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THE MOBILITY FIELD THEORY

A SPATIAL-BEHAVIOURAL FOUNDATION TO THE MOVEMENT DYNAMICS, WITH APPLICATION TO THE INDIAN SITUATION

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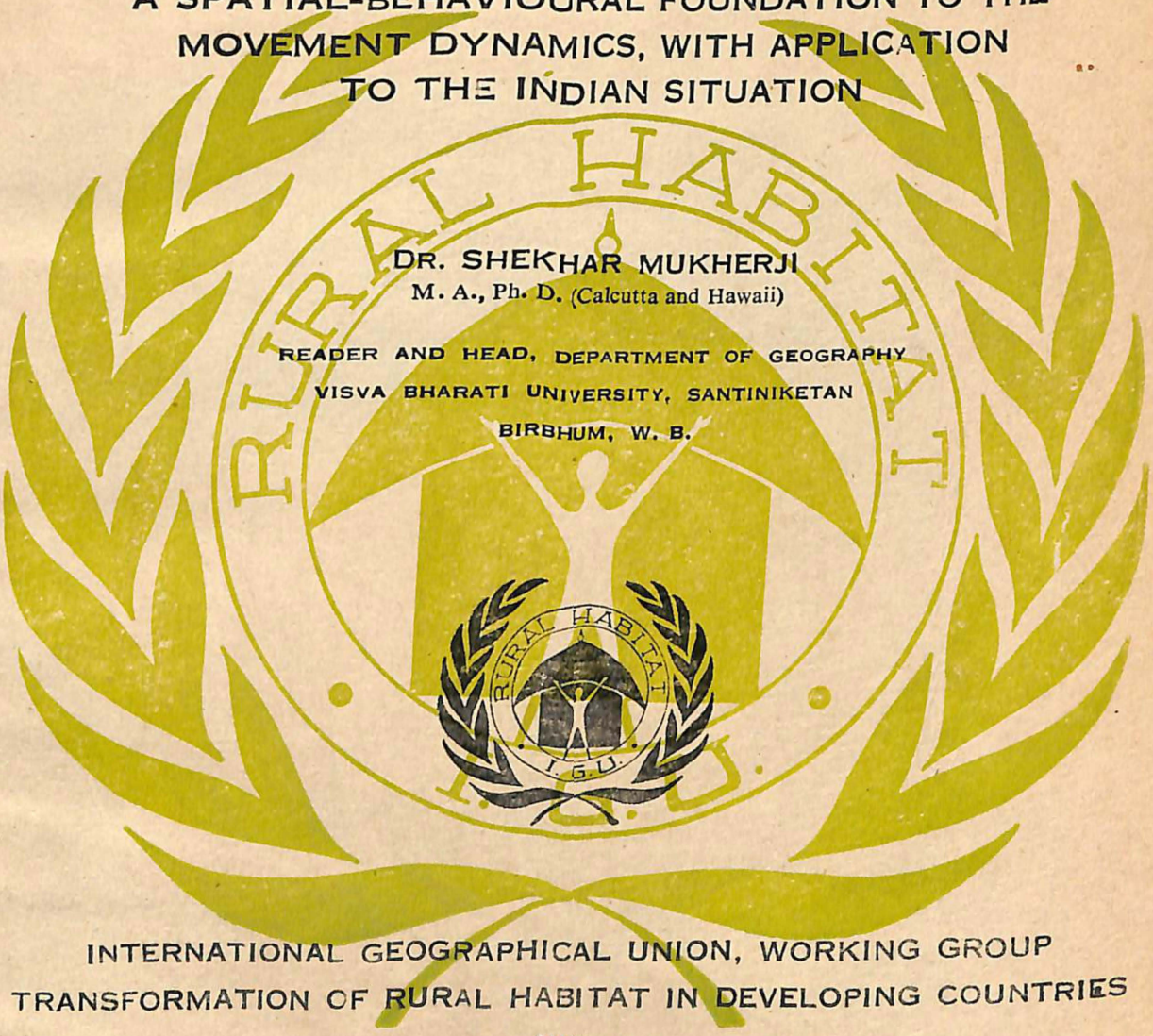

INTERNATIONAL GEOGRAPHICAL UNION, WORKING GROUP
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AND
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Dedicated To
my mother

Srimati Sushama Devi

and my father
Sri Gobind Prasad Mukherji

N. G. S. I. RESEARCH BULLETIN SERIES
SERIES—EDITOR'S FOREWORD

The main objective of this Series has been to highlight the role and application of specific and contemporary methodologies and techniques to the analysis of emerging problems and dimensions, and further to test certain generalizations formulated through comprehensive analysis, by micro level examples. Thus, both the approaches—atomistic and holistic—as synthesised together, help in crystallizing the emerging concept of geography as an integrating science.

To start with, the Series did project a somewhat diffused field of enquiry and such a situation continued till 1955. With a fairly long interlude (1955-1973), the Series are continued to promote the main objectives since 1974 as a momentum to the academically meaningful Silver Juvelee celebration of the Society (1971), when the morphometric analysis of terrain appeared as a taxonomical scale to be pursued by fellow workers. Subsequently, the analysis of communities—both rural and urban, in spatiotemporal frame has bean presented as exhibiting the application of the conclusions to the promotion of the quality of life while maintaining the ecological balance.

The present work, **The Mobility Field Theory** by Dr. Shekhar Mukherji, aims at formulating a theory pertaining to the *people on the move* within certain socio-economic systems with considerable success. He has furnished adequate analysis, justification through mathematical formulations, especially using factorial and cannonial analysis, of human behaviour with examples from Indian situations. His findings will have good scope for application to migration planning both in developed and developing countries, particularly leading to accentuation of the processes of rural transformation.

R. L. SINGH
U. G. C. Scientist in Geography
Banaras Hindu University, Varanasi
and
Chairman, I. G. U. W. G. Transformation
of Rural Habitat in Developing Countries

Varanasi
Vijai Dashmi
Ashwin, Shukla 10
1, October, 1979

PREFACE

Paradoxically, social science research is not yet really concerned with the problems of the poor. This is so unfortunate. The only purpose of this study, if any, is to draw attention of Geographers and Population Specialists to an urgent necessity for understanding the 'basic needs' ond 'stresses' of the people, instead of focusing upon classificatory description of patterns in spatial behaviour, as is currently done. Understanding of causal-functional links of people's need-stress systems to their spatial-economic-social-demographic behaviour, may enable us to focus directly upon people's real problems, to face and solve them, and to undertake more relevant research issues. Such a focus, eventually, may lead us to redefine the goal of social science itself, which fundamentally must aim at bringing change in the destiny of the people in distress. In so doing, may be it would be possible to introduce an ethical parameter in our scientific equations, that has been so unfortunately missing.

Consequently, in this study, central focus has been given to the understanding and explanation of the basic needs of individuals : their human need for food, shelter, sustenance, employment, education and self-esteem. Only with such a focus can spatial-behavioural studies be useful for planning mobility for the poor people. For the unfulfilment and denials of these needs lie at the core of human spatial problems.

This has been my perspective in this monograph. Most of this work was written during 1970-74 when I was preparing for my doctor's thesis in the University of Hawaii, Honolulu. Some parts were revised in 1975-76 when I was working as a Research Fellow in the Australian National University, Canberra.

A study of this kind cannot be accomplished without the support and help of many. My greatest indebtedness is, however, due to all those poor people of Uttar Pradesh some of whom were interviewed and whose story has been narrated here. I am most grateful to Professors Murray Chapman and Rudolf J. Rummel, both of the University of Hawaii, for their invaluable theoretical contributions to this study. Murray Chapman has been my guru who initiated me into mobility research, Rummel's continued research on the field theory was a great source of inspiration for the present formulation of the *mobility field theory*. In this connection, I also especially owe thanks to Professor Roland Fuchs, Forrest R. Pitts, Paul O. Schwind, Brian J. Murton, Gary Fuller (all from the University of Hawaii) and Robert Earickson (University of Maryland). I was also immensely benefited by suggestions and criticisms from Professors Brian J. L. Berry (University of Chicago), Richard Morrill (University of Washington), Gerard Ward and Terry McGee (both of the Australian National University). In this context, in India, my special thanks must go to Professors N. R. Kar (D. P. I., West Bengal), Satyesh Chakravorty (State Planning Board, West Bengal), Moonis Raza (J. L. Nehru University) and S. B. Mukherjee (C. M. P. O.), for all of them provided some valuable

suggestions and criticisms. I especially treasure the friendships of my colleagues Shinzo Shimabukuro, Fredrick Stone, and Jeffrey Davidson who continually stimulated me during my frustrating formative years.

During field work in Varanasi region in Eastern Uttar Pradesh many people were of great help. In this context, I am specially indebted to Professor R. L. Singh, U. G. C. Scientist in Geography, Banaras Hindu University, under whose able guidance the field survey was undertaken and whose encouragement made publication of this monograph at all possible. It is he who initiated me into geographic research two decades ago and his benedictions are still incessant. During computer analysis of field data, my friend Dr. Patrick Barnett D. Loughlin of Department of Sociology, University of Hawaii, helped me immensely and voluntarily. Indeed, without his voluntary, non-stop, round the clock computing assistance for two months, I wonder, whether such a complicated analysis as this, would ever have been completed.

I must also specially thank Mr George Chu of East-West Population Institute, East-West Center, for his excellent cartographic assistance. I am also specially grateful to Mrs. Katie Takeshita of University of Hawaii and to Mrs. Nadia Spesyvy of Department of Human Geography, the Australian National University, who were very kind and patient to make several typescripts of of the draft and the final manuscript for publication. Last, but not the least, I must also express my sincere gratitude to Dr. Rana P. B. Singh, Lecturer in Geography, Banaras Hindu University, who took great pains and care to help in editing and proof reading of the monograph eventually.

Finally, I am also very much aware that there are many others, not particularly mentioned here, to whom I owe acknowledgements for their invaluable cumulative contributions to this piece of research.

Santiniketan
(BIRBHUM, W. B.)

Shekhar Mukherji

CONTENTS

I. THE PROBLEMS OF MOBILITY

A. The Perspective

The main human problem associated with rural to urban movements in the Third World is that people are mostly moving from unemployment to underemployment, from green fields to dirty pavements, and from one poverty region to another, resulting in a colossal waste of human resources and perpetual human misery.

The failure of the social systems to provide basic human needs, and the inability of the locations of productive activities to adjust and to meet the demands of such movement behaviour further augments frustration, poverty and dependency. Such problems of human spatial mobility mainly arise out of economic underdevelopment and affect lives of millions every year. Set within this situation, it is alarming that whatever steps are taken to redirect these streams of population are generally ineffective, and policies are rarely formulated to train and utilize the available manpower at the source or destination regions. It is hard to overestimate the need for clear and effective migration policies, the lack of which is even more serious in Third World countries since it means that basic human needs remain unfulfilled, manpower unutilised, and the process of socioeconomic change sluggish.

In almost all developing countries, especially in south and southeast Asia, northern and central Africa, and parts of Latin America, the human and economic problems associated with rural to urban migration are being rapidly aggravated simply because the rural dispossessed, moving in search of jobs and better living, are in reality transferring from unemployment to underemployment, from one stress area to another. Being mostly landless agricultural labourers, they are virtually forced to leave rural areas and to take up in the towns and cities any manual work they can find[1]. A great majority live perpetually in urban sqalor and hope that someday they might accumulate sufficient money to buy land in the home village or find a decent living in the town. Occasionally, they reach the nearest town, but more often move to the largest city within a distance of 100-150 miles. Scores of them travel many hundreds of miles to the country's largest metropolis since they have a faint idea that the chance of obtaining any kind of work increases with city size. Typically, this migration is dominated by single males. Frequently they circulate between city and home village, but their hopes are never fulfilled, and the next generation may repeat the same miserable drama of life. In the village, they possess almost no land, and in the town, work is increasingly difficult to find and whatever manual work they can plunge into is barely sufficient for their sustenance. It is an utterly dismal situation, and a colossal waste of human resources.

Consequent to such movements, unemployment and disguised unemployment also shift from rural to urban areas. Since the available labour is unlimited, real wages in urban centres remain perpetually low and often swing downward. Many people, unable to find work in the town, are forced to return

1. Mountjoy, Alan B., "March of the Peasants from Land to City", *Geographical Magazine*, XLVI, No. 5-5, February 1974, pp. 208-215.

to the village. Such pattern of movement is neither creating a real transfer of population from the traditional agricultural to the urbanized industrial sector of a country's economy, nor is economic take-off occurring in spite of the fact that many such countries have launched centrally-organized planning programmes.

Given such crucial human problems, it is regrettable that few geographers and population specialists examine the issues entangled in people's mobility due to underdevelopment, view the act of movement in the total social co text, or seek means of alleviating them through migration-mobility planning. The overriding purpose is just to develop and demonstrate a philosophical and empirical perspective that will enable human mobility problems to be viewed more closely and more intently, to better appreciate the magnitude of the problems involved and hopefully to establish a broad theoretical basis upon which migration planning for economic development and social change might build.

An attempt is made here to take a system theoretic perspective of the problem, and it is argued that *need-attribute systems of the people, utility offerings of the places and different mobility behaviour that arise to satisfy those needs are interdependent parts of a system, called the mobility field, and it is postulated that any natural or induced change in any part of the system would generate corresponding changes in other parts.* The most crucial aspect is that the need systems of the individual are regarded as the causal forces behind their movement behavior, and consequently, it is suggested that if it is possible to induce desirable changes in the need-stress-attribute structure of the people, then it can bring changes in people's spatial behaviour, and vice-versa. It is also surmised that by inducing change in the spatial arrangement and the utilities of the places it is possible to induce changes in the spatial behaviour of the people and in their attribute structure. In short, mobility can be planned to act as an agent of bringing socio-economic change.

As a part of this overall goal, a working model is developed that would be capable of (1) explaining some of the behavioral aspects of migration, circulation and other kinds of movement, (2) capable of viewing mobility in the context of the social and spatial structure of the territory to be studied, and thus, (3) finally, capable of specifying the causal links between the needs of individuals, places offering to gratify those needs, and the resultant movement behaviour. From an understanding of such causal-functional links between the individual's need system and his movement behaviour, it would be possible to clearly specify what basic needs of the people ought to be provided, what utilities of places ought to be augmented, and eventually, to lay out what may be and should be done to redress the problems in human spatial mobility in any specific region. Perhaps, from such understanding, it will be possible to provide concrete clues for migration planning in a way which would facilitate better utilization of human resources. In this monograph, certain behavioral, social, economic and spatial aspects of different kinds of mobility are considered, not in isolation, but rather in an organized framework, in a field-theoretic perspective, and as a result, a field theory, called the **mobility field theory**, is developed. The model is finally tested in the Indian situation and evaluated in regard to its usefulness in suggesting planning strategies to redress the human problems noted above.

B. Problems in Mobility Studies

Although the migration literature abounds with studies by anthropologists, demogra-

phers, economists, geneticists, geographers, political scientists and sociologists, most of these take a specific and partial view of the mobility phenomena and often fail to recognize the role of individual decision-makers in the movement process. Migration research has often ignored the need to view mobility within the complex web of the socio-economic, cultural, and political structures of the society within which individnal actors and their movement behaviour is imbedded. Consequently, such studies are partial in explanation, at best average in predictability, lack insight into the complex interplay of social forces that underlie mobility behaviour, and consequently offer simplistic solution, if any, to problems of economic underdevelopment and mobile people under stress.

Under the influence of psychologists, social psychologists, and decision theorists a rather recent development in spatial interaction studies has been geographers' attempts to analyse movement from behavioral perspectives. In this connection, one of the major innovations was Wolpert's idea of 'place utility' and 'action space' in his proposal for a behavioral model of migration.[2] Although derived entirely from Kurt Lewin's conceptual constructs of 'valence' or attractiveness of a goal (or goal region), and the 'life space' of an individual[3], Wolpert, simply succeeded in conceptualizing a quite comprehensive behavioral model of migration, while failing to provide the means to implement it. The major weakness of his model lies in his use of groups or prototypes as surrogates for individuals and their place utility. Secondly, Wolpert's "model is designed to relate aggregate migration behavior in terms of migration differentials into measures of place utility relevant for individuals."[4] In effect, he therefore measures the utilities of a place by the number of people who have migrated to that place, that is, past migration flows are used to derive a measure of place utility which are, in turn, used to explain aggregate migration behaviour. Migration is thus being explained by migration—an example of circular reasoning ! Unhappily, such weaknesses and serious gaps between concepts and methodology are quite prevalent in geography. It is common sense that, if concepts are formulated at the level of the individual, then these must be implemented at that scale. Nor may they be extended to group or aggregate behaviour without clearly specifying how such transformations could be made. A fundamental requirement of any scientific study demands that theory, methodology, and technique be integrated and organised, to form a whole, all referring to the same theoretical text, before explanation can occur. Such challenges, however, have been subsequently taken up by Brown and Moore[5] and Golant[6] and others. Important contributions these may be, but their attempts also lacked an integrated theoretical text to support their formulations.

2. Wolpert, Julian, "Behavioral Aspects of the Decision to Migrate", *Papers, Regional Science Association*, 15, 1965, pp. 152-180.
3. Lewin, Kurt, *Field Theory in Social Science*, New York, 1951, pp. 30-297.
4. Wolpert, 1965, pp. 179-180.
5. Brown, Lawrence A., and Eric G. Moore, "The Intra-Urban Migration Process : A Perspective", *General Systems*, 15, 1970, pp. 109-122.
6. Golant, Stephan A., "Adjustment Process in System : A Behahioral model of Human Movement", *Geographical Analysis*, , 3, 1971, pp. 203-220.

C. An Alternative Approach: Mobility Field Theory

The formulation of a *mobility field theory* which lies at the core of this study, arose from dissatisfactions with such weaknesses of concept and methodology inherent in spatial behavioral studies. Consequently, the quest was for a philosophy of scientific explanation that would comprehend the complexity of spatial behavioral processes—a philosophical text that would organize and integrate all the territorial, behavioral and social aspects of the movement process into a general spatial theory of mobility. The goal, admittedly ambitious, is to develop a perspective in which theory, concepts, methodology and mathematical techniques were linked in a structured and tightly organised entity, capable on the one hand of providing operational definitions of the concepts and also of empirical verification of the theory on the other. The field theoretic perspective, first propounded by Kurt Lewin, provided an alternative line of thinking. Thus a major effort of the present formulation of a spatial theory of mobility behaviour involved tracing the main ideas of Wolpert's model to their original source in Lewin's writings and starting all over again.

But, in so doing, an entirely different philosofical base has been evolved which emphatically focuses upon the "basic needs' of the individuals, not upon 'place utilities' as such, nor upon classificatory description of spatial patterns *per se*.[7] Since the overall goal is to provide a philosophical and theoretical basis for understanding problems in people's movements from rural poverty to urban slums, at the outset, intuitively the need was felt to evolve a perspective which will fundamentally and essentially focus upon the "needs" of the people and their stressful socio-economic-political conditions in which people are imbedded, and view through them and integrate with them, everything else that is entangled in the people's movement behaviour. Evidently, 'needs' must be given exclusive emphasis because, fundamentally, human problems are caused by unfulfilment or denial of the very basic human needs of food, sustenance, employment, education, and self-esteem. Understanding of the causal-functional links of people's need systems with their spatial-economic-social-demographic behaviour will urge us to focus directly on people's real problems, to face and solve them, and to undertake more relevant research issues.

Set against this quest for a philosophy, the concept of the mobility field has been developed to provide a basis for such unifying and organising principle which may allow us a systematic understanding and to deal with such spatial processes and social structures, and to see them in their causal relations.

It is desirable to understand, explain, and affect needs-aspirations-roles-traits-stress systems of the individuals (and households). These themselves are constantly changing within the context of the specific socio-economic-political systems, and are in fact delineating different configurations of individual mobility fields at a given space and time.

7. Current spatial behaviour studies have yet to learn to focus upon "need-stress" of people in order to understand spatial behaviour, instead of mere academic model-building and irrelevant hypothesis-testing to describe spatial patterns. This can be evident in innumerable studies made on action space, awareness space, urban contact space, activity space, migration distances, migration differentials, movement patterns, distance or directional biases, acquaintance fields, movement transitional probabilities wrongly using Markov chains, and the like.

The purpose is to discover how such need-stress systems determine the field's various componential structures (spatial extent of life-space and place utility considerations) and induce individuals' different kinds of movement behaviour.

Thus, the present formulation involves viewing individual mobility behaviour in the context of the structure of the "field", giving operational definitions to life space, place utility, need-attributes, stress situations, and movement behaviour in the context of the life of the individual, within the concept of the mobility field. This effort involves considerable conceptualization, first, inductively about an individual's behaviour, and second, deductively about aggregate behaviour. In this way, a mobility field theory is evolved by mathematically specifying the linkages of the need-stress-attributes of an individual and his subjective place utility considerations to the resultant mobility behaviour that arises to satisfy those needs. The mobility field theory is formulated in such a way as to permit empirical verification—a fundamental requirement that any theory must fulfil.

D. Philosophy of Field theory of Social Sciences

The mobility field theory is primarily based upon the works of Lewin[8] and Rummel.[9] Field theory is, according to Lewin, not a theory, rather a method, a perspective, a way of building conceptual constructs and connecting causal relations. The mobility field theory, as formulated here, however, is an empirically verifiable and testable theory.

Lewin's central idea was that the mind is a complex energy field containing tension systems which are in various states of equilibrium, and behaviour is the change in the state of this field. He postulated the concept of a psychological field, called life space, which comprises an individual person's self and the subjectively relevant environment. Life space includes all that is subjectively meaningful in both an individual's mind (needs, goals, beliefs) and that individual's external environment (people, places, climates); and it therefore excludes anything personally not relevant. Thus the life space of a person consists of needs, attributes, and the subjective environment as it exists for the person at a given unit of time and space, and all behaviour (including thinking, striving, action) is conceived of as a change in some state of one's life space in a given unit of time.

In 1965, Rummel presented an explanatory-predictive model of conflict behaviour of nation states towards each other, and formulated a general theory of social action termed as *Social Field Theory*. The core philosophy of his theory views international reality as a field "in which one nation's behavior towards another is a consequence of the total situation, and this situation forms a field consisting of social characteristics, or attributes, which stand in definite relation to each other. Behavior, moreover, is relative to other behavior —in a context—as well as to the relative similarities and differences of social units, such as individuals, groups, or nations, or their attributes. These attributes and the interactions between social units....constitute a behavioral space, or bounded systems which define the total situation, and in which social units can be located"[10].

8. Lewin, Kurt, *Field Theory in Social Science*, New York, 1951, pp. 30-297.
9. Rummel, Rudolf J., "A Field Theory of Social Action with Application to Conflict Within Nations", *General Systems*, 10, 1965, pp. 183-204.
10. Rummel, *op. cit.*, 1965, pp. 183-204.

Thus, Rummel considered behaviour as "a coupled phenomena involving two distinct social units which are in a certain relation to each other. Social units thus coupled are considered as dyads whose existence and behavior can also be treated as a system. The relative position of a dyad in this behavioral system is a function of the relative location of the members of the dyad in the system of attributes. The last idea articulates the basic equation of the theory, that is $\vec{W} = \Sigma a_m \vec{d}_m$. This states that behavior ($\vec{W}$) is a linear function of relative location ($\vec{d}$) in the system of attributes and of proportionality constants (a_m)"[11].

In brief, social field theory "analytically divides social reality into two vector spaces. One is that of attributes of social units, be they individuals, groups, or nations, and the other is that of the behavior between social units. With the attribute space, each social unit is located as a vector (with length and direction) in terms of attributes. Within the behavior space, every pair of social units, called a dyad, is located as a vector in accordance with interaction of the two members. The heart of social field theory is a mapping of the position of a dyad in behavior space into the attribute space. This is, the dyad vector in behavior space is a vector function of the configuration of social unit vectors in attribute space. This function, or mpping, is based on defining a distance vector in attribute space which connects the social unit vectors"[12]. This theory is subsequently elaborated by Rummel in a series of studies on domestic conflict within nations and international conflict[13].

Brian Berry, applying this theory to a spatial context, investigated the relationship between spatial economic structures and commodity flows amongst the states of India, and postulated that spatial patterns of attributes of places and of interactions among them are interdependent and isomorphic.[14] Very recently, Schwind[15] and Parsons[16] have applied Rummel's model to study respectively of gross aggregated migration flows and social interaction patterns. However, none of these applications of social field theory by geographers offers any theoretical text, nor attempts

11. *Ibid.*, pp. 183-184.
12. *Ibid.*, p. 185.
13. Rummel, R.J., "Field Theory and Indicators of International Behavior", *Dimensionality of Nation's Project, Reserch Report*, No. 29, Department of Political Science, University of Hawaii, Honolulu, 1969, pp. 18-35.
14. Berry, Brian, J. L., *Essays on Commodity Flows and the Spatial Structure of the Indian Economy*, Department of Geography, University of Chicago Research Paper No. 111, Chicago, Illinois, 1966, Also see his
    "Interdependancy of Spatial Structure and Spatial Behavior: A General Field Theory Formulation", *Papers, Regional Science Association*, 19, 1969.
15. Schwind, Paul J., "A General Field Theory of Migration", *Economic Geography*, 51 No. 1, January 1975, pp. 1-18.
16. Parsons, John Sanford, "Interaction and Communication in a Phillippine Barrio: A Study of Social Space and Social Distance", unpublished Ph. D. dissertation, Department of Geography, University of Hawaii, Honolulu, 1973.

to redefine and transform essentially a social theory into a spatial theory.

