PRESIDENTIAL ADDRESS

WHAT ABOUT PEOPLE IN REGIONAL SCIENCE?

by Torsten Hägerstrand*

Since this occasion is the first time in the annals of the Regional Science As-
sociation that the presidential address is being delivered at a congress in Europe,
it seems appropriate to explore the past to see whether there has been a difference
in emphasis or tone between the European and the North American meetings. I
think there has been a difference although I am not prepared to show statistical
evidence. When looking over the proceedings of the sixties, one gets the impres-
sion that participants in this part of the world have preferred to remain closer to
issues of application rather than to issues of pure theory. We in Europe seem
to have been looking at Regional Science primarily as one of the possible instruments
with which to guide policy and planning. I have chosen to proceed along this
line by suggesting that regional scientists take a closer look at a problem which is
coming more and more to the forefront in discussions among planners, politicians,
and street demonstrators, namely, the fate of the individual human being in an
increasingly complicated environment or, if one prefers, questions as to the quality
of life. The problem is a practical one and, therefore, for the builder of theoretical
models, a 'hard nut to crack.'
Now, first of all, does the problem fall within the scope of Regional Science?
I think it does. A forest economist remarked some time ago that, "forestry is people,
not trees." How much more accurate it would be to say that Regional Science is
about people and not just about locations. And this ought to be so, not only for
reasons of application. Regional Science defines itself as a social science, thus
its assumptions about people are also of scientific relevance. Regional scientists
differ in their attitudes toward concepts related to the quality of life. In his pre-
sidential address of 1962 Ullman [10] concluded that the, "problem remains to
design cities to take advantage of scale economies and the other advantages of
concentration, and at the same time to provide optimum livability." This formula-
tion indicates a belief in 'livability' as a worthwhile problem for research and a
goal for planning. In 1967 Lowry [6] sounded more skeptical, at least as far as
the idea of an optimum in physical planning was concerned. "People seem able
to extract apparently equivalent values from diverse environments, so long as the
mechanics of the environment are comprehensible, and so long as its responses to
individual initiatives are predictable." However, the next sentence takes back
some of the conviction of that statement by arguing that, "when our cities become
too dismal for comfort, we retire to the suburbs and substitute the amenities of

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gardening for those of museums and bright lights."

One frequently notices that economists are very quick to suggest that we solve our problems by moving somewhere else. It is convenient in theory and often in reality, but the idea implies two things: first, that there is a worthwhile place to go to; and second, that it is of no relevance that some have to be left behind. To earn money and to find desirable things to spend it on is a basic part of livability and Regional Science has a lot to say about that. But it is also important that there be easy access to schools, other educational facilities, universities, libraries, theatres and concert-halls, doctors and hospitals, security services, playgrounds, parks, even silence and clean air. One does not find much written in Regional Science publications on the location and dimensioning of such items in relation to the spatial distribution of needs. Perhaps the problems involved fit better into the more restricted framework of specialism or operations research. I do not feel that this is good research policy. The sum total of these items is regionally too important to make it reasonable to leave them entirely in the hands of people who view them predominantly from the inside.

I am not going to carry this point further and it is not my intention to remain on quite so practical a level. Let me instead raise a question as to what regional scientists assume about people at the level of first principles. Have the efforts to give spatial realism and generality to economic matters also brought human realism and generality to matters of spatial organization? It is hard to find an answer to this, since, as Isard and Reiner [4] have pointed out, "models of human behavior over space have been almost entirely oriented to mass probabilistic behavior." These models of large aggregates are often presented without explicit statements about the assumed social organization and technology that exist at the micro-level from which the individual tries to handle his situation.

It may well be that when a region is given a certain areal size, which is well above the daily range of the majority of its population, it does not matter very much (as far as the aggregate spatial outcome is concerned) what forms micro-arrangements have happened to take. Such possible insensitivity would, in itself, be a problem for analysis. Nothing truly general can be said about aggregate regularities until it has been made clear how far they remain invariant with organizational differences at the micro-level. As an illustration, let me refer to the great number of studies of consumer and commuter behavior. In one case only I found the straightforward statement to the effect that in, "the modal case, the male traverses the habitat to exchange labor for money, and the female traverses it to exchange this money for food and other objects of value." See Fox and Kumar [2]. It could be argued that a modal case of that kind is a particular solution, typical of a given culture area and of a given period of time. What about a modal case where both man and wife exchange labor for money? Or what about doing away entirely with many of the retail trade establishments by equipping dwellings with refrigerators and storerooms beside the mailbox and having them filled from cruising delivery vehicles without the presence of the customer? Since we know that social roles can be re-defined and that experts on physical distribution are working on new technical

approaches, it would be rather interesting to determine to what extent variations in basic assumptions at the household level would affect the principles of Central Place Theory or those of traffic generation models.

