the acquisition, use, retention and transmission of information". This theory would apply equally to biological and socialogical organisms although the socialogical organism has less distinct form than the biological counterpart.

It is interesting to speculate whether food being digested, air being breathed, perceptions or thoughts are parts of the human organism. Wiener introduces the concept of homeostasis, equilibrium of the organism. On the other hand, communication contributes to the homeostasis indispensable to organic survival. For the organic community, participation in a

rhythm of collective life may be associated with the necessity of and opportunity for communication.

C.4 CONCLUSIONS

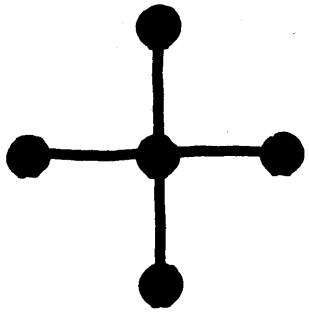
A certain number of people distributed over a landscape is not necessarily a social organism. Nor is a complete set of human parts necessarily a human organism. Organization manifests itself by the relationship of parts to perform a higher function than each could perform alone. In the case of humanity, organization appears to be more necessary as population increases relative to resources, or organization makes possible this population increase. Failure of organization is evident in many countries having a "population problem" or in cities having a "slum problem". On the local scene, the rigid inflexible pattern of political jurisdictions may interfere with possibilities for necessary organization without undue restriction of human freedom. If democratic organization is not adequate to minister to human needs, then a solution may be sought by the adoption of some less ideal type of political organization.

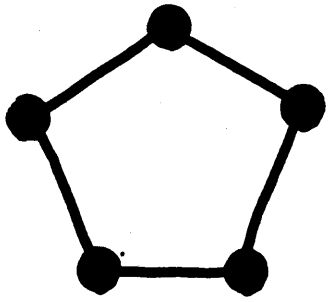
APPENDIX D

COMMUNICATION IN SMALL GROUPS - AN EXPERIMENT

D.0 THE EXPERIMENT

An experiment carried out under the guidance of Professor Bavelas at the Massachusetts Institute of Technology has sought to analyze communication within the small group. The results of the experiment may prove interesting in connection with the subject matter of this paper. In this experiment, five people sit around a table with certain channels of communication open to one another. The pattern of communication is not known to the participants, each of whom is given five colors. The group problem is to find the color that all have in common. The information must be conveyed to all members of the group before the problem is completed. The experiment has been performed using many different participants and several different patterns of communication. Of these, the most interesting are the star and circle patterns.





The star pattern places one person in a central position. This person receives maximum information, makes the decision and transmits the information to all the others, who meanwhile are either passive or ineffective. It is found that the central person enjoys his position of importance, while the morale of the passive participants is extremely low. When questioned, as a rule the passive participants had not enjoyed the experiment.

The circle pattern places everyone in an equal position. Every-

one, therefore, becomes equally involved in the process of making decisions. Although no one is as important as the central person in the star pattern, all are more satisfied with their roles than the passive participants. Not only is satisfaction equalized, but the overall satisfaction reaches a higher level. There is the partially off - setting disadvantage that more time is required to make a "democratic" decision.

D.1 SOME CONCLUSIONS FOR LARGE GROUPS

The star pattern is analogous to that which might prevail in a community or nation dominated by an autocracy or oligarchy. The circle pattern is analogous to a democratic society in the ideal sense. A pure geometrical pattern is impossible in practice. All systems are somewhere between the star and the circle. Examples are given of relatively autocratic and democratic institutions (groups) which are characterized by centralized and dispersed power respectively. Total satisfaction derived by the people involved is believed to be greater for the latter.

Institution	Relatively Autocratic	Relatively Democratic
Economic	Vested Monopoly	Cooperative
Governmental	Absolute Dictatorship	Representative Government
Religious	Authoritarian Church	Libertarian Church

APPENDIX E

TELEPHONE TERMINALS AS AN INDEX OF POPULATION

E.0 DATA

The list contains twenty exchanges which are contiguous with either one or a combination of two exchanges.

Column (1) Name of Exchange

Column (2) Population (1950)

Column (3) Number of Telephone Terminals (1952)

Column (4) Population Per Terminal (2) ÷ (3)

E.1 METHOD

Adding of Column (4) results in a total of 76.0, or an average of 3.8 people per telephone terminal. Twelve of the twenty items fall within the range of the average ± 10% (3.4 - 4.2 persons per terminal). Some of the larger deviations may be the results of institutional populations resident in some of the communities.

Throughout the study the population is represented by its index, the number of telephone terminals.

(1)	(2)	(3)	(4)
Williamstown New Ashford	6312	1812	3.5
Adams Cheshire	14056	3734	3.8
Windsor	372	105	3.5
Savoy	291	101	2.9
Worthington	462	196	2.4
Middlefield	295	90	3.3
Granville	740	239	3.1
Petersham	814	237	3.4
Barre	3406	854	4.0
Winchendon	6585	1586	4.2
Ashburnham	2603	746	3.5
Ashby	1464	381	3.9
Townsend	2817	794	3.6
Rutland	3056	537	5.7
Spencer	7027	1968	3.6
Charlton	3136	667	4.7
Oxford	5851	1323	4.4
Bolton	956	251	3.8
Grafton	8281	1624	5.1
Williamsburg Goshen	2377	650	3.6

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