In summary, Lewin postulated that the social milieu of any entity, such as groups, and associations—Rummel considered nations and Berry considered states as actors—is composed of the individual life spaces of the different actors which comprise the social system. An actor's relative position in the social milieu of the field represents the structure of the system at a given time and its ecologic settings, and expresses the "basic possibilities of locomotion (intergroup behavior, interactions or interregional flow of people) within the field."[17] In short, any system of social entities, such as individuals, groups, subgroups, barriers, communication channels, cities, states, and nations, can be regarded as social or spatial fields, composed of actors standing in definite relation to each other according to the degree to which their life spaces overlap. Interaction between actors in the system, then, is considered proportional to the actor's relative location in the attribute space.

E. The Basic Dilemma: Who is the Actor in Mobility Field Theory ?

To pursue a field theoretic approach involves six main steps : *first*, identify who are the "actors" (individual, group, state) in the particular system; *second*, clearly define the system's structure and its domain (macro, meso, or micro level); *third*, analytically divide the field into its componential subsystems of attribute (socio-economic status, wealth, education) and interactions (interstate flow of goods or people); *fourth*, define the dyadic interactions between the actors in the behavioral space; *fifth*, specify the relative position of the actors in the attribute space in terms of distance (relative similarities and dissimilarities between them on the attribute space); and *finally*, map out the basis of behaviour space on the attribute space, by mathematically linking the dyadic interaction patterns among actors on the behaviour space to their relative functional distances on the attribute space. Any attempt to construct a field theoretic model of the movement behaviour of individuals must incorporate all these steps in a clearly defined and carefully structured way.

With the need for such rigorous reasoning and a strictly structured framework, it is little wonder that thus far no mathematical formulation of a field theory on 'movement behavior' has been made and certainly not at the investigatory level of the individual. Because if an individual person is the focus of investigation, then, one stumbles over the very **first** step in identifying who really *is* the actor in the movement process : individual persons or discrete locations ? In both Rummel's and Berry's model, in which the focus is upon aggregate social units like nations or regional states, there are clearly definable actors and easily identifiable dyadic interactions between pairs of actors. Such models are neat, clearly bounded, and comprehensible. But in formulating a corresponding model for the movement behaviour of individuals, in which a *person* behaves towards a *place*, the crucial question is : are places interacting between themselves or are people interacting with each other or what ? Should it not integrate both persons and places in the model ? But Berry's model focused only upon the places, thus completely ignored the attributes of the individual decision-makers themselves. This dilemma may be solved by considering both the attributes of persons and places concurrently in the attribute space. **Second** crucial question is : can a field theory be formulated

17. Lewin *Op. cit.*, 1951, p. 200.

at the macro level (encompassing group, cities, states, or nations), as in Berry's model, and be transferable to a micro level (individual persons, individual places) ? And if so, in what philosophical and methodological ways can such transformations of scale occur ?

Within the field theoretic framework, and as developed in this monogrowth, such questions, therefore, demand resolution of the following four clusters of problems : (1) conceptually and operationally link the attributes of persons and places within a single composite notion, i. e. the individdal person's perception and evaluation of place attributes, through the notion of place utilities; (2) theoretically and methodologically project or collapse all three elements of the movement process (the attributes of persons, of places, and the resultant movement behaviour) on to the spatial-social-cultural space of the individual actor, and, finally synthesize all these interdependent parts of an individual's life space in a coherent and organized manner, in the concept of the mobility field of the individual; (3) analytically divide the field into *three*, not two, vector spaces, that successively describe (a) the attributes of persons, (b) the attributes or utilities of places, and (c) the dyadic mobility behaviour of person to places; and, (4) finally, mathematically link these three spaces by specifying relationships of patterns of movement behaviour to the patterns of need-attributes of individuals and their place-utility considerations.

In brief, this monograph aims to show one possible approach to the solution of crucial conceptual and methodological problems involved in micro-level study of movement behaviour. The mobility field theory focuses upon individual behaviour and therefore overlaps with Lewin's ideas, whereas analytically it borrows heavily from Rummel's theoretical structure, but elaboratcs his axioms and basic linkage equations in a spatial context. Detailed discussion of the mobility field theory is now in order

II. A SPATIAL BEHAVIORAL FOUNDATION TO THE MOVEMENT DYNAMICS

A. The Elements in Mobility System

Primarily, three main elements are involved in the movement process : (1) an individual mover, who has certain personal characteristics and who, in most cases, also makes the decision to move, (2) an origin, where he is presently located, and a set of alternative destinations, each characterized by a set of spatial, social, economic, and cultural attributes or utilities, and (3) a particular kind of mobility of the individual for a specific purpose, between an origin and destination.

Each individual has certain needs, aspirations, and roles, and in fulfilling those moves in certain ways within the universe of space and time, the combined result of which represents an individual's mobility behaviour. By definition, such behaviour consists of different kinds of move, such as, migration or circulation or oscillation for different purposes which may also involve different distance, direction and duration. A composite of distance-duration-direction-purpose characteristics of moves of all individuals in a sampled population and

their migratory-circulatory nature might manifest a broad movement behaviour pattern, what is regarded in this study as 'a particular kind of mobility behavior'. Such different composites, arising from different combinations of such movement characteristics, would manifest broad general mobility behaviour patterns of the population that may underlie multitudinous spatial aspects of movements of the individuals in a study population[18].

The first element of the movement process comprises of the human organism. Human being itself is a system with its own psychological structure and socio-economic-cultural needs and traits. Specifically for our concern here is the individual's need-aspiration-role-stress system, affectionately termed as Need-Attribute Set. The second element is the spatial system which consists of a finite number of places in a given territory—a set of origins and destinations with their different place-attributes or functional characteristics, and spatial interactions between them. This is an independent system in its own right. An individual organism is a sub-system within this larger and more complex spatial system, and is related to it according to his own relative location and unique transactions. Thus, these two systems are not isolated. There are shadings, wedges, and overlapping between the two—spatial system upon the human subsystem, as he perceives and interacts with it. His perception, thinking within his spatial system is determined and guided by his need set. Need set acts like a prism through which place attributes of origin-destination(s) are filtered as *place utilities. He perceives each location as a bundle of utilities in relation to his need systems.* This brings the person and the place—the two elements of the mobility system—in close integration, under a common conceptual construct.

Mobility behaviour, then, simply is a consequence and a result of the humam organism's perception of, and interactions with, his own unique spatial system. Different kinds of mobility behaviour of an individual are just different manifestations of such interactions at different points in time. His particular need set at one time-point colours his perception of utilities of places, giving importance to some utilities of certain location over others, and results in a particular kind of mobility for a specific purpose. Such multitudinous manifestations comprise the third element in the mobility system.

Therefore, the three elements, Need-Attribute System, Perception of Place Utilities, and Mobility Behaviour are interrelated parts of a system, termed as *Mobility System* or *Mobility Field.* Movement process is a subtle and underlying phenomenon of this mobility system. Understanding of the movement process is an impossible endeavour unless we perceive it in a system framework, through an organised and structured principle, untangle the process into those fundamental elements, examine the interrelationships between them, and specify the final linking equations in simplest form to explain mobility behaviour. The concept of the mobility field and a mobility field theory model, as tentatively developed here, will do just that.

Mobility field theory is an applied form of the general systems theory, providing it with a spatial rendering. *The mobility field of an individual is just a mobility system at the indivi-*

18. Mukherji, S., "A Spatio-Temporal Model of the Mobility Patterns in a Multi-Ethnic Population, Hawaii", in *People on the Move : Studies on Internal Migration,* Leszek A. Kosinski and R. Mansell Prothero (eds.), Methuen, 1974, pp. 325-346.

dual level. An individual's need set, his perception of place utilities, and his various mobility behaviour together comprise the essential ingredients of his own and unique mobility field. Mobility system at the aggregate level, comprising all the individuals in a population, corresponds to the mobility field at the aggregate level, a resultant of overlappings of tiny mobility fields of the individuals. As would be apparent from subsequent sections, the concept of the dynamic field of the individual mover enables one to look more closely and more intently into the underlying movement process, to describe his decision-making, and to formulate specific interrelationships between the three elements.

B. The Mobility Field

The mobility field is defined as a system which comprises the individual's needs, aspirations, roles and traits including stresses in his specific location, his perception of utilities of all those discrete locations that define his subjectively relevant environment or life space, and his different kinds of movement behaviour, and their complex interrelationships. All these are interrelated parts of an individual's mobility field. They are co-existing facts of his life at a given space and time, and his particular mobility behaviour is a resultant manifestation of changing constellations of all these co-existing facts of his life-space in a given unit of time.

The Mobility field is dynamic in nature. It is an abstract spatial component of an individual's life. It expands from birth to maturity, and changes, moulds and organises as an individual's needs grow, aspirations alter, roles multiply, stresses occur, places develop, information flows, perceptions change and the individual's unique transaction with his own spatial system organises, as life cycle advances. In short, each individual has his own unique mobility field, his subjective environment, his world, a medium in which his actions, movements, and living take place. His mobility field is spatial social-economic-psychological organisation about and around himself.

The most crucial to this field concept is that it regards the needs system of the individual as forming the nucleus around which the mobility field is structured (see Fig 1a and 1b). Needs are the sources of psychic energy—of social psychological tensions and stresses—generating driv-

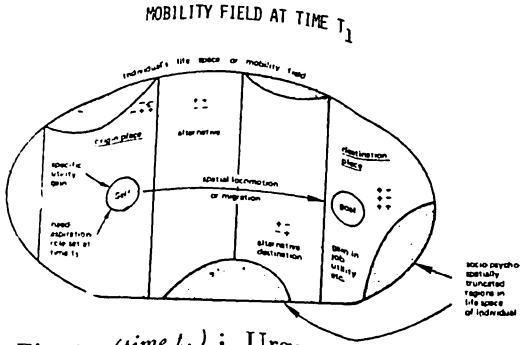


Fig. 1a *(time t_1)* : Urge to satisfy specific needs and perception of specific utility gain elsewhere are motivating an individual to migrate or move from his present location in mobility field to a destination within the mobility field in which the goal to gratify needs is located.

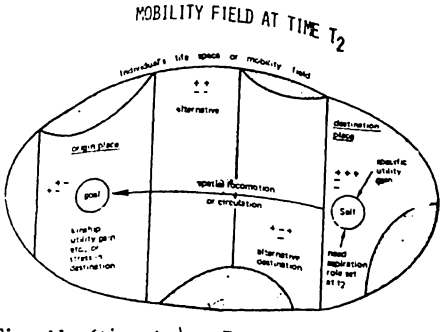


Fig. 1b *(time t_2)* : Individual's particular need-role-aspiration at a given moment, t_2, and/or the lack of gratification of them at the destination, are perceived and evaluatcd by him to consider specific utility gains from the origin place of more value, thus, motivating him to return to the origin place.

ing forces which motivate an individual to move spatially, and to reach out within the mobility field for a specific need gratification. Need-stress systems taint and pervade everything that could be subjectively relevant to the individual's environment. Thus, need systems determine and sample out the nature, content and spatial extent of the information that flow in—information about discrete locations—as a result of which the individual's life space or subjective spatial system is defined and delineated. This life space, in fact, delimits the utility space within which place utility consideration takes place and search for alternative destinations occurs. Although this is an abstract concept, this also indicates its importance as a tool for predicting search and movement behaviour.

In sum, the need-stress system of the individual determines the spatial extent and configuration of life space or utility space, generates the mobility field and causes movements to arise within the mobility field. This binds all aspects in the concept of the mobility field. Thus, following Rummel's recently stated psychological field theory,[19] mobility field also can be characterised by six main aspects:

1. *Complex spatial interactions*: Movement behaviour of persons to places. Such complex behavioral patterns can only be understood and explained if these are seen as mobility potentials or behaviour types, instead of an infinite number of single discrete moves of the individual(s).
2. *Actors*: Individual persons or movers.
3. *Energy*: Psychic tensions and stresses arising from actor's needs, will, drives, and social-political-economic stress situations.
4. *Generator*: Need-stress-attribute systems of the individual generating psychic energies and forces; generating the mobility field.
5. *Forces*: In the spatial situation, these are termed as spatial-behavioral forces, specifically referring to need-push and perceived place-utility distances between a pair of places.
6. *Medium*: Individual's life space or subjective spatial system acts as a medium comprised of a set of discrete locations of which he is aware of.

Conceived in this fashion, the concept of the mobility field, and consequently, the mobility field theory is essentially a philosophical perspective, an organising principle, a conceptual construct, a holistic view, a gestalt. It is also a theory of specifying spatial phenomena and human spatial problems, to untangle and understand them.

C. Field's Componential Structures and Spaces

Both at the level of the individual and the aggregate system, the mobility field constitutes three basic structural components and correspondingly three abstract multi-dimensional spaces. Each of these spaces delineates and describes the configuration of corresponding componential structures and specifies each individual's specific location, relative to all others, on such spaces. Each of these spaces, in turn, is constituted by certain independent sub-components or dimensions which form the basis of the space. In simpler words, certain independent dimensions generate a space, which, in turn, constitutes one of the three spaces, and the three spaces together

19. For detailed conceptual discussions of any field concept, social field or spatial field, see R. J. Rummel, *The Dynamic Psychological Field : Psycho-Philosophical Prolegomenon to the Dynamics of Conflict and War*, Sage, 1975.

form the mobility field. These componential structures and spaces are :

1. *Need-attribute structure* : This connotes individual's needs, aspirations, role; his social, economic and cultural traits, and also the stress conditions he undergoes due to his specific location in geographic space. Composites of these attributes would span the *attribute space.* These components specify an individual's relative location on this space.
2. *Subjective Spatial System or Structure of Place Utilities :* These imply a system of discrete locations, both rural and urban, with their relative place-utilities, as perceived by different individuals. Composites of utility considerations would span the *utility space.* Similarly, such utility components define an individual's perception of a location's relative utility on this space.
3. *Mobility Behaviour*: This connotes different general types of mobility behaviour. Compositely these describe migration, circulation, and other kinds of movement made for different purposes by the individuals in a population. These behaviour types span the *mobility behaviour space.* An individual's specific movement behaviour vector can be precisely located on this space.

The heart of the theory lies, then, in establishing the existing, but often overlooked, interrelationships between these three componential structures of the field, and thereby, to unfold the causal links of the need set and the place-utility considerations to movement behaviour that arise in attempting to satisfy those needs.

III. THEORETICAL TEXT

In the following sections, some behavioral aspects of movement process are explained within the concept of the individual mobility field. The main argument is developed through successive discussions on three componential structures and their corresponding spaces, especially with reference to an individual's specific location in them. This entire part III provides a theoretical text to the mobility field theory, a more formal presentation of which (at aggregate level) is given in the next part through a series of statements, assumptions, axioms, and matrix form. The main features of the discussion are also diagrammatically presented in Figure 2.

A. Need-Attribute Structure

Each individual has certain social, economic, and psychic needs and aspirations to be realised. This can be called individual's need system. Some of these needs and aspirations are related to the individual himself, some other to his household or peer groups, class or castes. Aspirations or needs may refer to education, job opportunity, social status, income, family life cycle, and so forth (Fig. 2: No. 1). Individuals vary in their need systems. Need-aspirations demand gratifications, and when denied, psychological tensions and stresses tend to arise in his field (No. 2). Tensions in his need systems define the strength of the motivational forces of his dynamic mobility field. For instance, if a certain need, say hunger, is not satisfied, he will be disposed to search for food. Or, if his need for a job does not meet with success at his present location, tensions or stresses would

Mobility Field Theory

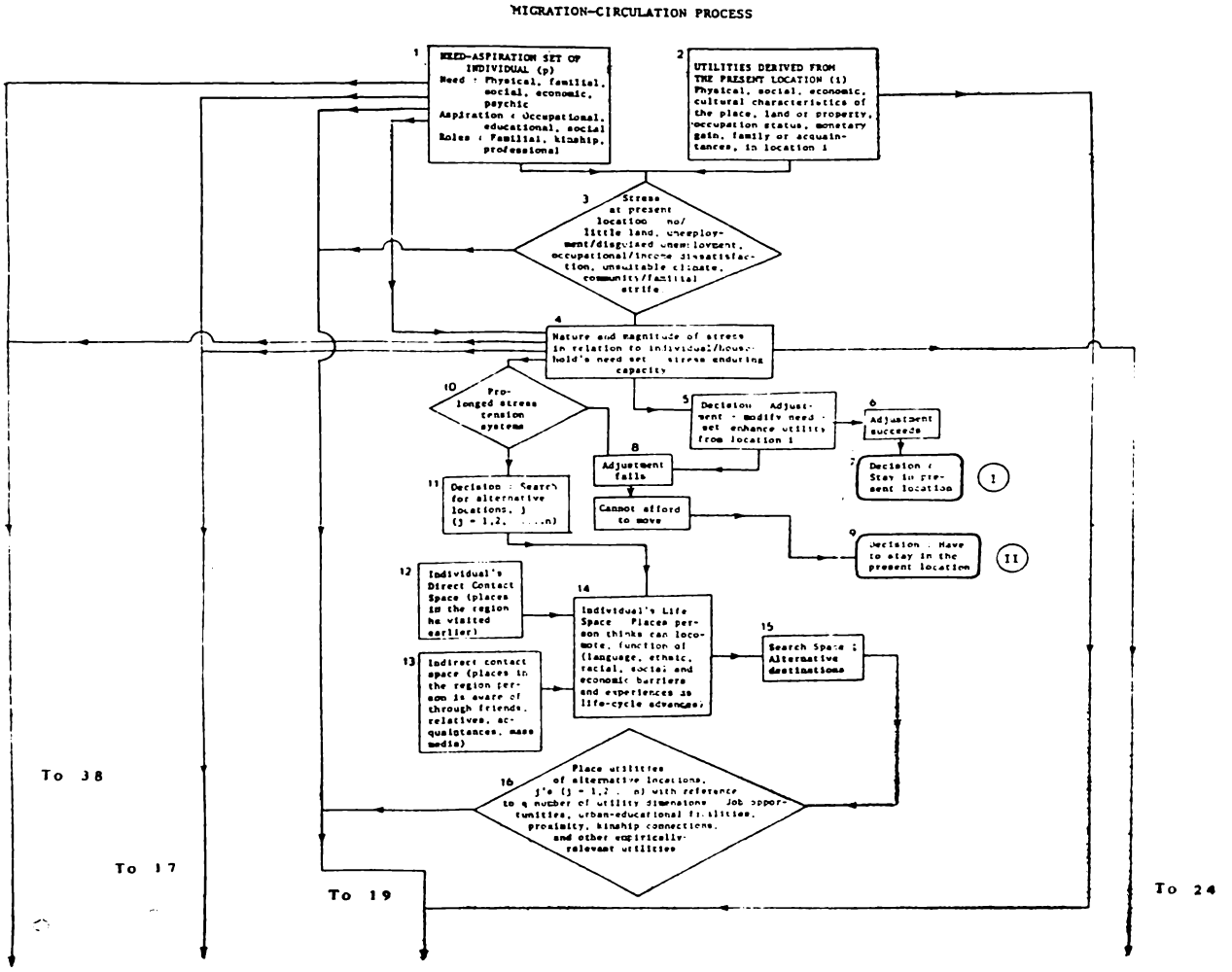


Fig. 2a. Decision-making process in different kinds of movement as viewed in the Mobility Field Theory Framework (continued).

develop in his field, and he might be disposed to search for a job in another place. Thus, the need-stress system creates forces in his field and gives it its dynamic nature. These forces, arising from the individual's need and stress systems, generate movement within the mobility field for gratification of a specific need (No. 3). These forces are adjusted and oriented among themselves by affixing valences or utilities to probable alternative destinations according to their abilities to provide need-gratification, and in so doing, these dynamic forces tend to equalize various tensions and stress systems within the life of an individual. (Figures 1a and 1b; Figure 2: 10-16).

B. Attribute Space

Need-stress-attributes of the individuals are potentially infinite, and are entangled in

MIGRATION-CIRCULATION PROCESS
(Continued)

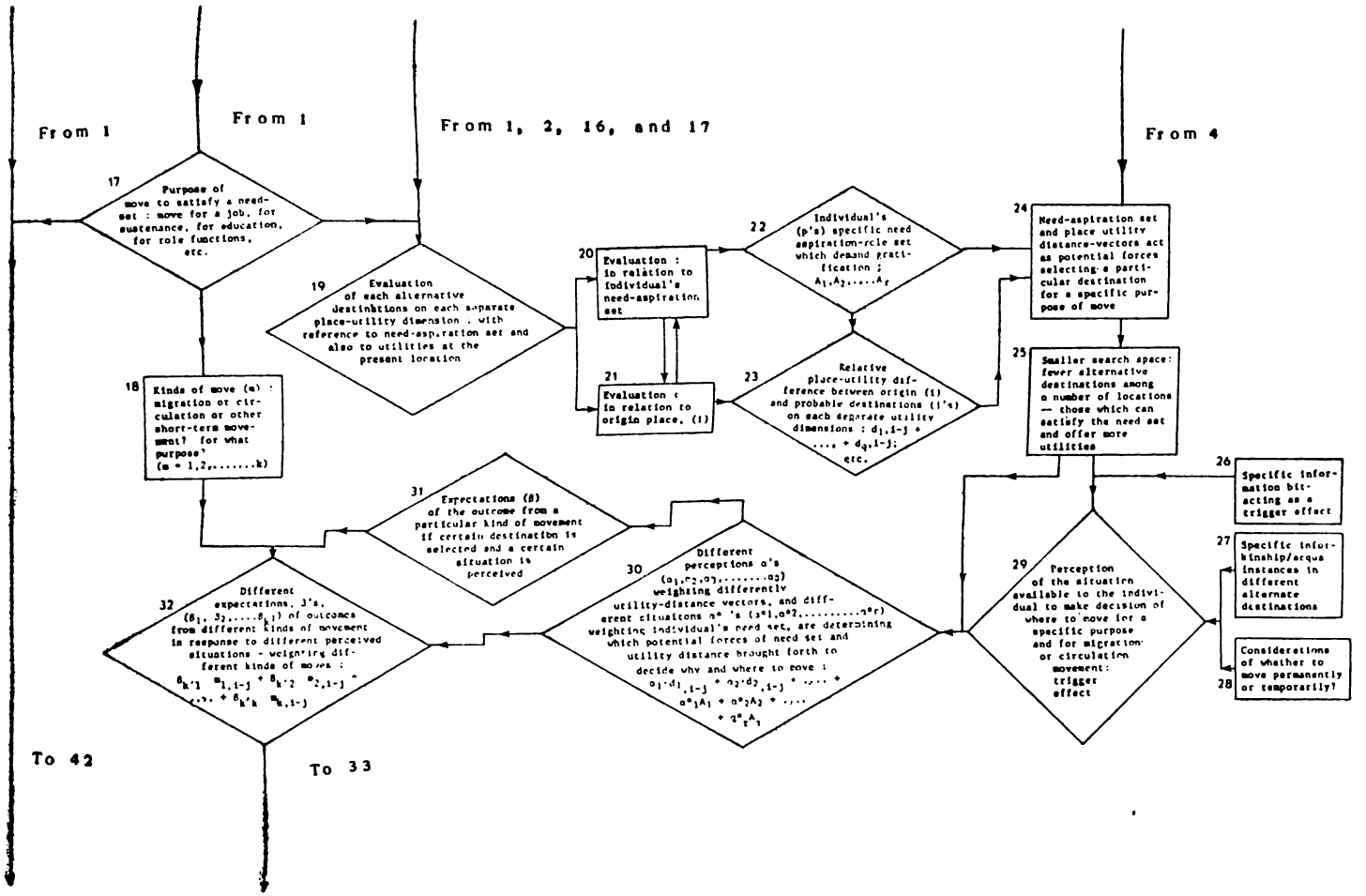


Fig. 2b. (Continued from Fig. 2b).

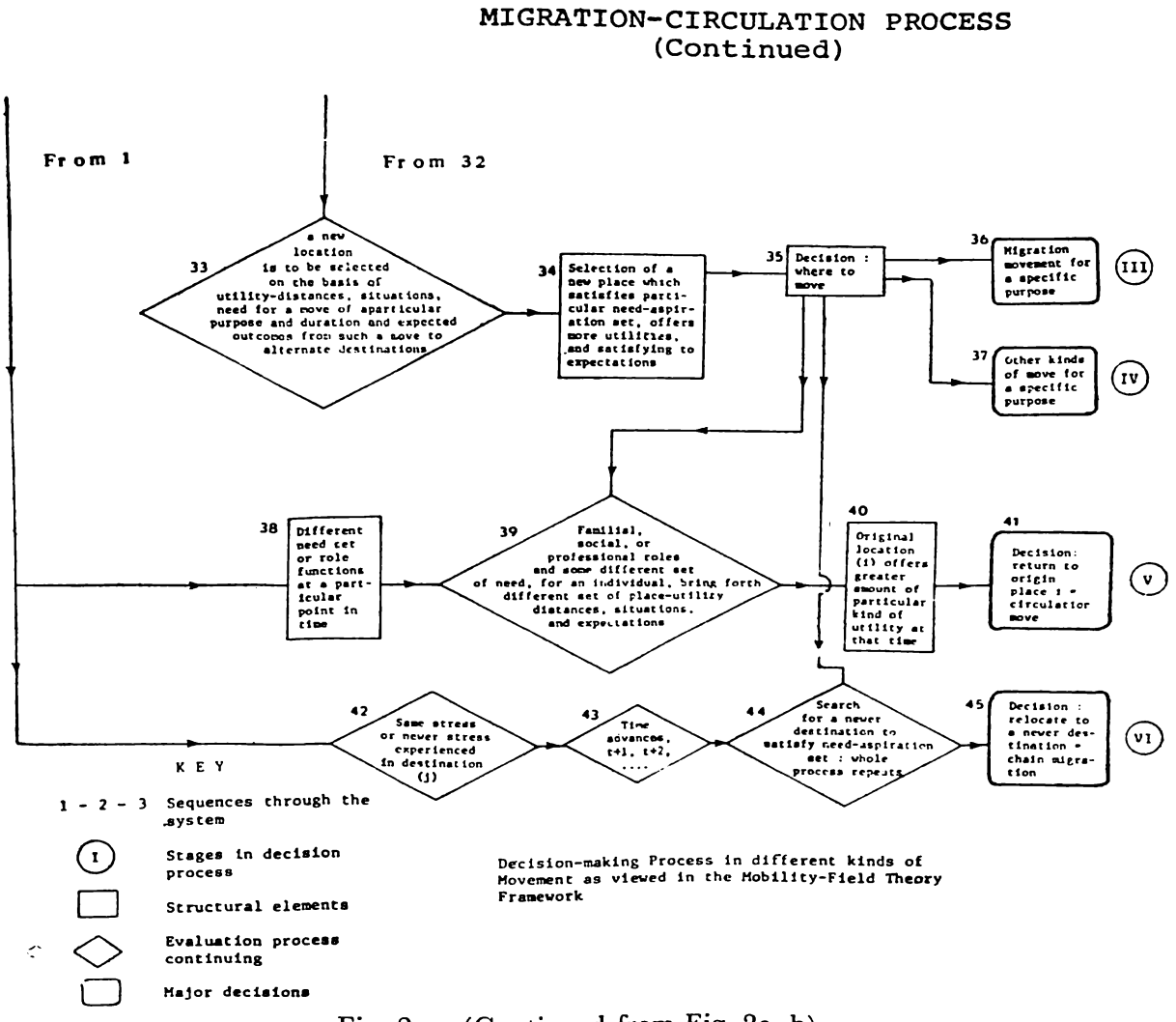


Fig. 2c. (Continued from Fig. 2a, b).

many unknown and complex interrelationships. The precise nature of these complexities are very difficult to unravel, unless we disentangle them into meaningful and empirically-derived basic components, and describe an individual's need-attributes in relation to these components. In this connection, Rummel argues that 'Manifest behavior is a function of latent dispositions, or potentialities or commonalities. These latent dispositions themselves are functions of many known or unknown latents, which we cannot cognize or intuit. So in explaining reality with our perspective, we indeed transform its multitudinous actuality and potentialities into simpler, more orderly and comprehensive relationships. We apprehend the functions themselves as latent—and call them as latent functions. Functions of latent functions presuppose a space delimited by the common latent func-

tions....which form the component of the space'[20]. The common latent functions, which are complex components themselves, form the coordinate axes and delimit a space in which individual person's (or places) manifestation can be given a point or a vector location with magnitude and direction. These components can describe the underlying structure of need-stress-attribute systems of the population, in relation to which an individual's relative need-stress-attributes sets can be better understood. (Figure 3). The same argument is also held in explaining the individual's utility considerations and their movement behaviour.

Thus, from an infinite number of need-stress-attributes of all movers in a study population, we can generate a common space, termed Attribute Space, which is spanned by a finite number of dimensions or components that underlie the attribute structure of all the individuals in a population. Hypothetically speaking, these components may define such composites of need-stress-attributes as socio-economic status, job-income dissatisfaction, a social aspirations (Fig. 4). On this space, an individual can be projected as a vector, with length and direction, which would specify his own unique location with reference to such attribute components. This individual

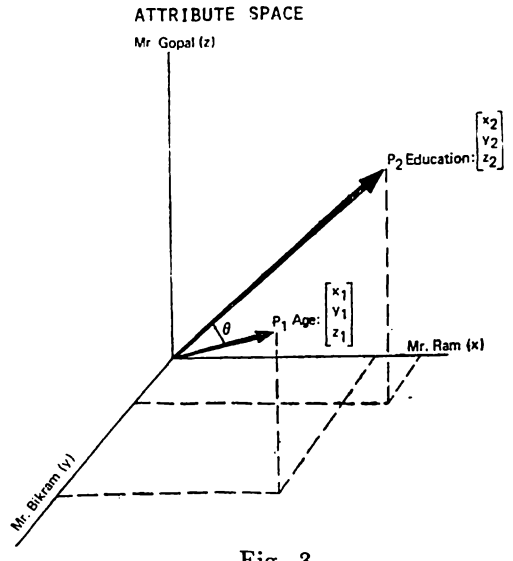


Fig. 3

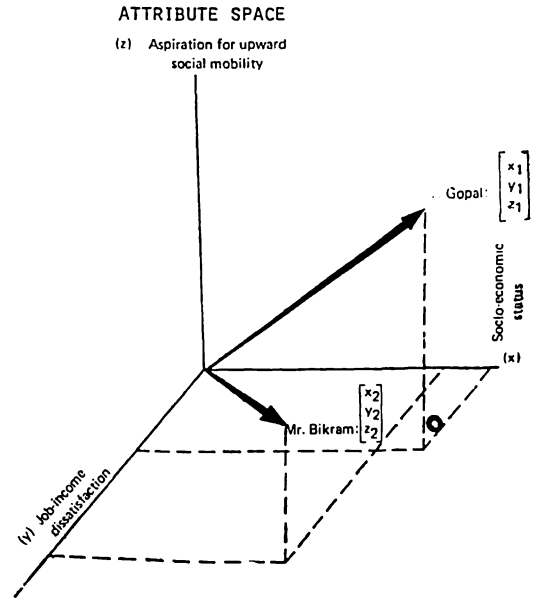


Fig. 4. Attribute Space-Location of individuals on the attribute space.

vector portrays a person's net need-strength and his specific share of the attribute structure, relative to all other individuals. An individual's separate vectors, defined with a reference to separate attribute components, provide measures of different aspects of his need-attribute sets. Some of these may define his need-aspiration set, some his stress conditions, and some his different attributes.

Then, for an individual, p, these can be expressed as :

$$(p, A) = a^{*}_{p1} A_1 + a^{*}_{p2} A_2 + a^{*}_{p3} A_3 + a^{*}_{pr} A_{r'}, \quad \ldots\ldots (1)$$

20. Rummel, *Op. cit.*, 1975, ch. x.

where, A's are different independent need-attribute component describing the underlying and unknown need-attribute structure of all individuals in a population, in relation to which an individual's need system can be delineated; a_p^* = different co-efficients or weightages according to the component's importance in defining an individual p's total need-attribute systems. The a's may vary according to different perceived situations of needs and stresses at different time points.

C. Place Utility Considerations and Utility Distances

When needs and aspirations are not fulfilled in a given situation, psychological stress begins to form, and a decision to move is initiated. The nature of such psychological stress, however, is difficult to understand and measure. Thus, instead emphasis is given here on sources of such stress-forming situations or stressors such as unemployment, drought, lack of land, debt, or anything that is relevant to the study population.

Movement behaviour in a spatial context implies some form of decisions and choice of a place where to move. "Even habitual movement when first initiated involved a conscious choice process".[21] Decision-making involves choices by the individuals, who have a specific level of information, between a set of alternatives which have specific and separate locations. Each of these places has certain utilities or opportunities to offer. Place utilities, according to Wolpert, refer to the net composite of utilities which are derived from the individual's integration at some position in space. As Wolpert puts it : "Place utility may be expressed as a positive or negative quality, expressing respectively the individual's satisfaction or dissatisfaction with respect to that place. He derives a measure of utility from the past or expected future rewards at his stationary point.....generation of population migration may be considered to be the result of a decision process which aims at altering the future in some way and which recognises differences in utility associated with different places".[22] This implies that an individual subjectively evaluates the disparities between his needs-aspirations and offerings of a given location, and tends to relocate himself at a place whose characteristics or opportunities possess a relatively higher level of utility than that in other alternatives.

The nature of place utilities relevant for the individual's decision-making is not yet precisely known, but in general such utilities can be recognised as functional utilities or attributes of places, accessibility, kinship connections, urban amenities, climatic conditions, and other empirically derived and relevant utilities (Fig. 2 : No. 16).

An individual's search behaviour occurs within his dynamic mobility field. Each place he is aware of is located in his life-space that defines his subjectively relevant region wherein he can locomote (No. 14-16). Thus, he perceives each alternate destination as a bundle of utilities in relation to his need systems (Fig. 2 : No. 19-23). His perception of places is thus coloured by his need-attribute sets and stress situations (No. 24-29). He derives certain utilities from his present location and evaluates the utilities of other places in comparison to that location (No. 21). Thus, he is concerned, not with absolute utilities of places, but rather with the relative differences

21. Simon, Herbert A., *Administrative Behavior*, New York, 1945.
22. Wolpert. *Op. cit.* 1965, p. 165.

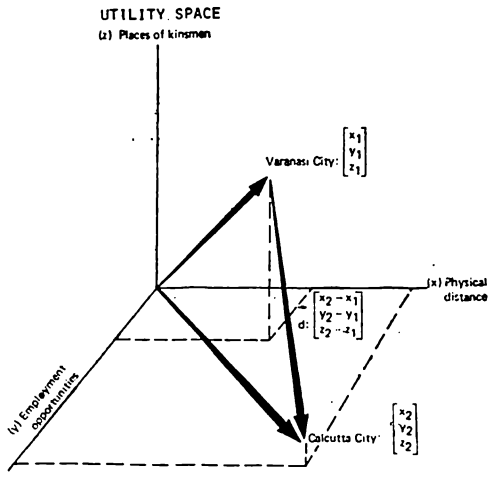


Fig. 5. Utility space-location of places in place-attribute space and resultant measure of perceived place-utilities difference,as a distance vector (d). Similar diagram can be drawn for an individual-showing his own unique place-utility distance vectors.

(gains or losses) between utility available at the places of origin and destination, defined as an *utility-distance vector* between them (Figure 5; Also 2 : No. 23). This concept of utility-distance vector was lacking in wolpert's model.

D. Utility Space

The diagram shows a multi-dimensional space called Utility Space (Figure 5). From data on the individual's perference ranking of all given locations in a region (measured with respect to a large number of place-utility variables), we can also generate this utility space which would be spanned by a finite number of independent utility dimensions. These dimensions would delineate the configuration of the structure of place utility of all given locations.....particularly as have been perceived and evaluated by all the individuals in a sampled population. These dimensions may represent such utility considerations as, for instance, physical distance, employment opportunities, kinship nearness, and so forth (Figure 5). Being defined and generated with reference to the individual's perception, such utility dimensions thus would unfold those basic independent utility considerations that are being perceived as meaningful to the population concerned. On this multi-dimensional utility space, each place then can be projected as a vector which will give a measure of net composite of place utilities of each specific location. A distance vector between a pair of places on the utility space (d) thence provides a measure of an individual's perceived utility difference (gains or losses) between them (Figure 5). Similarly utility distance vectors between a pair of pla ces (origin-destination) can be measured on each separate utility component for each individual. These distances would indicate the respective individual's perceived utility differences, gains or losses, betweeu them (with reference to separate utility components). These distances may be considered as potential spatial-behavioral forces to induce moves of the individuals between that pair of places.

Magnitude of the utility difference between a pair of places would vary proportional to the length of the distance vector separating them. The smaller the distance, smaller the utility difference between a pair of places and vice-versa. The smaller the positive distance, the smaller is the utility gain. Conversely, the greater the negative distance, the larger is the utility loss.

But, the prime consideration is not the net composite of utilities of a place, rather each separate utility dimension as it becomes meaningful to an individual. Thus, the relative utility differences between a pair of places are required to be considered separately with reference to each of the utillty dimensions, and they together need to be considered, not

TABLE I

MOBILITY FIELD

M-Matrix

Mobility Behavior

Individual mover	Labor migration for sustenance	Migration for education	Circulation to village for harvesting	.....	.....
	$m_{1,\ i-j}$	$m_{2,\ i-j}$	$m_{3,\ i-j}$	.....	$m_{k,\ i-j}$
1, i-j					
2, i-j					
3, i-j					
4, i-j					
5, i-j					
...					
...					
...					
...					
n, $i_{(n)}$-$j_{(n)}$					

D-Matrix

Place-Utility Distances

Pair of places	Distance on employment opportunity	Physical distance	Distance on urban facilities	.....	.....
	$d_{1,\ i-j}$	$d_{2,\ i-j}$	$d_{3,\ i-j}$	.....	$d_{q,\ i-j}$
i-j					
i-j					
i-j					
i-j					
i-j					
$i_{(n)}$-$j_{(n)}$					

A-Matrix

Individual's Need-Attribute Systems

Mover	Landless Agricultural labor	Underemployed	Need for Edun.	.....
	A_1	A_2	A_3	... A_r
1				
2				
3				
4				
+ 5				
n				

$$\beta_1 m_{1,\ i-j} + \beta_2 m_{2,\ i-j} + \beta_3 m_{3,\ i-j} + \cdots = \alpha_1 d_{1,\ i-j} + \alpha_2 d_{2,\ i-j} + \alpha_3 d_{3,\ i-j} + \cdots + \alpha_1^* A_1 + \alpha_2^* A_2 + \cdots + \alpha_r^* A_r + \cdots + U_i \text{ (unique experience of individual)}$$

EXAMPLE: Co-eff. (Migration of labor for search of any manual job, from i to j place) + ... = Co-eff. (higher utility of places j's providing jobs) + Co-eff. + ... + Co-eff. (perception of nearness) (need for sustenance) + ... + Co-eff. + ... + Co-eff. (severely underemployed) + Unique experience and will

separately by themselves, but rather in relation to the individual's need strength or attributes. In this design, thus, the place-utility distance matrix and the need-attribute matrix are considered together, as shown in Table I (also see Fig. 2 : No. 30).

Further, utility can be positive or negative according to an individual's subjective evaluation and specific need-stress situations. Thus, although the absolute functional distance between a pair of places, whether seen from i to j, or j to i, is always the same and positive, their subjective and situation specific evaluation at different time points would be either positively or negatively assigned. These 'signs' are to be empirically assigned on the basis of each individual's expressed 'direction' of perference for a particular place i or j, for the same pair of places i-j.

For instance, if the person is located at i (origin) and while evaluating along the job utility component, the place j is preferred, then the 'direction' of preference flows from i to j, and is positive. Consequently, a positive sign is to be assigned to his i-j distance along the job utility dimension. Conversely if the person is located at the same place i (origin), but while evaluating along the kinship utility dimension, the origin place i is more preferred to j (where he, however, moves for a job), then the direction of perference flows from j to i, and is negative. So, a negative sign is to be affixed to the i-j distance, but on the kinship utility dimension. Hence such utility distance vectors are to be multiplied by a matrix of positive and negative signs by empirically considering each individual's utility-distance vectors, at each specific situation of need-stress and purpose of move.

Then, for an individual (p), utility distances can be expressed in the following equation :

$$(P, U) = \alpha_{p1}d_{1,\ i-j} + \alpha_{p2}d_{2,\ i-j} + \alpha_{p3}d_{3,\ i-j} + \ldots\ldots + \alpha_{pq}d_{q,\ i-j} \quad \ldots\ldots(2)$$

where (p, U) = his net composite of utility differences between given pair of places, i and j (origin and destination).

d_{i-j} = his subjective utility distances between the place i and j, separately on q number of utility dimensions;

α_p = co-efficients weighting the relative importance of different utility distances in comprising an individual p's net utility considerations. These co-efficients may vary according to his specific need-stress situations and varying perception of places at different time points.

E. Mobility Behaviour

If different individuals are found to have broadly similar behaviour patterns, then we have the beginnings of generalisations about the mobility behaviour of a group or community, and individuals can be linked and separated in terms of similarities and dissimilarities in their mobility behaviour. Such different mobility behaviour are resultant manifestations of change in some state of the mobility field. Thus, different constellations of need-sets and place utility considerations at different time points may induce him to move for different purposes (Fig. 2; No. 30-37). Spatial movement, then, simply is a process of adjustment whereby one place is substituted for another in order to better satisfy the needs and aspirations of a mover and to lessen the stresses at the present location.

Such a general behavioral framework as that of the mobility field is capable of explaining the decision-making process with respect to, not only migration moves, but also circulation, oscillation or other kinds. Circulation,

thus, can be viewed as a process of movement in which the net composite of utilities or satisfactions derived from the destination place may be perceived as being slightly greater than those of the origin place but, some other specific kinds of satisfaction or utilities (like kinship bonds, familial or social ties) derived from the origin place, are considered more. And, this may induce a circular movement back to origin place at a particular time (Fig. 2; No. 38-45).

These can be explained better with reference to earlier Figures 1a and 1b. At one time, t_1, an urge to satisfy specific needs and a perception of specific utility gain elsewhere may motivate an individual to migrate or temporarily move from his present location (i) in mobility field to a destination (j) within the mobility field in which he perceives need gratification is achievable (Figure 1a). At another time, t_2, his different combination of need-attribute set or newer stress situations at the destination (j), may lead him to evaluate a specific utility gain (to meet family or kinsmen, etc.) from the origin place (i) is of more value Consequently, he may return to his origin place (Figure 1b).

F. Mobility Behaviour Space

As in attribute and utility space, likewise, we can also generate a Mobility Behaviour Space. From specific details all individuals' different kinds of moves and their spatio-temporal-directional-purpose characteristics, a Mobility Behaviour Space can be generated, to be spanned by a finite number of independent dimensions that underlie the structure of their mobility behaviour patterns. These dimensions may describe, for example, labour migration for any job, migration for education, circulation for harvesting in the village, etc. (see Figure 6). On this behaviour space, an individual's movement behaviour can be

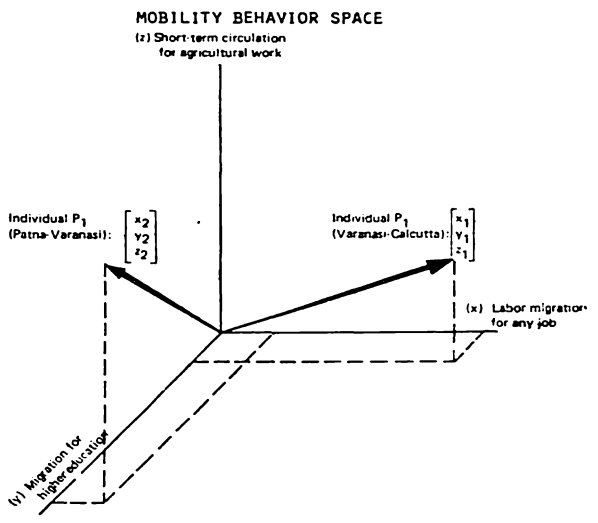


Fig. 6, Mobility behaviour space : Dyadic mobility flow of an individual P_1 from an origin to a destination.

shown by projecting a vector which would represent his share of the common structure of movement behaviour that are experienced by all the individuals in the study population. That is, his specific mobility behaviour is defined in relation to the basic underlying and unknown behaviour patterns of the population. This behaviour structure may vary from population to population, but the basic principle holds good universally. The crucial point to note here is, as shown in the Figure 6, that places are coupled into dyads representing the places of origin and destination involved in an individual's movement. That is, the projected vector shows an individuals's movement through a given dyad, from an origin to destination. It connotes that an individual (p) who is located at a place i, is behaving or moving towards a place j. Thus, a person and a place are coupled into a dyad, and thus movements, by definition, are always dyadic behaviour. Of course, an individual may not neccessarily reflect all the mobility behaviour components, nor always make such moves

through the same given dyad, i-j. But, their very presence or absence can describe an individual's specific behaviour structure.

Thus, an individual's (p's) different kinds of mobility behaviour can be expressed in the following equation :

$$(p, M) = \beta_{p1}M_{1, i\text{-}j} + \beta_{p2}M_{2, i\text{-}j} + \ldots\ldots + \beta_{pk}M_{k, i\text{-}j} \ldots\ldots\ldots\ldots (3)$$

where, (p, M) = individual p's total manifest mobility behaviour

$M_{1, i\text{-}j}$ = Different independent mobility potentials or mobility behaviour patterns of dislocating from place i to place j as defined by all movements of all individuals in a study population;

β's = Co-efficients weighting those behaviour components according to their relative importance in describing the individual's mobility behaviour. These co-efficients may vary according to the individual's different expectations from different perceived situations.

Thus, there are three mani elements in an individual's mobility field : the individual's attribute structure, involving need, traits and stresses; his perception of places, especially his utility distance-vectors; and his different kinds of moves between origin and destination. These three elements are interdependent parts of his mobility field, all are given their exact and synchronised positions in the concept of the human field. *In summary, needs create tensions; tensions lead to search behaviour; in the search process an individual perceives places as relative utility distances; his need strength colours his utility distances as more or less meaningful; and finally, the resulting mobility behaviour occurs as a manifestation of all these dispositions and the forces of his dynamic mobility field* (Figure 7). In essence, a specific mobility behaviour of an individual from an origin to a destination is a linear function of his need-stress-attributes and of his subjective utility distances between that pair of places (Figure 7, Table 1)

G. Linkage Equation

Thus, the final equation for an individual (p), linking his need-attributes, through his place utility considerations, to his resulting mobility behaviour, can be derived as follows:

$$\beta_{p1}M_{1, i\text{-}j} + \beta_{p1}M_{2, i\text{-}j} + \ldots = \alpha_{p1}d_{1, i\text{-}j} + \alpha_{p2}d_{2, i\text{-}j} \ldots + \alpha_{pq}d_{q, i\text{-}j} + \alpha^*_{p1}A_1 + \alpha^*_{p2}A_2 + \ldots + \alpha^*_{pr}A_r \ldots (4)$$

where, the $M_{i\text{-}j}$ comprises the *mobility potential* of a person who is always located at

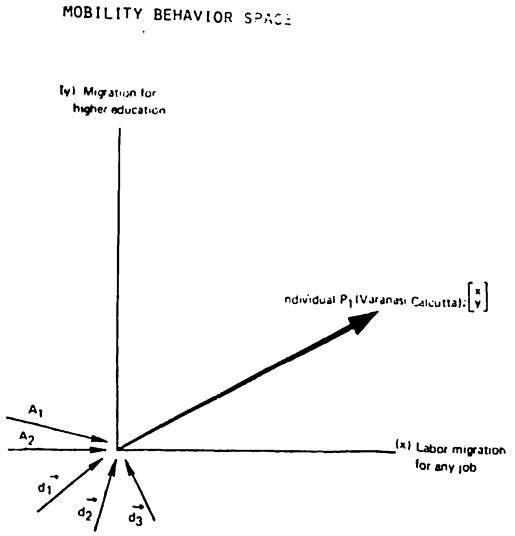


Fig. 7. Mobility behaviour space : Perceived utility differences, as utility-distance vectors, and needs acting as forces on Dyadic mobility flow of the individual P_1 from an origin to a destination.

place i, to move to place j, for a given kind of mobility behaviour type M_1, M_2, M_3...., M_k;

the β comprises the *co-efficients* or *weightages* of p corresponding to mobility potentials for different types of mobility behaviour to move to place j;

the d_{i-j} comprises the different kinds of *subjective utility distances* i – j for the person p;

the α comprises the *co-efficients* or *weightages* of p corresponding to his different subjective utility distances, weightages varying according to different perception of the places at different situations;

the A comprises the *need-stress-attribute sets* of the person p, different A's defining his different need-stress-attributes sets;

the α^* comprises the *co-efficients* or *weightages* of p corresponding to his different need-stress-attribute sets. Weightages varying according to the relative importance of specific need sets at a particular situation to cause specific kind of mobility behaviour.

These linkages are established at the individual's level. The central idea is that an individual's different need-stress-attribute sets and, in relation to these, his perceived different kinds of utility-distances between a pair of places i and j, are the causal psychic and spatial-behavioral forces that underlie his different kinds of mobility behaviour between that given pair of places, from i to j. This provides a general linkage equation applicable to all individuals in a population[23]. A brief explanation now follows.

H. Explanations

Firstly, such measures of mobility potentials, place-utility distances, and need-attributes are conceived and operationalised as 'potentials', as latents, as probabilities of behaviours and attributes, not as actual manifestations These potentials are based on components, which are probability density functions describing the common structure of the data, and specify the broad limits or range of probabilities that can happen. Hence, although the model is basically deterministic, it also incorporates the essence of a probabilistic model. In fact, explaining multitudes of

23. For an excellent theoretical treatment of a psychological field concept, see R. J. Rummel's recent work, *The Dynamic Psychological Feld : A Phycho-Philosophical Prolegomenon to the Dynamics of Conflict and War*, 1975, Chapters 1-18. Since Rummel's psychological field theory was evolving and was available only after the mobility field theory had been formulated, its details could not be included in the present formulation, but the essence of his ideas definitely filtered through even lately, especially in presenting theoretical text. Difference however remains, because at the outset, Rummel conjointed 'situation vectors' (α's) to the individual's each personality components and 'expectation vectors' (β's) to the individual's each behavioral dispositions, and then sequentially developed linkages step by step at the individual level. This provides a more flexible explanation; however, this could not be done here as it required reformulating the entire text sequentially again, especially at a very late stage. Instead, these were termed here as 'coefficients' or weights. However, it was Rummel who helped in defining the dyadic mobility behaviour by pointing out that "let a person (p) always be located in place i, and let i–j mean p's disposition to move from i to j", which resolved the basic dilemma in the present formulation, discussed earlier, and without which, indeed, the present formulation could not have been rounded–off.

needs, utilities and movements of any individual is an unachievable task unless we cognise and intuit the basic elements underlying those infinite multitudes and specify each individual's unique deviation from such elements. Secondly, the same argument can also be extended to the case of any single individual. He may or may not reflect all the behaviour potentialities, utility considerations or the need systems; nor would he show all kinds of movement between a given pair of places i and j. But their very presence or absence would show what is relevant for him as to be reflected in the magnitude of corresponding α's and β's in the general equation, and the general equation would hold good for him, too. Thirdly, these very co-efficients would reflect what constellations of particular needs and utilities are brought forth to induce what particular mobility behaviour. These α's and α_*'s would vary for an individual, according to his different perceived situations at different times (perceptions of need-stress situations and of place's utilities), and consequently, would determine the magnitude of β co-efficients on the left hand side of the equation. Different constellations of these behavioral forces at different times would determine individual's different kinds of mobility behaviour. Fourthly, although the general equation is perfectly capable of incorporating different sets of alternative destinations (all the j's that might be involved in the search procedure in a single move might also be considered by computing all those corresponding utility distances), this has not been done here because of operational difficulties involved. Theoretically, this is also justifiable because this study, essentially, aims to provide an 'explanatory' model, not a predictive model of 'search behaviour', though it can easily be extended. Lastly, the debate on the linearity-nonlinearity question also has to be answered. In this connection, probably the best available answer can be presented in the words of Rummel, who argues that "What is confused is the linearity of a first degree equation ($y=a+bx+cz+....$) with the linearity of the terms within a function ($y=a+bx+cx^2+....$). Thus, multiple linear regression ($\hat{y}=\alpha+\beta_1x_1+\beta_2x_2+....$) and curvilinear regression (e. g. $\hat{y}=\alpha+\beta_1x_1+\beta_2x_1^2+\beta_3x_1x_2+....$) are *both* linear. The first is linear in degree and terms; the second only in the terms. What the multidimensional methods do is to determine orthogonal functions that are linear in the terms (the argument), but the terms themselves may reflect complex nonlinear relationships in the data. *It is because of this ability to fit and clarify nonlinear complexity that multidimensional methods are particularly useful in understanding total societies".*[24]

Now a more formal presentation of the Mobility Field theory in aggregate level is given through general statements, assumptions, axioms and matrix form. The theoretical text, discussed in the foregoing, is equally applicable to the formulation at the individual level, as well as at the aggregate level.

24, Rummel, R. J., "Population Policies and Demographic Change : Dimensions, Projections and Linkages". Papers, PATH Institute, Honolulu. Hawaii, 1974, p. 8.

IV. THE MOBILITY FIELD THEORY

A. General Statement

Mobility field theory states, in both verbal and mathematical form, that :

1. at the level of the individual, movement behaviour of a person, located at place i, towards another place j, is a linear function of both that person's specific need-stress-attribute set and his perception of place utility distances between the pair of places (origin-destination), and
2. at the level of the aggregate system, the need-stress-attribute structure of the individuals in a population, their perceived place utility distances between pair of places, and their resultant types of mobility behaviour, are interdependent parts of the mobility system, called mobility field, and any natural or induced change in one part would generate corresponding changes in other parts of the field.

B. Assumptions

Five basic assumptions underlie this field theoretic model :

First, the *assumption of co-existence :* that is, an actor's attributes, his perception of place utilities and his mobility behaviour *co-exist* in a field, and the whole field is relevant to understanding of specific behaviour.

Second, the *assumption of contemporaneity :* that is, only the present is sufficient for explaining mobility behaviour, the past is presumed to operate through the behaviour, attributes and place utility considerations that are currently *co-existing* in the field. This concept of co existence of facts in the life space of the actor is fundamental in Lewin's field theory and also in the present theoretical perspective. Conceptually and mathematically, this notion of co-existence permits picking-off only those specific attributes, utility considerations and behaviour which are really co-existing in a field, which have demonstrable effects upon behaviour, excluding all others which *do not belong to that field.*

Third, the *assumption of interdependence :* that is various parts of a given life space of the individual actor are to some degree interdependent, i. e., the person's needs, his place utility considerations and his behaviour are interdependent parts of a whole, called the mobility field.

Fourth, the *assumption of relative functional distance* : absolute magnitudes of place utilities are considered irrelevant to mobility behaviour; what is relevant is relative behaviour of a person, located at place i, towards another place j and the utilities of these places relative to each other (gains or losses).

Fifth, the *assumption of need-stress-attributes* : crucial to mobility field theory is the basic assumption that the absolute magnitute of need-stress-attributes systems of the individual person is relevant to his mobility behaviour, and his perception of relative utilities of places of origin and destination is coloured by and filtered through the prism of this need-stress-attribute system. Thus, in explaining mobility behaviour these two elements must be considered, not in isolation, but rather simultaneously.

C. Axioms[25]

1. The Mobility system is a field consisting of all the attributes of persons and of places and all movement behaviour of persons towards places, and their complex interrelationships.
2. The mobility field can be divided analytically into persons' attribute, A, utility, U, and mobility-behavioral, M, spaces into which attributes of persons, perceived utility of places and movement behaviour of the person to places are projected, respectively, as vectors with length and direction.
3. The attribute, utility and mobility-behaviour spaces are spanned by dimensions which generate the spaces and which are finite and empirically determinant.
4. The attributes of places and attributes of the individual mover are required to be linked and subsumed in the notion of the individual mover's perception of place utilities. Thus, geographic units such as places and persons are located as vectors, respectively, in utility and attribute spaces and are coupled into dyads in mobility behaviour space, i.e , the dyad connoting a mover (P) located at a place i moving towards a place j.
5. Attribute vectors, $\vec{A}_1$, $\vec{A}_2$, in A space that describe the need systems of individual person and the distance vectors, $\vec{d}_1$, $\vec{d}_2$, in U space that connect a pair of geographical units (origin and destination) and which measure utility differences between them, are spatial behavioral forces determining the location, $\vec{M}$, of dyads in M space, according to the linear function $\vec{M}_{i-j} = \Sigma\alpha_q \vec{d}_{q,\,i-j} + \Sigma\alpha_r^* \vec{A}_r$. The basic axiom of mobility field theory is that the movement behaviour of a person, located at a place i, towards another place j is a linear transformation of the person's specific need-stress-attribute set and in relation to these, his perception of place utility differences between that pair of places.
6. The direction and velocity of movement over time of a dyad in mobility behaviour space is along the resolution vectors of the forces, $\vec{d}$ and $\vec{A}$, as person's needs change, places multiply and perception of their utilities change over time.
7. Mobility behaviour space is a sub-space of combined A and U spaces. M space is completely contained in A–U space and the dimensionality of M–space is less than or equal to that of A–U space. That is, a basis of M–space is a linear combination of a basis of A–U space and that a basis of M space is also possible to find that is a subset of a basis of A–U space.

D. Axioms Elaborated

The first axiom states that theoretically mobility phenomena form a field or a bounded system composed of need attributes of persons and of places (as perceived by the individuals) and movement behaviour of person to places, and their complex interrelationships. That is, the human subsystem, the perceived spatial system and the movement behaviour subsystem are interdependent parts of the mobility field.

Attributes of a person are any descriptive characteristics which define need sets and

25. For mathematical arguments behind similar axioms, see Rummel (1965), *op. cit.*, pp. 197-204.

socio-economic condition of the individual person relative to all other persons in the human subsystem, including all specific stresses he undergoes due to his particular location in the geographic space. These needs and attributes are already described.

Attributes of places, as perceived by the individual actor, are defined as place utilities, and such utilities can be any relative functional characteristics which differentiates one specific place from all others. Places can be origin and destination specific to each movement of the actor.[26] These functional characteristics are already described. Note that it is not the absolute functional attributes of places, but rather the individual's perception of them, his subjective preference rankings of the places with referenee to place-attributes, which become the relevant inputs and which define the perceived spatial system (perceived by the human subsystem).

The third element is movement which by definition, consists of an individual's actual travelling from an origin to a destination. It is neither an interaction between two persons nor between the two places, but rather a behavioral act of a person, located at place of origin (i), towards a place of destination (j), with a specific purpose. But the opposite is not true, a place does not move to a person obviously. A person and a place thus coupled by an act of movement, is called a dyad. The action that couples a person and a place of destination is treated, in this paper, as dyadic movement behaviour. In this respect, territorial displacements are always dyadic behaviour. Theoretically, dyadic behaviour may assume symmetrical behaviour, which is not true in the movement situation. Movement of a person (p) from place i to place j is not symmetrical in term of duration and purpose of move as to his return movement from place j to i. However, dyadic symmetrical interaction is not a prerequisite of this theory, because, by definition, movement behaviour is an action of a geographic unit (person) towards another unit (place), and such directed dyadic behaviour can be treated within the theory.[27]

However, such behavioral acts of persons to places are potentially infinite and include the individuals' different kinds of migratory circulatory or oscillatory movements for different purposes between different dyads i's to j's or j's to i's. These behavioral acts link multitudes of persons to multitudes of places. Such person-place moves comprise the dynamic movement behavioral system.

The attributes of persons, their utility considerations and their dyadic movement behaviours are all bound in a complex web of interrelationships. The aim of the mobility field theory is to uncover specific and unknown relationships among the three.

The second axiom is provided for analytic purposes. It divides need-stress-attributes,

26. Theoretically, alternative destinations can be easily accommodated here. However, due to operational difficulties in handling an infinite number of locations, these are not included here. A more elaborate search model will have to incorporate utility distances for each alternative destination.

27. Furthermore, theoretical requirement of symmetrical or assymmetrical dyadic interaction is immaterial to the present model. Because the purpose is not to test symmetric interaction between a given pair of places i and j, but rather to test whether movements of a person, separately from i to j, and from j to i, are dependent on his 'subjective' 'situation-specific' utility distances corresponding to that particular dyad i to j, and j to i.

utilities and movement behaviour into three separate bounded systems and corresponding three spaces.

The following discussion regarding vectors and vector spaces is general to all the three spaces, attribute A, utility U, and movement behaviour, M, and thus, reference will be made only to Attribute space.

The need-attributes that have been considered relevant and selected for analysis define a vector space bounded by the total number of geographical units or individual persons in the system. Within this space, each need-attribute, comprising of as many values as there are units or individuals, forms a vector. These attribute vectors have their magnitudes or lengths, and their direction from each other is a function of the correlation between them. These intercorrelations between various attributes, then define the *need-attribute system* of the study population.

These aspects can be graphically represented as in Figure 3, which portrays a hypothetical need attribute system. For the sake of example, consider for the present only three individuals—Mr. Ram, Mr. Bikram and Mr. Gopal—who represent the three coordinate axes and only two attributes—age and education. For illustrative purposes only, for the present, the three axes are drawn mutually perpendicular, with the coordinate for Mr. Bikram perpendicular to the plane of paper. The attributes, age and education, can be plotted as points P_1 and P_2, respectively, in terms of the standardized values for each individual. A vector is formed by drawing a straight line from the origin to the points; the angle, θ, betweeen the vectors is then a function of the product moment correlation between the attributes. The relationship between these two vectors forms a system, in "three dimensional, two attribute space."

This system can be enlarged, in the like manner, to include an infinite number of attributes, as well as individuals. The intercorrelations between the attributes constitute what is defined as a need-attribute system

Utility space and mobility behaviour space can also be represented in the above fashion, except that in utility space the coordinates of the space represent individuals' preference ranks of places and the vectors represent perceived utilities of places; and also that in mobility behaviour space the coordinates of the space represent all observed number of person-place moves, and vectors represent the individual's movement behavioral acts between a given pair of places.

The second axiom also points to an isomorphism or similarity of form and structure between the mobility field theory and analytical system of linear algebra and mathematical structure of such models as product moment correlation, muliple regression, factor analysis and the canonical model. It essentially stresses that these techniques are not imposed on the theory, rather can be derived from the analytical structure of the mobility field theory from its concepts of vectors, spaces, forces, force-fields, and the mapping of spaces onto each other. Thus, this axiom essentially links and binds the theory, concepts, methods and techniques within a whole, within the concept of the mobility field theory.

In this regard, the arguments forwarded by Rummel, while presenting his social field theory, are worth noting, as they are applicable to the mobility field theory as well. Rummel states : "The mathematical base of these well known techniques are part of, and indeed can be derived from, the analytic structure of theory. They thus can form the bridge to connect the abstract nature of social field theory to data. They allow for the falsi-

fying of the deductions of the theory. To any one familiar with the mathematics of regression or factor analysis, however, it would seem that these mathematical models are being elaborated in the guise of a social theory. This observation would be largely true in form, but not in substance. The multivariate model has been turned on its head, so to speak. It is employed not as a test of specific hypotheses, nor to generate findings about empirical relations. It is used, rather, as an actual model with a mathematical structure that describes this reality in a form sufficient for prediction."[28]

In essence, the notions of vector space or distance vector of linear algebra are isomorphic to concepts of attribute, utility and behaviour spaces and utility distance vector of the mobility field theory. Any deduction permissible within the mathematical structure of linear algebra is also permissible within the mobility field theory, and each of the axioms in both is empirically falsifiable.

Axiom 3 points out that from an infinite number of attributes, or utilities or behaviour it is empirically possible to delineate a finite number of bases of dimensions—which will generate their corresponding spaces. That is, all the separate attributes, utilities, and movement behaviour vectors are linearly *dependent* upon a finite set of dimensions or components which, in turn, are linearly *independent* of each other. It implies, that attribute vectors can be mathematically recombined or reduced in such a way as to form a smaller set of vectors, which, however, do not lose any properties of the original, but can represent the larger set of data. Each of the original vectors is linearly dependent on the new vectors, but the new vectors (components or dimensions) themselves are orthogonal or uncorrelated. These orthogonal dimensions can be regarded as a coordinate system with coordinates at right angles to each other.

Axion 4 states that on such multi-dimensional attribute space, each of the individuals comprising the system can be projected as a vector. Its precise location will depend on the linear dependence of its attributes on the various dimensions. Figure 4 graphically exemplifies such specific vector locations of two selected individuals on the attribute space. For illustrative purposes only, this space is shown as constituted by three main dimensions labelled as socio-economic status, job-income dissatisfaction and aspiration for social mobility. Two individuals—Mr. Bikram and Mr. Gopal—are shown projected into attribute space—their precise and unique locations being determined by the degree each shares these common attribute components.

Likewise, Figure 5 shows that from data on different utility measures of each specific location, a finite number of independent utility components can be generated to define a perceived utility space, on which each place can be projected as a vector whose specific location on the utility space would be determined by the extent each shares common utility components that are defined by all individual's perception. A distance vector (d) between two specific locations would determine the utility differences between them as perceived by an individual. This distance can be calculated by subtracting an individual person's factor score for one location (say, origin) from another location (say, destination) on each utility dimension. This measures his perceived utility difference between a given pair of places (origin and destination).

28. Rummel, *op. cit.*, 1965, p. 184.

The closer the distance, the closer they are in utility space, and less the difference. Distances can be positively or negatively assigned on the basis of an individual's subjective—and situation-specific evaluation of each location at different times, as discussed earlier.

Behaviour space can be considered in the like manner. All of the separate measures of movement characteristics between person-place dyads can be collapsed into a smaller set of independent behavioral components, uncorrelated with each other, but each consisting of a linear combination of the original variables. Figure 6 shows an individual's (p_1) two projected vectors on this behaviour space representing his movement through two given dyads (Varanasi to Calcutta and Varanasi to Patna) shown in relation to three different behaviour dimensions or mobility behaviour types (hypothetically speaking, these dimensions may represent labour migration, migration for education and circulation for agricultural work). His specific location in this behaviour space depends on the extent he shares the common behavioral components. He may share a part, none or all. An individual might even reflect only one kind of mobility behaviour, his share of other kinds being reduced to zero.

Axiom 5 states the essence of the mobility field theory, that is, *the magnitude of attribute vectors, $\vec{A}_1$, $\vec{A}_2$, etc. in A space that describe the need systems of individual person and the utility distance vectors, $\vec{d}_1$, $\vec{d}_2$.....etc., in U space that connect a pair of geographical locations (origin and destination), are psycho-social and spatial-behavioral forces determining the location, $\vec{M}$, of person-place dyads in M space according to the linear function :*

$$\vec{M}_{i\text{-}j} = \Sigma\alpha_q \vec{d}_{q,\, i\text{-}j} + \Sigma\alpha^*_r \vec{A}_r \quad \text{.....(5)}$$

This statement is axiomatic to the theory and is empirically falsifiable. This states that the magnitude of specific need sets, out of the total need systems, and the magnitude of specific utility-distance vectors (as reflected in corresponding α^*'s and α (co-efficients) determine which specific mobility behaviour, out of the different kinds, is picked-off from the equation (reflected in β co-efficients), and is being explained. Only those specific combinations of attributes, utilities and mobility behaviour are to be mathematically picked off which are really co-existing facts in the mobility field, excluding others which do not belong to that field.

Such mapping of the bases of the behaviour space onto the bases of the combined attribute-cum-utility space and testing of interdependencies between them are performed by the canonical model, as may be apparent from Table 2 and as elaborated in the section under the operationalization of the model.

The sixth axiom adds dynamism in the static relationship defined in Axiom 5, but this is beyond the scope of the present paper. Axiom 7 holds that M space is completely contained in joint A-U space and dimensions of M space are linear combinations of dimensions of A-U, which can also be tested through the canonical model.

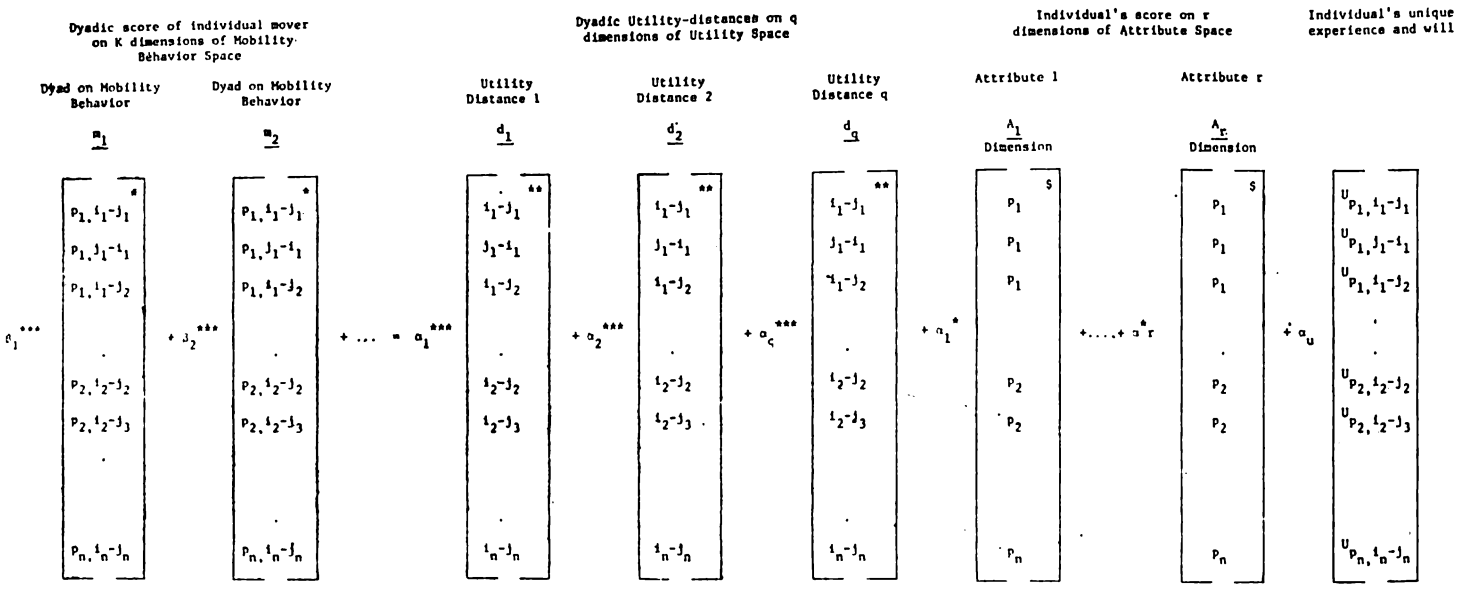
E. The Mobility Field Theory Formula

Axiom 5 categorically expresses the mobility field theory formula, that utility distance vectors in U-space and need-attributes sets in A-space are spatial-behavioral and psycho-social forces which determine the location of person-place dyads in M-space. This is expressed in the following *general equation*

TABLE II

MATRIX FORM OF MOBILITY-FIELD THEORY FORMULA

$$\beta_1 m_{1,i-j} + \beta_2 m_{2,i-j} + \cdots = \alpha_1 d_{1,i-j} + \alpha_2 d_{2,i-j} + \cdots + \alpha_q d_{q,i-j} + \alpha^*_1 A_1 + \alpha^*_2 A_2 + \cdots + \alpha^*_r + \alpha^u_u p_{,i-j}$$



* Value equal to (factor) score for the individual person's move through the dyad on the mobility behavior dimension, say, mobility behavior type 1.

** Individual mover's score for the dyad on the utility dimension; difference resulting from the subtraction of his one score from the other: a measure of his perceived utility distance between the origin and the destination.

$ Individual mover's (factor score on successive attribute dimensions.

*** Weighting scalar value equal to the amount of variance explained by the dimension--canonical coefficients--then all individual scores on that dimension are weighted equally.

and is shown in the expanded matrix form in Table 2 :

$$\beta_1 M_{1,\ i\_j} + \beta_2 M_{2,\ i\_j} + \ldots\ldots + \beta_k M_{k,\ i\_j} = \alpha_1 d_{1,\ i\_j} + \alpha_2 d_{2,\ i\_j} + \ldots\ldots + \alpha_q d_{q,\ i\_j} + \alpha^*_1 A_1 + \alpha^*_2 A_2 + \ldots\ldots + \alpha^*_r A_r + \alpha_u U_{p,\ i\_j} \ldots\ldots (6)$$

where, M_{i_j} = mobility potential to move from place i to place j of a particular kind of mobility behaviour, on k-dimensional mobility behaviour space;

β = corresponding canonical co-efficients (like regression weights) weighting respective mobility potentials;

d_{i_j} = different place-utility distance vectors between a pair of places i and j on q-dimensional utility space, which are defined by the individual's subjective perception/preferences of discrete locations;

α = corresponding co-efficients weighting respective utility distances;

A = different potentials of need-stress-attributes of movers on r-dimensional need-stress-attribute space;

α^* = corresponding co-efficients weighting respective need-stress-attribute sets;

U_p = a factor corresponding to individual's unique experience and will (which ensues as residuals from the equation);[29]

α_u = corresponding weightage.

This provides a general equation encompassing behaviour of all individuals, as aggregates. These linkages are established at the aggregate, general, system's level—unlike that in equation 4 where linkages are established at the individual's level, specifying each single individual's varying behaviour at different situations. Operationalization of equation 4, however, requires detailed data of each single individual over time (at different situations), or at least a sample of that. Although this model can also be operationalized, this is not shown in this monograph.

However, the equation 6, which has been operationalized in this study is a general formula which applies both to the aggregate systems level, as well as to the individual level : because, the individual's specific factors or deviations from the broad patterns would simply ensue as the residuals. These residuals may be regarded as an unknown U factor—accounting for an interplay of individual's learning, experience and will (Table 2). What equation 6 cannot categorically tell is related to the precise variations in each single individual's behaviour *at different situations* and accompanied different *expectations* of those perceived situations—a task which equation 4 can very well do.

F. Its Matrix Form

The expanded matrix form of the equation 6 is shown in Table 2. Here the utility distance matrix and need-attribute matrix (on the right hand side) are considered as the independent or explanatory sets and mobility behaviour matrix (on the left hand side) as the dependent set, and a canonical (regression) analysis is to be performed on them, as represented in the matrix form. In short, mobility matrix is to be explained by the combined need-attribute matrix and utility-distance

29. This U factor has been added to the equation, following Rummel's *The Dynamic Psychological Field, op. cit.*, 1975, Chapter 18.

matrix, and the 'U' vector (at the extreme right) would ensue as the residuals for each individual.

Within this matrix form, the rows in each vector represent the individual observations (often the same individual at different situations), and the columns represent different components or dimensions. Different mobility dimensions are shown on the left hand side of the matrix equation, whereas different dimensions of utility and need-attributes on the right hand side. Corresponding to each row in the mobility matrix (describing one move at a time), that mover's particular set of need-stress-attributes, as these are specifically related to that move, are to be placed in the attribute matrix. Likewise, his corresponding place utility distances for that pair of origin and destination are to be included in the utility matrix. Constructed in this way, then, a continuity and parallelism is ensured throughout the length of the three matrices, i. e., each element in these matrices essentially describes different aspects of the same move in question (Table 2). Then, through the canonical (regression) anlysis, the degree of interdependencies between these matrix-bases (of behaviour, utility-distances and attributes) are to be tested and causal-functional links of attribute-cum-utilities to resultant movement behaviour are to be specified.

Organised in this way, an individual's variations at different times (as discussed above) can also be included in the model as various inputs. For instance, as shown in Table 2, each individual's different movements through different pairs of origin-destinations (such as, $i_1 - j_1$, $j_1 - i_1$, $i_1 - j_2$ dyads) can be easily included in the matrix, provided that their corresponding utility distances are also considered. Given this, each individual's variations in behaviour at varying situations would also be reflected in the final results. However, these would appear rather more as broad patterns—as a group's behaviour—and less as one single individual's deviations at different times. This implies that if, for instance, a group of peasants are migrating to city slums at one time, and if some of them are also circulating back to their villages at other times—then, both these variations will be precisely reflected in canonical results—but as group behaviour, not that of each individual. Precisely these have been achieved in the final results (see section VIII).

It shows that equation 6 also incorporates some of the flexibility of equation 4. Both are general equations describing the movement behaviour of the individuals, though equation 4 has more flexibility. Operationlization of equation 6 (aggregate model) has been done in this study. This is discussed below, which, after necessary modifications, can be easily extended to implement equation 4 (individualistic model).

V. OPERATIONALIZATION OF THE MODEL

A. Steps in Analysis

The total package of analytical steps involved to operationalize the aggregate mobility model (equation 6) is briefly outlined here, and illustrated in the accompanying flow-chart (Figure 8). The following four steps comprise the analysis of the mobility fields and testing of the theory :

1. First, separate factor analysis is to be performed on the three data matrices : mobility behaviour (M), utility (U), and attribute (A) matrices.
   a. The Principal components solution of the movement set would systematically explore the many relationships between the migratory-circulatory-oscillatory kinds of movements and various purposes (along with their spatio-temporal characteristics), from the collapse of which the precise nature and bases of several broad 'mobility behaviour types' or 'mobility potentials' would be identified (F_M matrix in Figure 8).
   b. Similarly, the principal components solution of the individual's subjective preference rankings of a given set of discrete locations (which are to be evaluated along each of the specified place utility variables) will help to identify the precise nature and bases of the individual's perceived 'place utility considerations' or 'utility components' (F_U matrix).
   c Likewise, the principal components solution of the need-attribute-stress variables and other characteristics of individual movers will help identifying the precise nature and bases of their 'attributes' (F_A matrix). Three Separate factor analyses would produce corresponding three factor scores matrices (X_M, X_U, and X_A matrices in Figure 8), which would become inputs for all subsequent analyses
2. Secondly, using scores from the Utility Factor Score Matrix, X_U, utility distances are to be calculated between each given pair of origin and destination. As pointed out earlier, the factor analysis of this utility matrix originally has to use specific data on each individual mover's perception of utilities of each location, and as such, these distances then would measure each individual's perceived utility distances between each given pair. Such distances, however, may be calculated only for those origin and destination pairs which are specifically involved in the individual's movement. These distances are to be computed with reference to each separate utility components, results of which would constitute the 'Distance Matrix', $D\mathring{U}$, or the 'Selected Distance Matrix', D.[30]

30. In the flow chart, the larger distance matrix, DU, is shown mainly to indicate the general operational steps involved. This step may, however, be omitted because this matrix would be of very large dimensions—2n (2n–1)/2 dyads x q utility components. If number of observations (n) is 500 and the number of utilities (q) is 5, then, this will mean 2,497,500 dyad-distances, A 'search' model would multiply this many times more. Instead, distances may be calculated only for those pairs of origins-destinations which are specifically involved in the actual movement of each individual. Thus, the matrix, DU, can be reduced to only (n x q) dyad distances.

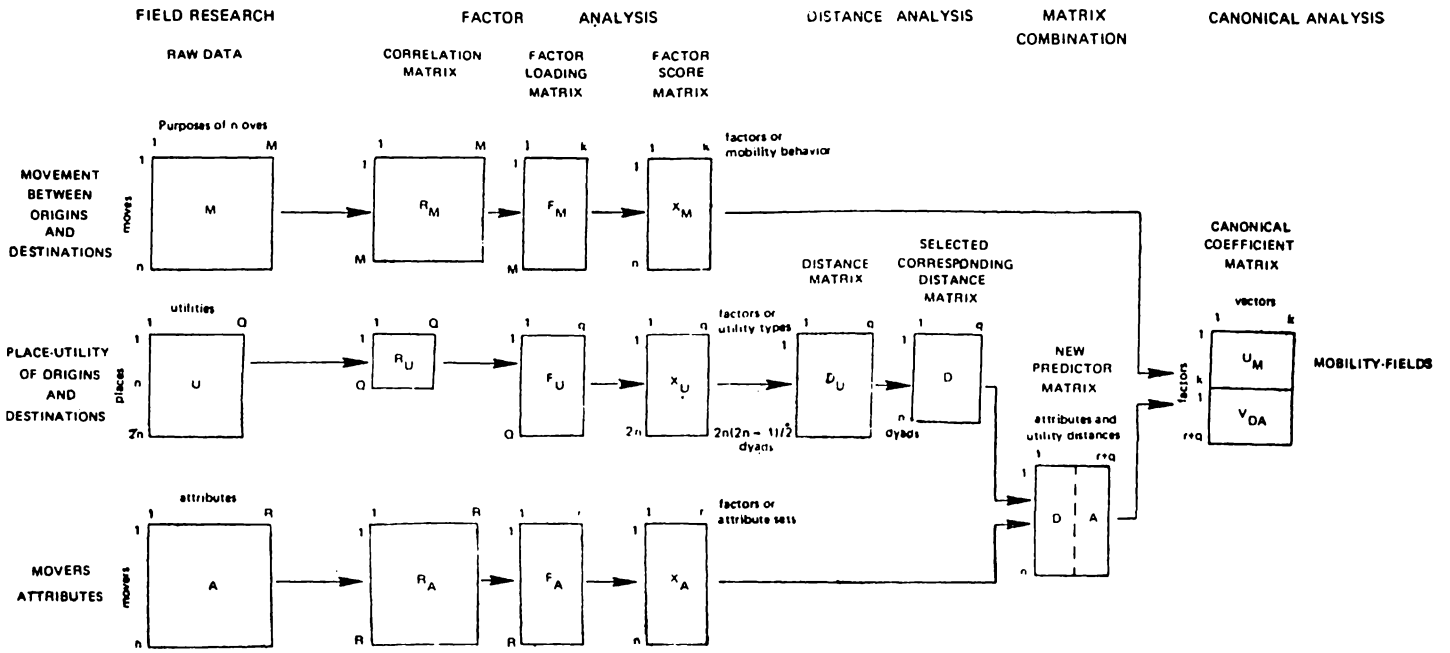


Fig. 8 Flow-chart showing steps involved and taken in the analysis and test of the Mobility Field Theory.

Thence, these distances are to be assigned with positive and negative signs, according to each individual's subjective—and situation—specific preferences, as has been elaborated earlier.

3. Thirdly, this Distance Matrix, D (of dimension $n \times q$) and Attribute Factor Score Matrix, X_A (of dimensions $n \times r$), can be simply put together to form a New Predictor Matrix, DA (of dimensions $n \times (r+q)$).
4. Fourthly, in the final step, a canonical analysis is to be performed on these matrices, i.e., Mobility Behaviour Factor Score Matrix, X_M, and the New Predictor Matrix, DA (or All), which comprise utility distances and attribute factor scores (Figure 8). Thus canonical analysis integrates all the three elements of the movement process, behaviour, utilities, and attributes. So this final canonical analysis is crucial, and as such, this last step is subsequently elaborated.

B. Mathematically Linking Attribute Structure, Utility Distance Vectors and Dyadic Mobility Behaviour: Canonical Analysis.

An essential postulate of this field theory is that a specific set of mobility behaviour is to be causally-functionally related to a specific set of need-attributes and utility distances—to produce a field—to pick off only those facts which *co-exist* in that field, excluding others which do not belong to that field, and the central goal is to test the degree of interdepencies between mobility behaviour and attribute-cum-utility matrices. That is, to test that the bases of the behaviour and the attribute-cum-utility spaces are the same, and each can be predicted from the other. Canonical analysis provides the appropriate mathematical model for testing the interdependencies of these matrix bases. Such mathematical behaviour, attributes and utility distances are also provided by canonical analysis.

Developed by Hotelling,[31] the canonical analysis basically elicits the maximum correlation between linear functions of the two sets of variables describing the same subjects. Given the two sets of data on behaviour and attribute-cum-utility variables, canonical analysis permits us to answer two related basic research questions: (1) What is the overall general relationship between individuals' attributes-cum-utility considerations and mobility behaviour; and (2) given this overall relationship, what are the underlying causal relationships between specific combinations of movement behaviour variables and attribute-utility variables?

At the outset, there are three matrices, Mobility Behaviour (M), Utility Distances (D), and Attribute (A)—the last two then simply combined together to produce a new predictor matrix, which from hence-forth will be called Attribute Matrix, and denoted by DA matrix to avoid confusion. Hence, these become two factor-score matrices, Behaviour(M), and Attribute (cum-utility) (DA), each of n x k dimensions (n = number of moves, k = number of factor scores or distance scores). In canonical analysis, these two matrices are analysed together treating behaviour matrix (M) as the dependent set and new predictor or the attribute matrix (DA) as the independent set. Each vector of M provides a measure of an independent kind of mobility behaviour, and each vector of DA provides the same for mover attributes or utility distances. Canonical analysis of these two matrices transforms the

31. Hotelling, H., "Relation Between Two Sets of Variates", *Biometrika*, Vol. 28, 1936, pp. 321–377.

vectors from M and DA to an independent, uncorrelated pair of vectors, U and V, in both the matrices without changing them. Unlike factor analysis, which maximizes the variance explained by individual factors, canonical analysis maximizes the correlations between certain vectors of the M and DA sets while reducing other correlations to zero. These correlations are called canonical correlations between each matched pair of variates, U and V. Corresponding to correlations, ρ_k, are vectors of canonical coefficients, β_k and α_k (like factor loadings), which are like regression weights that indicate which original sets of variables from M and DA are maximally involved in the new canonical vectors U_k and V_k and to what extent they determine variate scores of u_k and v_k. The new canonical vectors consist of standardized (of zero mean and unit variance) canonical variates (like factor scores)[32].

Unlike regression analysis, where there is a single solution because of only one dependent varible, canonical analysis yields a set of solutions as large as there are orthogonal patterns in M and DA matrices and as many as the smallest number of patterns among the two matrices. Hence, that many pairs of vectors, U_k and V_k, would be extracted successively from M and DA with decreasing order of predictability in the same manner as in principal components analysis. Consequently the 'm' types of mobility behaviour and 'a' types of attribute-utility patterns would be linked, and the canonical correlations between vectors maximized. In simpler words, the relationthips between the need-attributes systems and utility-distances of the movers and their mobility behaviour are specified. Each vector of V becomes a linear combination of DA, similarly each vector of U becomes a linear combination of M set. The vectors of U and V are equal in number, and the successive canonical correlations between each successive pair of vectors are maximized.

Geometrically, the canonical analysis measures the extent to which individuals occupy the same relative locations in the m-dimensional mobility behaviour space as they do in r+q dimensional attribute-cum-utility space. Thus, overall correspondence between the two spaces, between the two matrix bases, can be easily tested.

VI. A TEST OF THE THEORY IN THE INDIAN SITUATION

The theory was tested with fine grained data that referred to 305 sampled individuals and was collected during April to November, 1973 in a field survey of Varanasit city and adjoining region in Eastern Uttar Pradesh.

A. Study Area

Figure 9 represents the rank and spatial arrangements of numerous villages and towns that dot the umland of Varanasi city. Territory shown also includes parts of Eastern Uttar Pradesh, Bihar and West Bengal which lie beyond Varanasi's direct sphere of influence but from which movers are also drawn in.

This vast featureless Ganga plain of Northern India is characterized by a very densely settled agrarian population, engaged

32. Cooley, W. W. and P. R. Lohnes, *Multivariate Procedures in the Behavioral Sciences*, New York; Wiley, 1962, pp. 35–45. Also see,

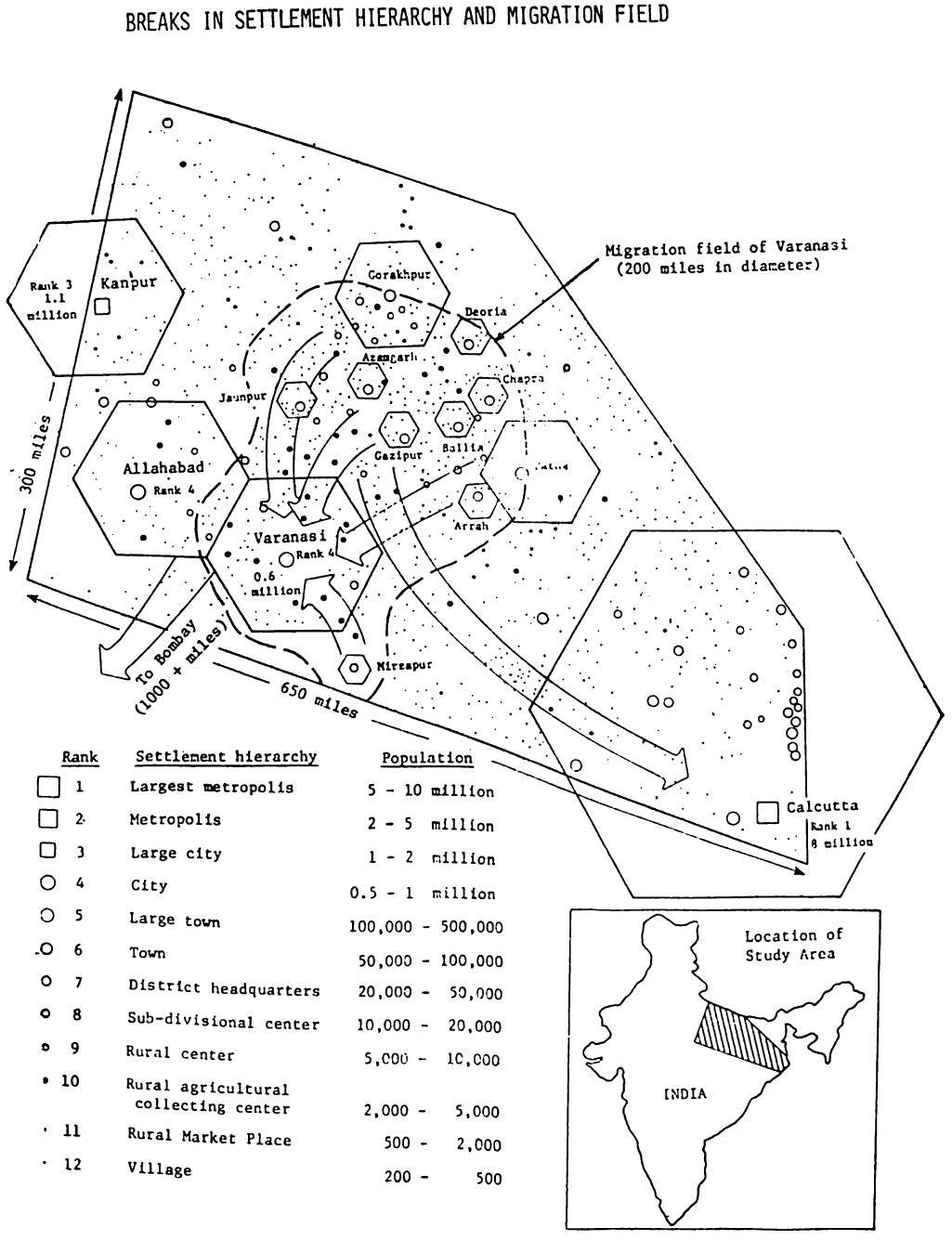


Fig. 9 A diachronic pattern and breaks in spatial economic structure and settlement hierarchy causing the villagers to make a quantum jump in migration—mobility from smallest villages to cities, bypassing smaller towns which are fading out.

mostly in cultivation of paddy rice, cane sugar, oilseeds, pules and vegetables. Very little industrial or manufacturing activities grew up within this zone, except in cities like Kanpur and Allahabad in the west and some scattered light manufacturing or trade in smaller urban centers of Gorakhpur, Gazipur and Azamgarh in the North. However, Calcutta and its surrounding manufacturing belt lies 425 miles eastward, to which millions of rural labourers from this territory out-migrate. Very high density of population (624 persons per square mile), accelerating population growth, continuing pressure on meagre amount of land, and absence of any industrial base are disquietening features of this zone. This region is often plagued by series of drought, flood, and crop failures. Numberless tiny rural hamlets and villages scatter this entire area where life is deadly stable and time stagnant.

Over and above the fact of unequal distribution of cultivable land among various groups of the poputation, especially among the unprivileged, such movements have also been induced by the uneven spatial economic structure of this region. During the Colonial period, the old indigenous settlements and trade links of India were disrupted, and instead, only a few trade centres and capitals emerged, in which amenities like schools, hospitals, urban services and modern communications were heavily concentrated. Hence, Berry notes for India that, "the process of colonial modernization thus also created regional islands by imposing new definitions to *centres* and *peripheries*. Coastal enclaves of rapid intensive development focussing upon major cities emerged, leaving stagnant peripheries in the rest of the traditional India imperfectly related to these centers."[33] This process of evolution of settlements conjointly created marked discontinuities in the socio-economic characteristics of various regions within the country. The resultant push-pull forces gave rise to a marked imbalance in migration movements directed only to a few towns, especially to capitals like New Delhi, Lucknow or Kanpur and ports like Bombay or Calcutta This aspect is further elaborated below.

B. Uneven Spatial Structure Causing Disruptive Movement Behaviour

An attempt has been made here tentatively to determine the pattern of settlement hierarchy in Great Plains of India (Figurd 9). This area corresponds to the territory wherein most of the movements of the sampled population tock place. Tentatively, a pattern of a 12-tier settlement hierarchy can be discerned,, in which a large metropolis, Calcutta (with 8 million population), represents the highest-ranking central place and numberless tiny farm villages (with less than 500 persons) appear as the lowest-ranking centres, with many step-like variations in between.

It is significant to mention here, as substantiated by Christaller and others, that the pre-requisites for efficient functioning of the spatial economy of any region are : (1) that there should be an increasing number of centres successively at the lower order of the hierarchy, usually observing a rule of three (i.e., 1, 3, 9, 27, 81, etc.) or four (1, 4, 16, 64, etc) or some variant of this; and (2) that the spatial arrangement of the centres be regular and uniform (i. e., centres in the same class are to be located equidistant from each other and also from the centre of the next higher order). However, such strict regularities do

32. Anderson, T. W., *An Introduction in Multi variate Statistical Analysis*, New York 1958.
33. Berry, op. cit. 1966, pp. 10-12.

neithhr exist in reality, nor are they expected here. But a serious gap in the hierarchy and discontinuity in spatial arrangement do really impair a smooth and efficient flow of commodities and services between different areas, thereby inhibiting economic growth of the entire region. This is happening in the area under study. Figure 9 shows that over a stretch of 650 mile long territory there is no 2nd-ranking centre (where at least 1 expected) and only one 3rd-ranking centre (expected about 9 centres), and even that is disadvantaged by its peripheral location. The situation worsens further at lower levels since just two 4th-ranking centres appear, but at close proximity; merely one centre each at 5th and 6th levels (expected numbers 81 and 243 respectively), and only a half-dozen centres at the 7th order (expected 729 centres). Surprisingly, very few central places exist at the next four levels where thousands are supposed to occur; on the contrary, innumerable small farm hamlets of the lowest 12th order dot the entire landscape, their number exceeding the expected number by 50,000. Indeed, only a few large former colonial administrative centres and a metropolitan exporting centre boast over a vast featureless rural landscape, as if mere three or four psychedelic neon signs can illuminate a great sea of darkness !

Uneven spatial distribution of central places, gaps in service areas, discontinuous nature of hierarchy, and the lack of uniformity in distribution of goods and services over the entire territory are the main drawbacks of this pattern. Reasons are not far a seek. Economic isolation of the villages and the rural poverty, lack of transport and communications, and overall low rate of economic development are major causes, among many others

Central places, if arranged in a hierarchy can provide the means of articulating the distribution of goods, services, ideas and innovations to, and organization and administration of, widely scatered settlements and their tributary areas. But, a diachronic pattern, such as this neither permits the effect of socio-economic change and innovations to trickle down the hierarchy, nor allows the rural masses to participate in the industrialization process. Therefore, a spatially integrated pattern of market and settlement hierarchy is all the more essential for rapid economic growth.

Set against this background, movement behaviour of people can be better understood. The rural dispossessed, in search of jobs and better conditions of living, are increasingly moving towards the larger towns and cities, bypassing the smaller towns and urban centres which are soon decaying and fading out (See Figure 9). A large number of rural labourers are moving out from the economically depressed areas of the north and crowding to the cities such as Varanasi and Allahabad to the south, and scores of them are reaching Calcutta, 500 miles eastward, and Bombay, more than 1000 miles away. Long distance cityward move *per se* is not a problem, if such moves are economically successful. But, they are moving from the green fields to the dirty pavements. From unemployment to disguised unemployment. From a stage of a landless peasant to a rickshawala. From darkness to darkness.

C. Service Area Vis-a-Vis Migration Field

Expression of such movement behaviour can be summarized in the concept of 'migration field' of a settlement. This is an extension of the previous concept of mobility field but, instead of referring to a person, refers to a place. What is mobility field to an individual mover, is migration field to a settlement. Each central place has its own movers-drawing or

migrants-drawing field, a territory from which people pour in to the centre (called migration field, instead of mobility field, to avoid confusion). Only the migration field of Varanasi city is shown, fields of other centres are omitted for the sake of clarity (Figure 9).

A crucial point is that the migration fields of some centres have overgrown in size than their respective service areas, and the two are not overlapping. The migrants are pouring out from a much larger area than a centre can serve. Most centres have very small migration field, that is, attract and sustain very few migrants from very small surroundings; but some others draw a large number of migrants from a vast extent of area, but are unable to provide them with adequate jobs, education, medical, housing, and other necessary amenities. Even then, people do flock in to such cities, simply because previous migration streams have moved in, because they have friends and kinsmen there, and largely because they are left with no other choice.

This provides the background of the study area selected and also describes what is happening in the territory. Such movements are studied in much detail through a sample survey in Varanasi city.

D. Survey Methods

Individuals were selected through a multistage selection procedure constituting a stratified simple random sample. Questionnaire surveys were conducted to elicit detailed information on recent movement history of sampled individuals and their social, economic and political conditions. The questionnaire contained three sets of information: spatial aspects of movement behaviour, perception of place utilities, and need-attribute-stress characteristics of movers. The details of the variables used are listed in the first column of tables 3 to 5. The 305 individuals made about 436 moves each for more than one month's duration during the period July 1, 1970–June 30, 1973. Such moves were made in and out of Varanasi and between other places. Analyses of these 436 moves are presented in this monograph.

VII. COMPONENTIAL STRUCTURES OF THE MOBILITY FIELD AND RESULTS

The following discussions set out to define the basic sub-constituent structural components of the Attribute space, Utility space and Mobility behaviour space; the components which enable to assign a relative location of each respondent on each of such spaces. Final mapping out of the individual's such relative locations on to each other's space is performed through canonical analysis discussed in the next part. Since the findings from the three factor analyses are merely intermediary steps towards the final canonical linkage model, the present discussion is purposefully very brief. For details see an earlier paper published.[34]

34. For details of this section VII see Mukherji, Shekhar, "Need System, Place Utilities and Mobility Behaviour in an Indian Situation: Structures, Dimensions, Linkages and Migration Planning Policies." in *Man, Culture, and Settlement* by Robert C. Eidt, K. N. Singh, and Rana P. B. Singh (eds.), National Geographical Society of India, Varanasi, Res. Pub. 17, 1978, pp. 287-313.

Tables 3 through 5 provide the major results of the three factor analyses and describe, respectively, the structure of need-attributes, of utilities and of mobility, in that sequence. In each case, the respective table summarizes the names given to the factors, the individual and cumulative percentages of the total variance accounted for by each factor, and the communalities and the principal loadings for each variable, the latter serving to define the underlying dimensions of the factor structure. Identification of factors is largely done by examining the variables most closely associated with a factor and the concept expressed by that cluster of interrelated variables.

A. Need Systems

Table 3 summarizes the principal findings of factor analysis of 44 attribute variables of sampled 436 movers. As a result, ten independent orthogonally rotated principal components with eigenvalues greater than 1.0, were successively extracted and identified, explaining 66.6 percent of the total variance. The first factor alone explains about one-fourth, and the first five together about half, of the total variance. These dimensions define the underlylng bases of the need-stress systems and attribute structure of the sampled population in the Indian situation. These ten dimensions are identified as : (1) poor economically deprived and socially disadvantaged people, (2) youth aspiring to vertical social mobility, (3) restricted awareness of places and opportunities, (4) young people with no or little family burden, (5) high job-income dissatisfaction, (6) educated unemployed looking for jobs and security, (7) high-caste rich landowners, (8) landless unemployed peasants and workers, (9) people in debt and familial stress, and (10) scheduled castes and low castes under severe drought conditions. Although based on a very small sample these dimensions together do really capture the essence of the prevalent socio-economic situation in India as a whole. Together they describe what India has become today.

1. Poor, Landless, Socio-Economically Deprived People : This first principal axis forms a tremendously compact cluster of about half of the total number of variables. Defining basically the existing stressful social-economic-political conditions of people in the study region, this cluster of interrelated variables provides a composite disadvantaged-advantaged scale or a continuum against which different individual's relative positions can be well measured.

The variables with very high positive loadings include : (1) living below subsistence level (0.83) (per capita monthly income less than Rs 50), (2) per capita land less than 0.5 acre (0.84), (3) person's total family income less than Rs 100 per month (0.79), (4) less than 4 years of schooling (0.76), and (5) food for sustenance not daily available (0.72). These variables indicate a most pitiable economic condition of the proletariate, and pauperization of the peasants in India. Only hunger can describe the actual state of most people.

The variables with very high negative loading include : (6) years of schooling (-0.91) (virtual illiteracy), (7) minimum level of social aspiration (-0.88) (even very lowest cadre of occupations acceptable); (8) previous occupation index (-0.86) (occupation ranks on a scale of 1 to 100, showing low cadre occupations prior to move), (9) desire for education (-0.77) (almost no desire for education), (10) index of modernism (-0.59) (traditional views about fate, political system, social change), and (11) high castes (-0.71) (not belonging to upper three castes of Brahmin, Kshatriyas or Kayasthas). This cluster of variables, thus, clearly indicates that, not only people are

Table III. Factor Analysis of Movers' Attribute Data
(Variables – 44, factors – 10, Variance explained = 66.6%)

Factors		1	2	3	4	5	6	7	8	9	10
Factor Name		Poor landless econ. depr. people	Young want vert. mobility	Restricted awareness	Young, no burden	High income job disat.	Educ. Unemployed f/inc. gain	High caste rich, land owner	Landless unemployed	People in debt. stress	Sched & low castes suffer drought
Indv. Variance (%)		26.1	7.5	6.4	5.4	4.6	4.1	3.7	3.3	2.8	2.7
Cuml. Variance(%)		26.1	33.6	40.0	45.1	50.0	54.1	57 8	61.1	63.9	66.6
No. Variable name	*Communality*										
1. Household size	0.69				–.75						
2. Sudra caste	0.24	.54									
3. Hige castes	0.57	–.71						(.30)			
4. Scheduled castes	0.58	(.34)									.62
5. Age	0.63				–.65						
6. Per capita income	0.84	–.47						.76			
7. Yrs of schooling	0.85	–.91									
8. No. of persons/room	0.62	.41									50
9. Per capita land	0.77							.79			
10. Moved alone	0.69				.79						
11. Prey, occup. index	0.89	–.86									
12. Desire of educ.	0.68	–.77									
13. Index of modernism	0.52	–.59									
14. Min. social aspiration	0.85	–.88									
15. No. of dependents	0.54				–.59						
16. Income dissatis.	0.83					.83					
17. Job/income dissf. index	0.87					.89					
18. Below subsist. level	0.77	.83									
19. Extent of life space	0.92			–.95							
20. Awareness of adj. ditt.	0.83			–.90							
21. No. of towns know	0.91			–.95							
22. Family in origin	0.65		.65								
23. Family in destination	0.72		–.78								
24. Degree of debt	0.50									.62	
25. Unemployed	0.53	(.33)							.64		
26. Degree of underemployed	0.58	(.38)							–.54		
27. Educ. unemployed	0.65						.74				
28. Stress of no college	0.70	–.49	.43								

29. Nature of job search	0.69	−.46	.58				
30. Places visited (info.)	0.49				(.36)		
31. News information	0.49	(−.37)	(.30)				.44
32. Move even no kin ties	0.53		.65				
33. Income gain from move	0.57		(.31)		.62		
34. Familial stress	0.57					.63	
35. Drought effect	0.55						.63
36. Degree of lack mony	0.56	.52					(.39)
37. Familial responsib.	0.72		−.79				
38. Per CaPita land < 0.5 a c	0.78	.84					
39. Landless	0.46	.41				(.35)	
40. ≠da/mo food available	0.67	.72					
41. Income Rs. 100/mo.	0.63	.79					
42. Occup. diff. due to move	0.79	.40				.58	
43. 0-4 yrs. schooling	0.62	.79					
44. Need-income differ.	0.59				.65		

socially and economically pauperized, but they have also been subsequently deprived of their very sense of deprivation !

Besides, this dimension is also constituted by such variables as being : (12) landless peasant (0.41), (13) sudra caste (0.54), (14) scheduled caste (0.34), (15) underemployed (0.38), (16) unemployed (0.33), (17) living in very congested room (0.41), (18) having very low per capita income (–0.47), (19) acutely lacking money to support family (0.52), (20) searching very low category of manual job (–0.46), and (21) occupational rank difference after move quite negligible (0.40). Due to shortage of space the rest of the dimensions are not discussed in detail (See Table 3).

General Evaluation of the Need Systems

In sum, three general comments can be made on the need-attribute structure of the study population in India :

1. Dimensions show the important characteristic of being independent of each other and each unfolds a part of the whole story revealing bit by bit details of need-stress-attribute systems of the study population.
2. By far, the first factor, termed as 'poor, landless, socio-economically deprived' tells the most telling story of precarious and stressful situations of people in India in which they are imbedded and within which their movements occurring.
3. Supplementing to the first component, while the rest of the story of the proletariate is being told particularly by components 8, 9 and 10; by contrast, the story of the socially advantaged segments, is being unfolded specifically by components 2, 6 and 7. The remainning dimension, 3, 4 and 5, are probably shared by both. In sum, the need-stress systems of

the poor are characterized by landlessness, real and disguised unemployment, debt, drought, familial stress, illiteracy, poverty, lack of food, money and shelter; whereas that of the rich are characterized by job-income dissatisfaction, higher social aspiration, lack of educational facilities and unemployment of the educated.

B. Structure of Place Utilities

Factor analysis of the utility matrix (436 by 5 dimensions) generated three major underlying utility components with eigenvalues greater than unity, explaining about 89.4 per cent of the total variance (Table 4). These utility components can be termed as "major utility considerations" that are found to be relevant criteria in the movement decision making process so far as the study region is concerned. According to importance, 'job-urban utility' component is the most significant factor (explaining 37 per cent of the total variance), followed by 'kinship-physical nearness utility' (32.7%) and lastly, by 'mentally perceived nearness utility' (19.7%). These are very briefly discussed here.

1. Job-Urban Utility: The first utility dimension is being interpreted as job opportunity-cum-urban-educational utility dimension. The utility variables are: (1) job opportunity of a place (0.932) (preference ranking of places according to their perceived utility to provide work opportunities), (2) urban-educational facilities of a place (0.939) (preference ranking of places according to their perceived utility to provide urban-educational amenities). This component, thence, strongly indicates that at least in the study region the job opportunities are heavily concentrated only at the urban centres, not in the rural or rurban centres; and also that people studied do not evaluate urban facilities of a place as such as they do consider the ability of a location to provide jobs. This is an important finding. Negating currently held "pull" theory of urbanism as a way of life as causal explanations of movement—it, rather, testifies that in the Indian situation such factors as 'job availability' and 'urban facility' are evaluated together in the decision process, not in isolation; and if jobs were made available also in non-urban centres, people would have moved in to these locations, too.

Table IV
Factor Analysis of The Utility Matrix
(Variables—5, Factors—3, Variance explained—89.5%)

Factor numbers		1	2	3
Factor name		Job-urban utility	Kinship-physical nearness utility	Mentally perceived nearness
Percent of total variance		36.989	32.712	19.748
Cumulative Variance		36.989	69.701	89.449
No. Variable Name	Communality			
1. Job utility	0.898	0.932		
2. Urban utility	0.989	0.939		
3. Physical distance	0.814		0.838	
4. Kinship utility	0.864		0.916	
5. Perceived nearness	0.998			0.952

2 Kinship-Physical Nearness Utility component is identified as kinship connection-cum-physical nearness utility dimension. The variables are : (1) kinship nearness of a place (0.916) (preference ranking of places according to their perceived utility to provide relatives/friends/kinship connections), (2) physical nearness of a place (0.838) (ranking of places according to actual physical distances from individual's origin place). This dimension, in fact, reinforces the importance of 'distance-decay' function and roles of relatives and friends in movement process, and testifies that acquaintance fields are also spatially arranged and these two together form a conjoint utility consideration. By interpreting the respective loadings, the ksnship connection appears to be a more important factor than mere accessibility; that is probabilities of a distant destination being selected are more if it also provides some kinship connection, than otherwise.

3. Mentally Perceived Nearness: Evidently, one's native village is normally perceived as the nearest place to most of the rural folks, followed closely by the most common destination selected, Varanasi city. Between these two, other locations were found to be Perceived near or distant according to those places being known or unknown to respective individuals. Since this 'perceived nearness' component has emerged as the least important it warns against supra enthusiasms of mere perception theorists and indiscriminant use of simplified mental maps in mobility analysis.

C. Structure of Mobility Behaviour

The third principal component analysis performed on the thirty-four characteristics of 436 moves (made between 436 pairs of origins and destinations) enabled to extract thirteen major dimensions of the structure of the mobility behaviour of the sampled population (Table 5).[35] These thirteen dimensions with eigenvalues greater than 1.0 explain about 84.7 per cent of the total variance. Given a yes-no type of data, this amount of variance explained indicates surprisingly highly ordered regularities in the behaviour structure. Each of them defines a specific mobility behaviour pattern, or a behaviour potential, which underlies the multitudes of movements of all individuals in the study population. To the extent an individual shares all or parts of these basic behaviour potentials, defines his own movement behaviour.

A snapshot look at table 5 may reveal many general characteristics of this orthogonally rotated factor structure. Namely, the first component alone—defined as rural to urban migration in search of any kind of manual job—accounts for about one-fifth, and the first six components together about 56 per cent, of the total variance. Components 7 through 11 are also very meaningful, explaining another 25 per cent. The next two components are of lower predictability, each explaining only 3 per cent. Secondly, most of these components reflect a set of independent and mutually exclusive mobility patterns or bheaviour potentials, each encompassing only one major

35. Mobility matrix is of 436 by 34 dimensions, i.e., consisting of 436 person-moves between a given i-j pair of origin-destination and thirtyfour spatio-temporal-purpose-characteristics, corresponding to each such dyadic person-moves. Hence, 436 moves occur through corresponding 436 dyads of origing-destination—and it must be remembered that mobility behaviour has been defined as dyadic behaviour specifically in this sense.

purpose of move and delineating a specific combination of spatio-temporal-kind-direction-purpose characteristics of movement. However, sometimes, spatial characteristics themselves represent an independent (as in VII or XIII), and these also reflect different aspects of reality. Thirdly, in contrast to attribute and utility matrices, some of the components of mobility matrix are bi-polar, especially the 1st, 7th, 8th, 12th, and 13th, and whenever necessary, bi-polar names are given in order to reveal their true nature. Components 2 through 6 are also bi-polar, which are elaborated later. Fourthly, factors 2nd through 6th, 9th, 10th, and 12th are interpreted rather 'negatively' by reversing all the signs of their factor loadings and corresponding factor scores (not shown in table). These thirteen major dimensions are identified as follows, with names of their bi-polar counterparts where applicable given in the parentheses :

1. rural to urban migration for more than one year to search for any kind of manual job (urban to rural circulation for less than 3 months for vacationing);
2. transfer for security purposes (moves of the underemployed for search for any manual job);
3. moves for higher study in big university (moves of the unemployed to search for any manual job);
4. urban to rural circulation to native villages for harvesting and meeting family;
5. moves of educated unemployed to join in professional jobs (moves of unemployed to search for any manual job);
6. moves for prospect, more earning or future reward (moves of unemployed and underemployed to search for any manual job);
7. short-distance rural to urban moves within 100 miles (medium-distance urban to urban moves between 200-500 miles);
8. migration for more than 1 year (temporary moves for 3 to 12 months);
9. circulation to resume work;
10. to and fro oscillation between origin-destinatian because it is nearer to native place;
11. moves of the unemployed;
12. long-distance urban to urban moves for more than 500 miles (short-distance rural to urban moves within 100 miles); and
13. medium-distance moves between 100 and 200 miles (short distance moves within 100 miles).

Lastly, as apparent from the list, the first three components and the fifth are essentially complex bi-polar dimensions which reveal only a part at a time of the total story of movements of the unemployed-underemployed seeking manual jobs. Each of these factors (when signs are unchanged) indicates a positive polarity representing "search for manual jobs of the unemployed" and a negative polarity showing other kinds of mobility potentials. In short, the behavioral act of 'search for manual job' is a function of complex relationships of all these four factors thus emerged, and of some other unknown factors, as expressed in the following equation :

$$v = \text{function } (F_1, F_2, F_3, F_5) + U$$

or (Search for manual job) = (factor 1) + (Factor 2) + (Factor 3) + (Factor 5) + (Unknown Factor).

1. Rural-Urban Migration to Search for Any Manual Job : The first principal component of the mobility factor structure is represented by the "rural to urban migration

Table V. Factor Analysis of Mobility Matrix
(Variables – 34, Factors – 13, Variance explained – 84.7%)

			1	2	3	4	5	6	7	8	9	10	11	12	13
			Migration Search manual job/circ. for vacation	Transfer for security	Move for Higher study	U-R agric. circulation	Profnl. job for educated unempl.	Move for Prospect	Short. R-U 1-100ml/Med. U-U 200-500 ml.	Temp. Move 3-12mo/Migr. for 1 year	Circulation to resume work	Oscill. to near native places	Move of unemployed	Long U-U move/ Short R-U move	Medium dist. move 100-200ml/ short dist. move 1-100 m
	Indv. Variation		18.7	10.8	7.6	6.8	6.4	6.0	5.5	4.9	4.6	3.7	3.5	3.0	3.0
	Cuml. Variation		18.7	29.5	37.1	43.9	50.3	56.2	61.7	66.6	71.2	74.9	78.4	81.7	8.7
	No. Variable Name	*Communality*													
Dist-	1. 1-100 miles	0.76							.43						
tance	2. 100-200 ml.	0.76												(.34)	– .75
	3. 200-500 ml.	0.86													.95
Dura-	4. 500 ml+	0.92							– .84						
tion	5. 1-3 month	0.86	– .72											– .84	
	6. 3-12 month	0.78							– .47	– .40					
Kind	7. Stay 1 yr.+	0.77	.74							.53					
of	8. Migration	0.86	.62							.49	.43				
Move	9. Circulation	0.84	– .71			(– .33)					– .46				
	10. Temp. move	0.46								– .89					
Direc-	11. Gscillation	0.95										– .54			
tion	12. Rural-Urban	0.83	.50						(.39)					,47	
	13. Urban-Urban	0.65							– .45					–.58	
	14. Urban-Rural	0.96	– .52			– .68									

First	15. Srch manual job	0.97	.46	(.33)	.40		(.35)	(.37)			
Pur-	16. Profes. job	0.88					.96				
pose	17. Promotion	0.85						−.93			
of	18. Transferred	0.97		−.89							
Move	19. Higher study	0.88			−.97						
	20. Harvesting	0.90				−.93					
	21. Vacation	0.94	−.91								
2nd	22. Resue work	0.96							−89		
Pur-	23. Unemployed	0.97	(.26)	(.19)	(.30)		(.21)	(.21)			.77
pose	24. Underemployed	0.87	(.28)	(.20)	(.28)		(.22)	(.23)			−.80
	25. Big university	0.97			−.96						
	26. Family security	0.91		−.88							
	27. Educ. unemployed	0.86					−98				
	28. More earning etc.	0.90						−.94			
	29. Family respons	0.84				−.92					
3rd	30. Near native pl.	0.78								−.71	
Pur-	31. Native place	0.85	−.68			−.53					
pose	32. Friends in distn.	0.66								.79	
	33. No kinship consid	0.66		−.52			(−.38)				
	34. Recreation	0.88	−.92								

moves of the unemployed and underemployed labourers for more than one year in search of any manual job", explaining about 18.7 per cent of the total variance. The variables that show high positive loadings are listed below.

Migratory kind of move	0.62
Duration of stay at destination place for more than 1 year	0.74
Direction of move from rural to urban areas	0.50
Purpose of move is to search any kind of manual jobs	0.46
Underlying reason is being unemployed	0.26
Underlying reason is being underemployed	0.28

Bi-polarity of this component can also be seen from the negative coefficients of the following variables :

Circulatory kind of move	–0.71
Duration of stay at destination place between 1 and 3 months	–0.72
Direction of move from urban to rural areas	–0.52
Purpose of move is vacationing	–0.91
Underlying reason is recreation	–0.92
Underlying reason that destination is native place	–0.68

This polarity can be interpreted as short-term circulatory moves to native places for vacationing. However, careful comparison of factor scores with original data strongly confirmed that in relation to this dimension, all unemployed/underemployed labourers or peasants show high positive scores and educated university students moving for recreation show high negative scores. Hence, this dimension has been labelled as such. Further, it may be well to remember that about 47.9% of all moves recorded in the raw data were made by the manual job seekers. But, in factor analysis results, this movement pattern instead of emerging as one strong single component by itself, has rather evenly spread out : That is, movement behaviour of labourers is found to be so overriding and so prevading that it emerges as an essential part of the first six underlying dimensions of the mobility structure. Does it not describe existing situations in India more precisely ?

2. Transfer Moves for Familial Security : Component II describes involuntary transferred moves of the employees of various government offices. The variables that load highly are noted as follows, with their negative signs changed : involuntarily transferred in service (0.89), underlying reason is to maintain financial/familial security (0.88), no kinship consideration in movement decision (0.52).

3. Moves for Higher Studies : The third dimenison is identified as moves for higher academic or professional studies. Most such moves are made mainly to study in the Banares Hindu University, but some moves are also made to other cities. The variables that define this factor are : purpose of move is professional education in college/university (0.97), underlying reason is to join a big central university (0.96).

4. Urban to Rural Circulation for Harvesting and for Familial Purpose : The fourth component, constituted by the following five variables, describes circulatory moves of the former agricultural peasants and labourers (component I) but now living in cities for sustenance, back to their respective native villages for the purpose of harvesting crops or meeting families : purpose of move is to look after agricultural field harvesting (0.93), under lying reason is to meet family (0.92), underlying reason is that destination being native

place (0.53), direction of move from urban to rural areas (0.68), kind of move is circulatory (0.33). This component indicates that although peasants are forced to leave villages for cities, they rarely intend to live there permanently, rather they make very frequent visits to their origin places; and most of them indeed would be more happy not to leave their villages at all. This observation reinforces rather more strongly the great need for eliminating all kinks of stresses in the rural areas and for effecting immediate land reforms therein.

5. Moves of Educated Unemployed for Professional jobs : Component V is also interpreted negatively after reversing all signs : purpose of move is to join first professional job offered (0.96), underlying reason is being educated unemployed (0.98), no kinship consideration in movement decision process (0.38). This also shows a bi-polar characteristic (of manual job seekers). This factor delineates a continum representing 'movement of educated unemployed who are searching professional, not manual jobs'.

6. Moves for Prospect and More Earning: Component VI reveals that those who have moved for future prospect or promotion have also expressed that their only reason for doing so is simply to have more earning, irrespective of distance, duration or kinship consideration. In contrast to component V, this indicates movement of already employed persons, of those who enjoy some kind of decisional choice where to relocate.

7. Short-distance Rural-Urban Moves Versus Medium-distance Urban-Urban Moves: While all the former six components revealed more or less clear-cut mobility patterns, each precisely encompassing one major purpose of move, such however were not the case with the remaining seven components. For instance, component VII, combines only spatio-temporal-direction characteristics of movements, without associating with any 'purpose' of move : distance travelled in a move is less than 100 miles (0.43), direction of move is from rural to urban areas (0.39). This also happens to be a bi-polar factor as being characterized by negative loadings of some other variables. Considering both positive loadings, this component thence uncovers both short-distance rural to urban moves as well as medium-distance urban to urban moves. Such interpretation is more appropriate, because the original data reveal existence of both.

8. Migration for More Than 1 Year Versus Temporary Moves for 3 to 12 Months: Dimension VIII can be interpreted as semi-permanent migration performed for more than one year vis-avis temporary migration made for 3 to 12 months : migratory kind of move (0.49), duration of stay is more than 1 year (0.53), temporary kind of moves (-0.89), duration of stay is 3 to 12 months (-0-40). Temporary moves, as recorded in original data, were performed mostly by agricultural workers; whereas migration moves, by all categories of population : rich and poor, educated and illiterate, unemployed as well as professionals. To the extent each individual has a positive or negative factor score on this component, reveals each individual's own unique movement characteristics : the individuals with negative score represent temporary migrants, and individuals with high positive scores, semi-permanent migrants.

9. Circulation Moves to Resume Work : Dimension IX is easy to identify, being constituted by the following variables : purpose of move is to resume work in the city (0.89), kind of move is circulatory (0.46), kind of move is migratory (-0.43).

10. Oscillation Moves to Native Places : Compared with dimensions II through VI which describe movements of relatively upper classes of people, by contrast, dimensions X and XI unfold pictures of the poorer segments of the society. Noteworthy characteristic of component X is the association of oscillatory movement with the nearness of the destinations to the movers' native villages : kind of move is oscillatory (0.54), underlying reason that destination is nearer to native place (0.71), consideration of presence of friends in the destination (-0.79). This component represents, in fact, those segments of the rural population who are forced to move back and forth between the village origin and city destination owing to the presence of stress in both the places. Emergence of this compoent alone strongly testifies the essence of the mobility field theory and verifies its fundamental postulate that the need-stress systems of the individuals generate corresponding movement patterns.

11. Moves of the Unemployed : Dimension XI replicates the above observation. Variables constituting this dimension, are : underlying reason for move is being unemployed (0.77), underlying reason for move is being underemployed (-0.80). Presence of a high negative loading of the variable 'underemployed' indicates that this dimension probably portrays both sides of the appalling situation, of both unemployed and underemployed workers. So, this component should be regarded as such.[36] Components XII and XIII are interpreted as long-distance urban-urban moves and medium distance moves. These last two components are not very meaningful and not discussed.

D. Summary

Briefly summarizing this entire section the following five general comments can be made :

1. With respect to all the three structures of attribute, utility, and mobility, separate factor analysis reveals a number of meaningful basis dimensions which underlie their respective factor structures. Being hitherto unexplored, these dimensions discover some very meaningful findings that surely have tremendous significance in describing and understanding the existing situations within which people move in the study region. These dimensions reveal the need-stress situations and movement patterns not only in Varanasi region, but also point out a few general features that may have relevance to the Indian situation as a whole. The plight or flight of the landless peasants is precisely a case in point which is generalizable for the entire country.
2. While the attribute structure vividly describes the 'need-stress' systems of the people, the utility structure supplementing to this picture describes, on the other hand, three broad utility considerations that are being perceived by the sampled population as being the most important to movement decision-making process. Filling gaps in this broad canvas, finally, different patterns of movement behaviour then portray the details of behavioral acts that arise from such need-push and utility considerations, and eventually, complete the total picture of mobility systems of the study region in India.

36. This appears to be mainly due to our mutually exclusive definitions of unemployment and underemployment. If considered together, this component in fact describes movements of both the groups that are searching manual work.

3. In regard to each structure, the different components tell only part of the story and add, bit by bit, to the complete picture.

4. The first component, in both attribute and behaviour structure, surprisingly uncovers the same miserable story of the landless proletariater eiterating time and again the most stressful social situation that exists for the poor in India.

5. As all other underlying dimensions gradually are also unfolded, a remarkable similarity in their order and characteristics, both in attribute and behaviour structure, can be easily noticed. This is founnd to be true both for the privileged and underprivileged classes. In short, a parallelism and isomorphism between aligned patterns can be traced throughout the length of the picture thus discovered.

So far known in mobility-migration studies rarely attempts are made to draw such a holistic canvas and rarely studies are done to explore and integrate social matrix, utility matrix and mobility matrix as a tightly organised entity, such as this. Thus, apart from many canonical interrelationships imbedded between these three matrices, to be described in the next section, multitudes of these basis dimensions themselves would provide insightful clues to further exploratory research in mobility analysis.

VIII. LINKAGES BETWEEN NEED-ATTRIBUTE STRUCTURE-CUM-UTILITY DISTANCES AND MOBILITY BEHAVIOUR : CANONICAL RESULTS

As indicated earlier, mobility field theory states that the need-stress-attribute structure of the individuals in a population and their perceived place-utility distances are the causal psycho-social and spatial-behavioral forces underlying different types of mobility behaviour of the population. These two forces and resultant mobility behaviour potentials are interdependent parts of the mobility field. A change in any one generates corresponding change in the other. Crucial to this theory is the notion of 'co-existence'. It implies that only those specific combinations of attributes, utility-distances and behaviour would be conceptually and mathematically picked-off which are really co-existing facts in the mobility field, excluding others which *do not belong* to that field. This enables to specify causal-functional links between structures of attributes, utilities and behaviour. Such causal-functional links and tests of interdependence between them are established by canonical analysis which permits mapping out of the bases of the mobility behaviour space onto the bases of the combined attribute-cum-utility space. Attribute and place-utility distance matrices were operationalized together to form the 'independent' set which, in turn, was utilized to explain mobility behaviour matrix, regarded as the 'dependent' set. Both are matrices of same order containing the factor

Table VI

THE CANONICAL STRUCTURE MATRIX

Canonical Analysis of Indian Mobility, Utility and Attribute Data

Canonical Variates	1*	2*	3*	4	5	6	7	8	9	10
No. Mobility Behaviour Variables										
1. Migration to search manual job/ circulation for vacation	**0.610****	**-0.515**	0.086	-0.060	**0.411**	0.103	-0.110	-0 178	-0.200	-0.113
2. Transferred for family security	-0.273**	-0.098	0.410	-0.354	0.327	-0.112	-0.236	-0 091	-0.107	-0.343
3. Moves for college/university study	**-0.552**	**-0.447**	0.410	0.372	-0.122	0.151	-0.091	-0.095	-0.060	0.040
4. Urban to rural circulation for harvesting and meeting family	-0.121	**0.508**	0.135	0.130	0.255	0.391	-0.464	-0.027	0 077	-0.277
5. Moves for professional job of unemployed	-0.178	-0.243	**-0.849**	0.145	0.073	0.320	-0.123	-0.121	0.131	0.071
6. Moves for prospect & more earning	-0.320	-0.145	-0.073	0.363	**0.353**	-0.127	-0.046	0.317	0.029	0.018
7. Short distance move/medium distance	0.151	-0.155	0.014	-0.018	-0.201	-0.132	-0.161	0.193	**0.510**	0.100
8. Migration for more than 1 year/ temporary move for 3-12 months	-0.164	0.022	-0.028	-0.165	0.012	-0.274	0.336	**-0.656**	0.363	-0.305
9. Circulation to urban area to resume work	-0.067	-0.050	0.057	-0.321	0.054	-0.258	-0.383	0.044	0.243	**0.458**
10. Oscillation because near native place	0.039	-0.082	0.197	-0.035	0.295	**0.432**	0.414	0.291	**0.561**	-0.076
11. Moves of unemployed	0.025	0.050	-0.073	**0.850**	**0.437**	**-0.558**	-0.045	0.135	0.158	-0.031
12. U to U long distance/R-U short distance	-0.116	0.203	0.081	0.036	**0.436**	0.108	0.271	-0.287	-0.146	0.650
13. Medium distance moves/short distance moves	-0.175	-0.003	-0.155	-0.075	0.047	-0.116	**0.399**	0.424	-0 330	-0.165

Utility Distances and Attribute Variables										
1. Job-Urban utility distance	**0.522**	**-0-655**	**0.037**	-0.067	-0.153	-0.274	-0.072	-0.010	-0.044	0.291
2. Physical-kinship utility distance	-0.106	0 345	0.187	0.043	0.377	0.113	0.251	**-0.427**	0.236	0.594
3. Perceived nearness utility distance	0.008	-0.112	0.040	-0.105	0.118	0.072	0.045	-0.358	0.022	-0.363
4. Poor, landless socio-economically deprived	**0.815**	0.390	0.161	-0.040	0.111	0.116	-0 128	-0.030	-0.047	-0.220
5. Want vertical social mobility	0.320	**-0.875**	0.137	-0.111	0.146	0.029	0.068	0.083	-0.058	-0.184
6. Small awareness space	0.036	0.053	0.054	-0.003	-0.127	-0.037	0.302	-0.053	0.269	-0.072
7. Young adult with no family burden	-0.012	-0.127	0.075	**0.661**	-0.353	**0.530**	0.099	0.021	-0.207	-0.016
8. Job-income dissatisfaction	0.091	0.083	-0.128	-0.126	**0.380**	0.290	0.260	**0.620**	-0.220	0.309
9. Educated unemployed wanting earning	0.178	-0.081	**-0.952**	0.092	-0.009	0.043	-0.034	-0.045	0.128	-0.047
10. High caste and rich landowners	-0.103	0.055	0.008	-0.074	-0.025	-0.158	**0.659**	0.220	0.205	-0.308
11. Landless and unemployed	0.103	0.023	0.035	**0.706**	0.380	**-0.538**	0.034	0.106	0.024	-0.041
12. In debt and stress	-0.264	-0.061	0.075	0.060	**0.455**	0 255	**-0.451**	0.143	0.482	-0.154
13. Scheduled castes suffering droughts	0.241	-0.029	0.083	0.066	-0.389	0.071	-0.033	0.303	**0.685**	0.156
Canonical Correlation	0.912 *a*	0.885	0.791	0.645	0.572	0.482	0.324	0.250	0.211	0.170
Chi-square	2434.333	1683.300	1038.749	623.612	396.608	229.527	118.084	71.264	41.732	22.472
Degrees of Freedom	169	144	121	100	81	64	49	36	25	16
Probability *c*										
Trace Correlation	0.51760 *b*									

* Canonical variates are separate patterns of relationships between 'input' variables.

** Loading degree and direction of relationship of the specific variables with this pattern.

a Canonical Correlation : the statistical dependence between each matched pair of variables.

b Trace Correlation : general overlap between Attribute Utilities set and mobility behaviour sets.

c See Text.

scores (plus utility distance scores)[37] generated by the previous matrices. Let the first matrix be denoted by M, and the second, by AU (or DA). Each vector of AU provides a measure for a particular kind of uniform attribute or utility pattern, and each vector of M also does the same for mobility behaviour. In order to measure the degree of interdependencies of the two bases, successive canonical correlation ($\hat{c}$) between canonical vectors U and V are estimated which link the 'M' types of behavioral patterns and 'AU' types of attribute (and utility distance) patterns. Successive pairs of vectors V and U are produced from AU and M, such that maximum relations of need-attributes of the movers, through their perceived place-utility distances, to their mobility behaviour are specified.

A. Statistical Results

Results of the canonical analysis are presented in Table 6. Canonical analysis usually yields a set of solutions as large as there are orthogonal patterns in M or AU matrices, whichever has the smaller number of dimensions. Since there are thirteen patterns in our M and AU matrices, thirteen pairs of canonical vectors are extracted successively from M (called behaviour variate) and AU (attribute) with decreasing order of predicta bility, in the same manner as in principal components analysis. Of these, only the first nine statistically significant patterns are reported here, the last four are omitted as being statistically non-significant. As may be seen, a specific type of mobility behaviour and a specific type of attribute-cum-utility distance are linked. Values of canonical correlations are given at the bottom of Table 6. Corresponding canonical loadigs describing the correlations of the variables with the variates are also given for the behaviour and attribute sets. Comparison of the loadings for all variables with the pair of variates permits the identification of those attribute and utility (distance) variables most highly related to particular mobility behaviour (S) (under lined in Table 6).

The trace correlation is quite high, 0.518, indicating a significantly high overlap in the two spaces described by the original behaviour and attribute-cum-utility variables. Given the fact that most *multivariate* tests in social science research have correlations ranging only around 0.4 and 0.5, and also given the fact that only sample survey data are employed in the present research, this value of trace correlation can be considered quite significant. The interdependence of the attribute and behaviour matrices is also tested by such a significant value of the trace correlation.

Besides, successive canonical correlations between pairs of canonical variates also provide *nine* statistically significant measures of inderdependence of the bases of the behaviour and attribute matrices: first is 0.91, the second 0.88, the third, 0.79, the fourth 0.64, the fifth, as high as 0.57, and the sixth, close to 0.49. Even the seventh is also of quite importance (0.32), after which correlations however drop rapidly showing weaker relationships. The first six canonical relationships are significant at 1 in a billion level or more[38]. That is, the

37. Note that instead of using place utility dimensions *per se*, rather the utility distances between origins and destinations (measured on each dimension) were utilized in the canonical analysis.

38. Usual chi-square tests of significance show that first eight correlations are significant at 001 level or beyond—exact level of which cannot be estimated from the chi-square table. Instead, z-score transformations of the chi-squares are used (for degrees of freedom greater than 30) which specified the corresponding areas under the normal curve for each such correlation and the probabilities of occurring such relationships only by chance or random error. Thus, first six results are found to be significant at 1 in a billion level or more.

chance is only one in a billion tests that such relationships could occur only by random or systematic error. In other words, odd of accepting such results as trivial is only one in a billion. The seventh result is also significant at .000,000,05 level. The first three canonical results are regarded as the *major findings;* by comparison, the next four as the *minor findings.* These seven results are not only *statistically significant* but also *practically significant.* The eighth and nineth canonical correlations are *only statistically significant* (at .02 level or beyond), but not practically significant. The remaining four results (X-XIII) are statistically not significant and can be regarded as patternings of *random behaviour.* A very brief outline of these canonical variates follows.

B. Interpretations of Canonial Variates

1. Poor Economically Disadvantaged People Searching for Manual Job : In the first pair of canonical vectors the Behaviour variate 'migration moves to search for any kind of manual job', of canonical loading of 0.610, is found to be highly correlated with the Attribute variate 'the poor and landless socio-economically deprived people' (0.815) and with larger 'job-urban utility distance' (0.522).[39] Amidst multitudes of data, observations, and relationships, this particular result is of greatest importance. Corresponding canonical correlation is remarkably high, 0.912, which indisputably testifies that in the Indian situation the grim reality is that the poor landless socio-economically disadvantaged and deprived people are migrating merely in search of any kind of means for sustenance. And, in their movement decision-making the fundamental criterion is simply to have greater job-urban utility difference between the places of origin and destination—i. e. to obtain higher job utility gains from such moves. Telling against simplistic push-pull theory, this canonical result indisputably establishes a causal relationship between people's basic needs and people's movements for survival, a relationship that is of overriding significance for migration planning in the Indian situation.

For those unfamiliar with such canonical interpretations, the following elaboration may be helpful. Since each Behaviour and Attribute variate are linear combinations of the vectors of earlier Behaviour and Attribute (plus utilities) Matrices, the following relationships may be shown for new canonically-transformed scores (u and v), written with respect to the first pair of behaviour and attribute variates (Table 6) :

$u_1 = \mathbf{0.61}$ (migration to search for any manual job) − 27 (transfer moves for security) − **0.55** (moves for higher study) − 0.12 (urban to rural circulation for agricultural work) − 0.18 (moves for professional job) − 0.32 (moves for prospect) + 0.15 (short distance move) − 0.16 (migration for more than 1 year) − 0.06 (circulation to resume work) + 0.04 (oscillation to near native place) + 0.02 (moves of unemployed) − 0.12 (long distance urban to urban move) − 0.17 (medium distance moves).

$v_1 = \mathbf{0.52}$ (job-urban utility distance) − 0.10 (physical and kinship distance) + 0.01 (perceived nearness) + **0.82** (poor landless socioeconomically deprived) + 0.32 (want vertical social mobility) + 0.03 (small awareness space) − 0.01 (young adult with no family burden) + 0.09

39. Important canonical loadings of value greater than 0.40 are usually considered (i.e., explaining about 16% of variance) and underlined in the table. However, there is no rule of thumb, and such cut-off points are decided by the individual researchers.

(job-income dissatisfaction) + 0.17 (educated unemployed) −0.10 (high caste rich landowners) +0.10 (landless and unemployed) − 0.26 (in debt and familial stress)+0.24 (scheduled castes droughtstricken).

therefore, 0.61 (migration to search for manual job)=0.52 (job.urban utility distance)+0.82 (poor, landless socio-economically deprived persons).

Noteworthy feature is that while a few specific variables (with higher loadings) are picked-off from both attribute and behaviour set to show their maximal relationship, the relationships with other variables are reduced to near zero. Closer examination of loadings further points out that a single attribute variable 'poor landless socio-economically deprived people' alone explains about 66 percent (loading of 0.815 squared and multiplied by 100) of the variation in 'migration movement for manual job', that is there exists almost a one-to-one relationship between the two (evidently, such moves are not for higher srudies, see its negative loading). And 'job-utility gain' explains only another 25 percent of the variation.

For the study region in northern India, then, such relationships clearly reveal at least three important findings: first, it is mainly the need-stress-attribute component—the 'stress' factors in the orlgin places—that is much more important causal reason for such labour migration than merely job-urban utility gains or attractive 'pull' forces of the city destination, as has been frequently emphasized in many migration-mobility studies. This finding is of tremendous importance for migratiod policy making, as it emphatically calls for focusing upon the 'need-stress' situation of the people and in the rural areas to attack and solve them there instead of programmes of urban renewal or squatter eradication in the cities. Secondly, this also indicates that given job facilities in the rural sector, people would also like to live there. Thirdly, conspicuous in the linkage equation of two utility factors (physical-kinship utility distance and perceived nearness utility distance) clearly dispelled another set of current beliefs of most migration researchers who often emphasize that as if mere physical distance, kinship facilities or perceptual factors are of greater importance than hunger itself in the mechanism of labour migration in the Third World. The findings are just the contrary. Hungry people do not consider distance barriers, kinship acquaintance fields or cognitive mapping of their geographic worlds–no wonder why such current geographic concepts thus fail to explain why people move in the Third World. People here rather move anywhere just to survive.

In like manner, successive canonical correlations, canonical loadings and corresponding patterns of causal-functional relatianships between the behaviour set and the attribute set can be easily interpreted (Table VI, columns 2-9). Also see the final summary table VII which presents all the results of this monograph in nutshell.

2. *Young People Aspiring to Vertical Social Mobility Moving for Higher Studies.*

The second pair of canonical variates (Table VI, column 2) is interpreted as a negative canonical vector, as customarily done with factor analysis results. In such interpretation. higher negative loadings among both the attribute and behaviour sets are considered to be interrelated. Highest negative behaviour variable loading is for the moves for college-university study (−.447), the highest negative attribute loading is for a desire for vertical social mobility (−0.875) and that of utility

Table VII
Summary Of Mobility-Field Theory Results

Sl. No.	Results of Factor Ananlyses[a] Mobility Behaviour Matrix M	Place-Utility Matrix U	Need-Attribute Matrix A	Results of Canonical Analysis of three matrices Name of Canonical Variates Pair M v d + A U	Corresponding Canonical Correlation between matched pair	Significance Level	
1.	Rural to urban migration for more than 1 year to search any manual job (Urban-rural circulation for vacationing) (18.7%)[b]	Job-urban-education utility (37%)	Poor, landless socio-economically disadvantaged (26.1%)	Poor economically disadvantaged people searching for any manual jobs	0.912	$1 \times 10^{-9}+$	Major Findings
2.	Transfer for familial security (moves to search any manual job) (10.8%)	Kinship-physical nearness utility (32.7%)	Youth aspiring to vertical social mobility (7.5%)	Young people aspiring to vertical social mobility moving for higher studies	0.885	$1 \times 10^{-9}+$	
3.	Moves for higher study in big university (moves to search for any manual job) (7.6%)	Mentally perceived nearness utility (19.7%)	Restricted awareness of places and opportunities (6.4%)	Educated unemployed moving for professional jobs	0.791	$1 \times 10^{-9}+$	
4.	Urban to rural circulation to native villages for harvesting or to meet family (6.8%)		Young people with no/little family burdens (5.4%)	Landless and unemployed people moving for employment	0.645	$1 \times 10^{-9}+$	Minor Findings
5.	Moves of educated unemployed for professional jobs (moves to search any manual jobs) (6.4%)		High job-income dissatisfaction (4.6%)	Moves of unemployed-dissatisfied-indebted people for employment-security-prospect	0.572	$1 \times 10^{-9}+$	
6.	Moves for prospect (6.0%)		Educated unemployed looking for jobs and earning (4.1%)	Moves of underemployed and oscillatory moves of young people with no family burden	0.482	$1 \times 10^{-9}+$	

7. Short-distance rural-urban moves within 100 miles (medium distance urban-urban moves 200-500 miles) (5.5%)	High caste rich landowners (3.7%)	High caste rich landowners moving medium distance and circulation of people in debt and familial stress	0.324	.000,000.05	
8. Migration moves for more than 1 year (temporary moves for 3-12 months) (4.9%)	Landless unemployed peasant and workers (3.3%)	Temporary migration for high job-income dissatisfaction	0.250	.0003	Statistically Significant
9. Circulation to resume work (4.6%)	In debt and familial stress (2.8%)	Oscillation of scheduled castes affected by drought and debt	0.211	.02	
10. Oscillation moves between origin and destination because it is near to native place (3.7%)	Scheduled castes and low castes severely drought-striken (2.7%)	Circulation to resume work and long distance urban-urban moves due to more utility gains in physical and perceived nearness	0.170	.13	Random Behaviour
11. Moves of unemployed (moves of underemployed) (3.5%)		Not easily interpretable	0.128	.35	
12. Long distance urban-urban moves for more than 500 miles (short-distance rural-urban moves within 100 miles) (3.0%)		Not easily interpretable	0.078	.40	
13. Medium distance moves between 100 and 200 miles (short-distance moves within 100 miles) (3.0%)		Not easily interpretable	0.036	.48	

a Only those dimensions were considered which have eigenvalue greater than unity.
b Variance explained by the factor is given in the parenthesis. Since canonical analysis attempts to maximize correlation, not variance explained, it is not shown here.
c Regarding M, U, and A matrices, 84.7%, 89.4% and 66.6% respectively were being cxplained.
d Instead of using utility factor scores, rather utility distances between a given pair of origin-destination were used in the final canonical analysis.

variable is job-urban utility distance (–0.655). Since all of them are negatively loaded, their associations are easy to interpret as : young people who want vertical mobility are moving for higher studies and relocating to places of high urban-educational utility gains. Also note that only young aspirants of the social elites (who do not belong to poor deprived class) are moving for higher studies. In the same manner, all the positive loadings within this matched pair of variates can also be regarded to be associated. Thence, the two behaviour variables, circulation for vacationing (0.515) (when negative polarity of first component is taken, see table 5) and urban to rural circulation for harvesting (0.508), can be considered maximally associated with utility variable 'physical-kinship utility distance' between origins and destinations (0.345). In general, both the kinds of circulatory moves are found to be causally-functionally linked with wider physical-kinship utility distances or positive gains. It confirms that circulatory moves basically are dependent on physical and kinship 'distances'. Greater the distances or utility gains, the more chances of circulatory moves. Thus, this second pair of canonical variates unfolds two sets of relationships, both of which have great practical and statistical significance, for this pair has a very high correlation of 0.885.

3. Educated Unemployed Moving for Professional Jobs

The third canonical correlation is also of high value, 0.791. This pair of canonical variates (column 3) reveals almost a one-to-one relationship between the attribute variable 'educated unemployed wanting jobs and earning' (–0.952) (Attribute variate) and the behaviour variable 'moves of unemployed for professional jobs' (–0.849) (Behaviour Variate). That is, the attribute 'educated unemployed' alone explains about 90 percent of the variation in the behaviour variate (comprised mainly of the variable 'moves for profestional jobs'). Of course, another behaviour variable, 'moves for college-university study', also has a positive loading (0.410), but all other variables both in behaviour and attribute sets are insignificant. Considering all three, this canonical vector then means : the more an individual is educated and unemployed wanting jobs and earning, the more probability of his moving only for professional jobs and less for higher studies. Conspicuous absence of any utility variables testifies, quite strongly, that jobless educated persons are ready to move anywhere, irrespective of presence or absence of distance barriers, kinship ties, urban facilities or proximity.

Since the words 'educated unemployed' appear both in attribute set and behaviour set these may imply that such an explanation is mere tautology. In this connection, it may be well to remember that throughout our analysis both the attribute set and the behaviour set are defined, measured and operationalized independent of each other and, as such, such argument is unwarranted. And more importantly, none of the 'input variables' in canonical matrix is merely a single variable, rather they themselves are factors or compound variables. Each of them rcprents a cluster of interrelated variables, each of which, in turn, comprises of many original measures, indices and data. Canonical correlation between such matched pair of canonical variates, then indicates interrelationships at much higher order of complexities, between more compound variables, instead of citing a tautology. The above argument holds good for all canonical results.

4. The landless and Unemployed People's Move for Jobs

The fourth canonical vector (Table VI,

column 4) is characterized by a very high degree of association between behaviour variable 'moves of unemployed' (0.850) with two attribute variables 'landless and unemployed' (0.706) and 'young adult with little/no family burdens' (0.661). Corresponding canonical correlation is still remarkably high, 0.645. This association emphasises that the attribute factor 'landless and unemployed' alone accounts for 50 percent, and the next factor 'young adults with little family burden', another 43.5 percent, of the variation in movements of the unemployed workers (behaviour variate). That is, the more an individual is landless and unemployed young adult with less family burdens, the higher the probabilities of his moving out from the native village for employment elsewhere. Also note the absence of such factors as awareness space, job-urban utility distance, kinship-physical distance or perceived nearness, which establishes that such considerations are unimportant to most of the unemployed persons who are desperately searching any kind of work.

5. Moves of Unemployed-Dissatisfied-Indebted People for Employment-Security-Prospect

In contrast to former one-to-one relationship between a single behaviour type and a single attribute type on the fifth canonical vector, a cluster of behaviour patterns is found to be associated with a cluster of attribute structures in a complex way, as listed below :

Atiribute variate

Physical-kinship utility distance	0.377
Job-income dissatisfaction	0.380
Landless unemployed	0.380
In debt and familial stress	0.455
Scheduled castes suffering drought	-0 389
Young adults with no/little family burden	-0.353

Behaviour variate

Migration in search for any manul job	0.411
Moves of unemployed	0.437
Urban to Urban long distance move	0.436
Moves for prospect	0.353
Transferred moves for family security	0.327

Though interpretation becomes difficult nonetheless, one major relationship does emerge : older people who do not belong to scheduled caste but share some familial responsibility and who are being affected by medium to high level of debt and stress and also have some income dissatisfaction (Attribute set) are moving either for manual job/ other kinds of employment or for prospect/ family security (Behaviour set). In essence, this canonical vector unfolds a hidden dimension commonly shared by different groups of people. The fifth pair of canonical variates still shows a remarkably high correlation (0.572).

6. Moves of Underemployed and Oscillatory Move of Young People with No Family Burden

The sixth canonical correlation, of value 0.482, is interpreted rather negatively as apparent from the following loadings :

Attribute Variate

Underemployed (considering negative polarity of dimension landless and unemployed)	(–) 0.538
Young adult with no/little family burden	0.530

Behaviour Variate

Moves of underemployed (considering negative polarity of dimension moves of unemloyed)	(–) 0.558
Oscillation because destination is near native place	0.432

If attribute and behaviour factors of Tables III and V are re-examined, it may reveal that in both the cases the negative polarity of 'unemployed' dimension is represented by an 'underemployed' dimension (of Attribute matrix) and 'moves of underemployed' (of Behaviour Matrix). In the like manner, the remaining two positively-loaded and interrelated variables represent an oscillatory type of moves of single males who have little familial responsibility. In sum, this entire canonical vector shows moves of single male and underemployed labourers and workers.

7. High Caste Rich Landowners Moving Medium Distances for More than One Year and Circulation of People in Debt and Stress

The seventh pair of canonical variates is less interpretable because at each subsequent step canonical analysis linearly recombines both sets of variables in order to determine the new matched pair of variates and to maximize the remaining interrelationships, and more and more variables are added to a canonical vector. This can be easily seen from the following :

Attribute Variate	
High caste rich landowners	0.659
In debt and stress	-0.451
Behaviour Variate	
Oscillation moves to near native places	0.414
Medium distance moves (100-200 miles)	0.399
Migration for more than one year	0.336
Urban to rural circulation for harvesting	-0.464
Circulation to urban area to resume work	-0.383

Yet two patterns can be discerned, one each for positive and negative associations : (1) high caste rich landowners are migrating or oscillating for medium distances, and (2) other people in debt and familial stress are circulating back to their villages for harvesting or returning to the city to resume duty. This variate pair shows a correlation of 0.322.

8. Temporary Migration for High Job-Income Dissatisfaction

The eighth canonical variate pair shows a correlation of 0.260 which is significant at .0003 level. Two movement patterns constitute the behaviour variate : temporary moves for 3 to 12 months (-0.656) (considering negative polarity of this component, see table 5) and medium distance moves that are made within 100-200 miles (0.424). These two movement types are found to be causal-functionally linked with two attribute variables : high job-income dissatisfaction (0.620) and no considerations for physical-kinship utility gains (-0.427). The significanoe of this canonical component can be at once apparent as it again confirms that it is the 'dissatisfaciion' or need-stress system of the people that induces temporary moves (within 100-200 miles), and not mere distance-decay function or kinship facilities, nor even perception of nearness of a destination (-0.358).

9. Oscillation of Scheduled Castes Affected by Drought and Debt

The last canonical result is of great policy significance (Table VI column 9). It clearly indicates that 'scheduled castes affected by droughts' (0.685) and 'people in debt and familial stress' (0.482) (Attribute variate) are forced to make 'oscillatory moves to near native places' (0.561) or to make 'short distance moves within a 100-mile zone' (0.510) (Behaviour variate). In orher words, drought- and debt-stricken low-caste people and untouchables are helplessly moving to and fro bet-

ween their origin villages and the city destination (Varanasi) with the sole purpose of merely to survive and settle down somewhere, but under crushing pressure of circumstances they are unable to do so. Canonical correlation is 0.211 which is significant at .02 level of significance. That is, chances are only 2 in 100 that this finding could be random, trivial or unacceptable. It comes out still sufficiently strong to indicate an urgent need for alleviating the social-economic conditions of the low castes and the untouchables in India.

All the results of this final analysis testify, quite conclusively, that most of the people's movements in northern India are caused by unfulfilment and denial of their basic human needs for food, sustenance, employment and security. The focus, then, must be given to understand why are people hungry, why are they deprived, what situations maintain such exploitative designs and what must be done to change the destiny of the people in distress.

Lack of space does not permit further discussions. The main findings from the cononical analysis are now presented in a series of propositions, as follows (see Table 7).

C. Major Findings

- The more an individual is poor, landless and socio-economically deprived, the greater the chance of his migrating from the rural to the urban areas in search of any kind of manual job and to move from a place of less job-urban utility to a place of greater provision of such utilities. This canonical result is found to be of such great overriding power and statistical significance that it can be easily regarded as a general rule of movement behaviour applicable to the entire population of the study area (canonical equation 1).
- The more an individual is young and aspiring for vertical social mobility and the wider is job-urban-educational utility distance (gain) between origin and destination, the more chance of his moving for college-university education (canonical equation 2).
- The higher the gain in physical-kinship nearness utility, the more frequent are circulatory moves to native places for harvesting, for meeting families or vacationing (canonical equation 2).
- The more an individual is educated and unemployed wanting a job and earning the more chance of his moving only for professional jobs and the less chance of his making a move for further education (Equation 3).
- The more an individual is landless, unemployed and of young age and having less family burdens, the more chance of his moving out from his native village for outside employment (Equation 4).
- The more an individual is an upper-caste, older person with family responsibilities, and the more he is dissatisfied with job and income situations, and at the same time being partially indebted, the more chance of his moving out in the hope of employment, security or future prospect (Equatiou 5).
- The more an individual is underemployed, the more chance of his moving out for employment elsewhere. Also, the more an individual is young adult with less or no family burdens, the more chance of his making oscillatory moves (Equation 6).
- The more an individual is high-caste, rich and landowner, the more chance of his migrating medium distances (200-500 miles) for more than one year (Equation 7).

- Also, the more a person is in debt and familial stresses, the more chance of his making frequent circulatory moves from the native village to the city (Equation 7).
- The higher the job-income dissatisfaction among the individuals, the more chance of their temporarily migrating for a period of less than one year, and less chance of considering physical-kinship utility gains or losses (Equation 8).
- The more an individual happens to belong to lower scheduled castes and more being affected by drought and debt, the more chances of his helplessly oscillating to and fro between the same pair of origin village and city destination for sustenance (every time for less than one year's duration) (Equation 9).

These are eleven canons, generated by nine canonical linkage equations. The planning significance of the first canonical component is most glaringly apparent : it simply reiterates the most urgent need for making a frontal attack at the roots of the poverty and underdevelopment in India. The fifth, seventh, and ninth canons are emphasizing that not only the peasants and the agricultural labourers need attention (first canon) but there are also multitudes of very marginally employed or totally unemployed people even in the non-agricultural sector, and whose needs for survival demands nothing less than a total change in existing patterns of industries, investment technology, means of production and production relations in favour of generating more employment. The eleventh canon again unfolds a most pitiable situation of the low castes and the untouchables in the study region and demands a far greater social reform than that which can be achieved merely by economic growth process. And, then also exists the ovewhelming problem of the teeming millions of jobless educated people (fourth canon), which awaits solution before it explodes into a volcanic situation.

IX. MIGRATION PLANNING POLICIES

A. Policy Directives

Previous discussions have amply demonstrated that the problem of movements due to underdevelopment appears to be so complex and so entangled that no matter what aspect of this phenomenon we look into the patterns lead us to very many related problems awaiting solutions. These include land reforms, construction of irrigation networks for controlling droughts, rural development programmes, optimum rural-urban balance policy, restructuring the space economy by setting growth or development centres, education, training, and better utilization of human resources, and social mobilization of all people for comprehensive developmental planning. In short, the situation calls for nothing less than a new politico-economic revolution ! These are the broad policy directives that should be followed if we are desirous of lessening the problems of movements that arise from undevelopment and which have been identified in this study of Varanasi region. Some of these policy directives are briefly discussed in the following sections.

Why is such movement happening on so

great a scale ? The findings of this study point out that, basically, the causes appear to lie more in the rural areas, in stresses in the origin places, and less in the pull forces or in the attractiveness of the urban centres. This is generally true in most parts of India and elsewhere in the less developed countries, where subsistence agriculture and primitive husbandry still prevail, and over-fragmentation of holdings and inefficient farming techniques make cultivation a hazardous way of life.

B. First Possible Solution : the Creation of the Viable Villages

In regard to the whole problem of migration and underdevelopment, first, we must have to eliminate various stresses in the rural areas. Rural problems range from shortage of owned or cheaply leased land, rudimentary production techniques and lack of irrigation and fertilizer to the almost total absence of school, health and welfare services. Any solution that can be envisaged must attempt, first, to strike at the roots of these stresses in the rural areas; it should try to alleviate the socio economic political conditions there, to alter the very production system of the agricultural land. Unless there are changes in the pattern of land ownership and adequate safeguard against drought, flood, pests, and seasonal unemployment, underemployment and rural poverty millions of people will continue to crowd in the city. Land reforms, cooperative farming, and increased productivity through a network of irrigation channels, and multiple cropping are the only democratic answers to these problems of inequalities. Land reform is bound to come. But, unfortunately, due to vested interest groups, land reforms would take long battles before it is rigorously implemented. But, at least, cooperative farming can be initiated through peasant unionism without much difficulty.

Recently Minhas[40] has also advocated in favour of cooperative farming and argued that taking up development of cultivable land on a community basis, land levelling, reconstructing field drains and irrigation channels, and starting cooperative farming—all these will not only add considerably to the total cultivable land and to productivity, but will also create jobs for the landless labourers and seasonally unemployed.[15]

In such a cooperative society, a rural bank, agriculture extension work, rural family planning centre, a sales depot for seeds and fertilizer, community warehousing, a school, and a recreation centre, all these will soon emerge. Gradually, extension of rural electrification, road connections with the nearest viable small town, and flow of goods and services will initiate the beginning of agro-industries in such villages. This cooperative technology and organised rural works programmes will ensure viable villages. The main benefit will be the creation of new jobs in the villages themselves and the regeneration of the village economy.

C. Second Solution : Plugging Breaks in Settlement Hierarchy to Induce Balanced Flow

Findings from place utility considerations, especially the job-urban utility distances, also indicate that such massive rural to urbanward movements are caused by the presence of an uneven spatial economic structure and an unbalanced regional economy in the territory.

40. Minhas, B. S., *Planning and the Poor* (Chand, 1974), pp. 1-141. Also his "Rural Poverty, Land Distribution and Development", *Indian Economic Review*, April (1970).

Unfortunately, processes of development of settlements in India are spatially concentrated only to a few nodes—to former colonial administrative capitals and exporting ports amidst a vast featureless plain dotted only with innumerable number of small rural hamlets. These processes have left stagnant regions in the surroundings imperfectly related to these centres. The structure of the spatial economy developed in such a way that there was very little 'trickling-down effect' of the developmental process down the rungs of the settlement hierachy. The same kind of spatial disorganization continues even today. Unless the entire space economy is restructured by a network of local and regional centres of productivity, it seems that there is no escape in the foreseeable future from such human problems. There is no way to halt the flight of the peasants to city footpaths and their concomitant human sufferings.

Thus, labour migration, breaks in settlement and regional hierarchy, and poverty are parts of a broader problem, of spatial disorganization due to the process of economic underdevelopment. This is another important policy directive that can be taken for future action. Thence, to ease the oppressive situation, it is imperative to have a programme contributing to the emergence of a spatially-integrated hierarchical system, and thereby plugging the breaks in the system. One possible way to do this is to regenerate the economic growth of existing smaller towns and to create a network of new growth pole centres or multifoci growth points at some vantage locations. Such new growth centres are required to be set up in between origin villages and the city destinations so that a more balanced spatial flow can be induced. The main objective, then, will be to identify and determine the locations of growth centres at those suitable locations where such centres can make effective use of local agro-industrial resources, introduce and develop labour-intensive and capital-generating industries and construction work, provide gainful employment to the local and the migrant labour, satisfy and fulfil their minimum needs in life, and thereby ensure a better utilization of the human resources.

The main idea would be to induce changes into the existing inefficient pattern of a few large and overgrown migration fields of major cities by disintegrating and transforming them into a honeycomb of a larger number of spatially-integrated and economically viable smaller migration fields. Such changes would ensure that the migration field conform and overlap with the centre's own service area and that the centre provides the necessary amenities to the incoming migrants. As a result, it can be hoped that there will be better conditions of living and little waste of human resources. The growth centres should be planned to perform fourfold functions, as listed below :

a. These centres should evolve as self-sufficient and self-generating centres of production. Since most of the cities of India are merely places of tertiary activities, especially services, trade and commerce; it is no wonder that the uneducated and untrained rural peasants migrating to such cities frequently remain unemployed, or at best, engaged in indigeneous transportation activities. Such pursuits contribute very little to the overall economic growth, nor do they create aggregate demand for labour. Hence, the growth centres should emerge as centres of labour-intensive and capital-generating industries and construction work. Agro-industrial and marketing activity, rural electrification and road construction are suitable activities which are the greatest

generators of direct and indirect demand for labour, and also contribute directly to the productivity.

b. These places should originate as nuclei of diffusion of the process of economic development to their respective service areas, and act as vehicles of bringing technology closer to the agricultural sector. Through organized activities and arteries of road communications, these centres should be able to diffuse to the surroundings such innovative ideas and practices as fertility control, farm management, cooperative farming, household and cottage industries, peasant unionism, and vocational training to the unskilled and semi-skilled labourer. In return roads will promote flow of marketable goods from the villages to the growth centre. In short, the purpose of such centres will be to initiate, maintain, and evolve socio-economic change in the tributary areas, transforming the entire cultural landscape.

c. The nature of programmes of growth centres is required to be sufficiently flexible as to meet the needs of the migrant and local population. The functions should vary from area to area according to the attribute structure and need systems of the population involved. Therefore, in addition, some of the centres should also provide college education, health facilitles, clinics, professional training and the like.

d. Through different classes of growth centres, these primary centres are required to be linked with the lowest order farm villages, on the one hand, and with the larger towns and cities, on the other. This step will bridge the gap in the hierarchy and facilitate an efficient functioning of the economic process.

D. Third Solution : Eliminating Barriers in the Individual's Mobility Field

The creation of the viable villages and growth poles are but only partial remedial measures to this entire problem of movement and underdevelopment. This is just one way to look at this problem. Another way, supplementary to the former perspective, would be to provide a field solution. This implies letting the forces in the individual fields automatically adjust themselves to their respective life spaces, so that the individual's needs are fulfilled, satisfactions derived from utilities of the places are enhanced, and their movements become gainful.

In the individual mobility field, there are three kinds of forces : (1) driving forces that cause spatial or mental locomotion towards a goal, (2) restraining forces that result from different kinds of social, economic and political barriers, and (3) induced forces that correspond to the wishes of others, for instance, government or local authorities. Driving forces are the inner motives that spring from basic human needs and are associated with utilities of the corresponding goals. Need-push and place-utility distance vectors are then driving forces in an individual field.

There are also different kinds of socio-economic-cultural-political-linguistic barriers in the individual's field, which block need gratification and restrain free field adjustments within the individual's life space. Caste system is one such barrier. Deprivation is another. Land tenancy, land mortgage and debt are some other kinds of barriers which bind the rural folks to perpetual serfdom. Sometimes, the government's coercive actions against the hawkers, vendors or squatters in the urban areas and the lack of encouragement or subsidy to small-scale entrepreneurs act as barriers in the fields hampering free field

adjustments in the individual movers' life spaces. Such barriers could be innumberable in number, diverse in character, and variant in degree.

The field solution, then, involves identifying these different kinds of socio-economic-political barriers in the individual mobility fields and finding ways and means of eliminating them from the social mix of the population. The purpose would be to eliminate these barriers that prevent field forces from automatically adjusting themselves within the life spaces of the individuals and thereby to enable men to forge out their best abilities and right to decide thir own lives.

Hence, probably a more comprehensive solution to this entire problem of movement and underdevelopment may be to envisage an economic and social planning programme in which all these possible solutions (among others) are effectively integrated into an organised whole, and the planning goals and machinery are oriented toward providing the basic human needs to the poor, the damned, and the downtrodden.

X. EVALUATION

A. Evaluation of the Mobility Field Theory

Evaluation of the theory is discussed with respect to its universality, generality, flexibility, applicability, utility, dynamism, and contribution to migration planning.

Universality : mobility field theory equips us to view problems of movement, not in isolated and fragmented ways, but rather within a system—a mobility system—in which the parts are integrated into a structured whole. It brings together within one framework a variety of prevailing models and theories (like perception theory, utility theory, gravity model and movement flow, theory of functional distance, etc.); gives a spatial rendering of the general systems theory; and unifies diverse observations and considerable data. It makes a shift from an emphasis on absolute characteristics of and fully specified relationships amongst specified movers to a holistic view of the movement process; to the interrelatedness of people, their needs, and their utility considerations in the decision to move. Viewing the movement process and mobility behaviour in such an organised way gives insight into the interplay of cause and effect, of the socioeconomic situations in which people are imbedded and within which their movements occur. As a matter of fact, the organization of elements into a structured model that mobility field theory permits, allows the understanding and planning of mobility to be viewed as other than a hopelessly impossible task.

Generality : as noted earlier, the basic philosophy of the field theory, and its accessory concepts, hold good for any population. For instance, the three elements of the field—the structure of movement behaviour, of utilities, and of movers' attributes–may vary from population to population over time, but the underlying philosophy that these three elements are interdependent parts of the mobility system is generally true. Like any analytic strategy, mobility field theory is applicable to any country.

Flexibility and Applicability: since no limits are being imposed upon the dimensions of the three matrices and their corresponding spaces of behaviour, attributes, and utilities, this model provides tremendous flexibility to incorporate whatever variables are appropriate to the population under study. Of course, the structure of movers' attributes may vary greatly from population to population, but the structure of place-utilities and of movement behaviour would also manifest corresponding differences. The three spaces together would indicate the degree of interdependences between movement behaviour and need-systems of the population, at that time, as well as the cause-and-effect relations between them.

Utility in migration planning: to indicate the degree of interdependences between various attibutes of the population and utility-distances, on the one hand, and mobility behaviour on the other, makes it possible to specify what attributes of people and places would bring change in the movement behaviour. Such specifications may provide important clues for migration planning for any developed or developing countries.

Dynamism: if the variations in such interdependencies are observed over time, then the dynamic nature of the mobility field can be unfolded. Once we know what attributes of people and places change what patterns of behaviour, we can begin to plan mobility for the future of given countries and in terms of the socio-economic and political context of each.

Applicability of Analytic Techniques: mobility field theory rests upon a coherent and ordered sequence of techniques, which consists of factor analysis, distance analysis, matrix manipulation, and finally, canonical analysis. These techniques clearly specify the means of delineating those three structures (attribute, behaviour, utility) that generate corresponding spaces and, finally of operationalizing the tests of interdependence and isomorphism between the bases of attributes and behaviour. This technical sequence becomes a package of standard tools for generating mobility fields for a wide range of countries—although these techniques may, of course, have to be modified according to the data reality of the different countries under study.

B. Contribution of Mobility Field Theory to Migration Planning

The mobility field theory, thus, integrating the three main aspects of movement process can provide many clues to planning movements, especially in the following areas :

1. *On Needs of people:* tells who are the movers, what are their different kinds of needs, and what social, economic and demographic variables play important roles in inducing movements;
2. *On Stress Situations*: describes what stress conditions (like drought, land mortgage, debt, unemployment, lack of amenities) trigger-off people's move, where are depresseed areas in the country located, and what we ought to do about those stresses ?
3. *On Utilities*: specifies what utility considerations are more or less important in their movement decision-making, and how does spatial distribution of such utilities affect their movements. Indicates how we ɹɹsuch amenities of life can be provided with minimum effort but for maximum benefits.
4. *On Success of Movement*: indicates whether movers are gainfully employed.
5. *On Mobility Rates*: indicates what classes of people are more or less mobile, and why ? What social, economic, and demographic

variables can be and ought to be changed to induce desirable behaviour change ?

6. *On Location of Growth Centres :* analyses the presence and absence of essential facilities in origin and destination places; it may also suggest where existing and new growth centres be] located in order to induce a balanced spatial flow.
7. *On Prediction and Estimation of Future Movements* : from the present emphasis on explaining individual's movement behaviour through individual's utility and behaviour spaces, it is extremely easy to reconstruct utility and behaviour spaces corresponding to the gross aggregate movement flows between a pair of places. Then, distance between a pair of places (origin-destination) on that aggregated Utility Space will be a Predictor of their distance on the corresponding aggregated Behaviour Space, which in turn, will be a predictor of nature and volume of particular movement behaviour in future. This prediction is of great value in town and country and economic planning.
8. *On Inducing Change in Behaviour and Attributes :* testifies that inducing change in parts of the attribute structure, e.g. in education or training, corresponding positive changes might occur in specific movement behaviour, i.e. in movement of skilled labor. Again, inducing change in the spatial organization of any area by creating a local growth centre between origin and destination, may redirect spatial flow along the more desirable channel, and may also pay dividends in changing positively the attributes of people, say, employment of migrant labour.

CONCLUSION

This monograph has focussed upon the need for solving the human problems involved in people's movement caused by underdevelopment. In this connection, this study has also emphasised upon the need for viewing the mobility phenomena integratively with the total social context. A philosophical perspective has been evolved here which emphatically focuses upon studying the 'basic needs' of the people, and their stressful socio-economic-political conditions in which people are imbedded and within which their movements occur. Hence, to provide a philosophical and theoretical basis for dealing with such human problems a mobility field theory has been developed here which basically specifies causal-functional links of the need-stress-attribute systems of the individuals, as filtred through their perceived utility distances between the places of origin and destination, to their movement behaviour which arises from attempting to satisfy those needs. As a result, this field theoretic model permits an evaluation of the relative importance of various need-stress sets and place utility considerations of the individual movers in causing different types of movements.

In this monograph two models of linkages between the needs, utilities and movements are developed (individualistic and aggregative), both of which are operational and empirically verifiable. The aggregative model has been tested here with the fine-grained data of individuals that are collected at the north Indian situation and it has been found highly successful.

The usefulness of this theory may be at once apparent as a tool for planning mobility to alleviate the conditions of the people in distress in the underdeveloped countries. Since the theory specifies the causal-functional links between the basic needs of the people and the movemnt behaviour that arises from their unfulfilment, it permits to indicate what

basic needs of the people to be fulfilled, what utilities of places to be augmented, and what ought to be done in a specific territory to redress the plight and flight of people from one poverty condition to another.

This study, by providing many evidences of interdependence between need-attribute-cum-utility distances and mobility behaviour patterns, not only empirically verified the main postulate of mobility field theory, but also generated many clues of great practical significance for formulating migration planning policies. These findings from canonical analysis indicate a dire need for immediate land reforms and developmental programmes in the Indian villages, for alleviating social-economic-political conditions of people in general, for setting up a network of growth centres in order to redirect movement flows to more desirable places and for mobilization of all human and economic resources for liquidation of poverty from the surface of India. In the final analysis, however, it should also be remembered that such measures of migration planning or growth centre strategy or rural development, etc, are only palliatives, and that these alone cannot make a frontal attack at the roots of the entire problem of movements due to underdevelopment and poverty For this problem is global in its setting and overwhelming in its complexities, it calls for a vast systems transformation.

ABSTRACT

The main human problem of rural to urban movements in the Third World is that people are mostly moving from unemployment to underemployment, from one kind of poverty to another, resulting in a colossal waste of human resources and great human misery. Set within this context, there is a surprising lack of concern among geographers and population specialists with such problems and no adequate spatial theory for understanding and dealing with such considerable mobility. This study attempts to fill this lacuna. The concept of mobility field and a mobility field theory model are developed, at the level of both the individual and the aggregate system, to provide a theoretical basis for understanding the complex of factors that lead people to move, as well as to generate clues for migration-mobility planning to help alleviate such human problems. The field theory is tested with fine-grained data that refers to 305 sampled individuals and was collected in a field survey of Varanasi City, Northern India.

Mobility field theory states, in both verbal and mathematical form, that (1) at the level of the individual, the movement behaviour of a person located at place i, towards another place j, is a linear function of both that person's specific need-stress-attribute set and his perception of place utility distances between that pair of places (origin-destination); and (2) at the level of the aggregate system, the need-stress-attribute structure of individuals in a population, their perceived place utility distances between pairs of places, and the resultant types of mobility behaviour, are interdependent parts of the mobility system, called mobility field, within which any natural or induced change in one part generates corresponding changes in other parts.

The crux of the theory lies in mapping out the bases of mobility behaviour space (M)on to that of the combination of utility distance-*cum*-need-attribute space (AU), and ascertaining the degree of interdependence and isomorphism between the structure of attribute *cum*-utilities and the patterns of mobility behaviour. This test of interdependence and causal-functional links is performed by canonical analysis and in canonical form the theory can be represented as M∼AU. Mobility field theory thus indicates the causal relationships between people's needs, as filtered through place utility considerations, and the resultant mobility behaviour that arises from attempting to satisfy those needs.

The final canonical analysis identified nine patterns of causal relationships between attribute-*cum*-utilities and movement behaviour that were statistically highly significant. These were : 1) poor, economically disadvantaged people searching for manual jobs and moving to places of greater job-urban utility gain; (2) young people, aspiring to social mobility are moving for higher studies; and also the urban to rural circulation of former peasants back to their respective villages for harvesting or visiting family and for kinship utility gain; (3) educated, unemployed persons looking for professional positions; (4) the landless and unemployed seeking gainful employment; (5) unemployed, income dissatisfied, and indebted people moving in the hope of employment and security; (6) movements of the underemployed (7) high-caste, rich landowners migrating medium distances; (8) temporary migration due to high job-income dissatisfaction; and (9) oscillation of scheduled castes under conditions of severe drought and debt.

This study, by providing many significant tests of interdependence between need-attribute-*cum*-utility distances and mobility behaviour patterns, not only empirically verified main postulate of mobility field theory, but also generated many clues for planning. These findings from canonical analysis call for alleviating the social, economic, and political condition of village people in India, as in immediate land reforms and developmental programmes and for setting up a settlement network, wherein growth would be focussed so that movement flows could be redirected to more desirable places.

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