In a different problem area it is unquestionable that there are fundamental direct links to be explored between the micro-situation of the individual and the large scale aggregate outcome. I am referring to migration. In spite of the intuitive feeling among all workers in the field that micro-environmental factors are important in the decision to move, nearly all models involve only the extrapolation of current aggregate behavior. These observations are sufficient to illustrate that there is a purely theoretical case for taking a closer look at the individual human being in his situational setting. To do so would improve our ability to relate the behavior of small scale elements and large scale aggregates. Failure in this respect is a common, fundamental weakness of all social sciences. To focus "on the locational dimension of human activities," as Isard and Reiner [4] have argued the regional scientist is obliged to do, should be a point of departure as promising as most others, or perhaps more so, for tackling the problem of establishing coherence between the two ends of the scale.

The initial task is, I think, to eliminate imprecise thought processes which conceptually deceive us into handling people as we handle money or goods once we commence the process of aggregation. In order to illustrate this I would like to relate an experience which can hardly be unique. When I was three or four years old my father tried to teach me the principles of banking and we trotted along to the local establishment to deposit what I had accumulated in my savings box, including a very shiny silver crown. The next day I insisted on walking back to the bank to make sure that the people had really guarded my money. The clerk was very understanding and showed me the correct mix of coins. But the shiny crown was not among them and it could not be produced. I decided that savings banks did not really save money.

It was primitive economics to assume that banks should worry about the identity of coins. Is it advanced or primitive social science to disregard the identity of people over time in the same fashion? This is what we do in most cases when we treat a population as a mass of particles, almost freely interchangeable and divisible. It is common to study all sorts of segments in the population mass, such as the labor force, commuters, migrants, shoppers, tourists, viewers of television, members of organizations, etc., each segment being analyzed very much in isolation from the others. As one of my students put it, "we regard the population as made up of 'dividuals' instead of individuals." Of course, we cannot focus on every single individual in the aggregate. We have to leave it to the historian to concern himself with biographies of sample individuals. But on the continuum between biography and aggregate statistics, there is a twilight zone to be explored, an area where the fundamental notion is that people retain their identity over time, where the life of an individual is his foremost project, and where aggregate behavior cannot escape these facts.

With a concern for the individual, it follows that we need to understand better

what it means for a location to have not only space coordinates but also time co-ordinates. It might be quite reasonable to eliminate time by concealing it in costs of transportation and storage, as long as the handling of material is the main concern of locational analysis. But it is hardly reasonable to do so when the problems of people are brought in. When, for example, in a general equilibrium model, it is assumed that every individual performs a multitude of roles, it is also implicitly admitted that location in space cannot effectively be separated from the flow of time. Sometimes, of course, an individual plays several roles at the same moment. But more often the roles exclude each other. They have to be carried out within a given duration, at given times and places, and in conjunction with given groups of other individuals and pieces of equipment. They may have to be lined up in non-permutable sequences.

Of equal importance is the fact that time does not admit escape for the individual. He cannot be stored away for later use without complications for himself or society. As long as he is alive at all, he has to pass every point on the time-scale. Every point in space does not demand the same of him; he need only be somewhere in an environment which grants at least minimum conditions for survival. But this 'somewhere' is always critically tied to the 'somewhere' of a moment earlier. Jumps of non-existence are not permitted. To argue that time has to be taken into account along with space does not necessarily mean that studies of change and of development trends should take precedence over examinations of equilibria and steady states. See Stewart [9]. It means primarily that time has a critical importance when it comes to fitting people and things together for function-ing in socio-economic systems, whether these undergo long-term changes, or rest in something which could be defined as a steady state. What I have in mind is the introduction of a time-space concept which could help us to develop a kind of socio-economic web model. The model would be asked what sorts of web patterns are attainable if the threads in the web (i.e., the individuals) may not be stretched beyond agreed levels of 'livability.' And when I speak of a web model, this is not just a metaphoric expression but a way of indicating what kind of mathematics one would need in order to handle it. Let me try to illustrate these ideas in an informal and surely very 'half-baked' fashion. I will not be concerned with a research technique. I am stressing a point of view by indicating the outlines of a model presently under study. As you will see, the various traditional concepts will be tied up in only a few packets with new labels.

In time-space the individual describes a *path*, starting at the point of birth and ending at the point of death. (Inanimate things also follow time-space paths but the characteristics of these are excluded here although they are needed in the com-plete web model). The concept of a life path (or parts of it such as the day path, week path, etc.) can easily be shown graphically if we agree to collapse three-dimen-sional space into a two-dimensional plain or even a one-dimensional island, and use perpendicular direction to represent time. In a Garden of Eden in which life was so entertaining that we did not even feel the need for regular rest, with a continually pleasant climate, ubiquitous self-replacing fruits to consume, and no

social responsibilities, the path could be a true time-space random walk. In a more earthly environment it cannot be so, even if some drop-outs would have us believe otherwise. Assuming that continued survival is the first choice of those who have already set out on their life path, then some sort of counter-randomness programming has to occur.

When Robinson Crusoe found himself alone on his island, he could make up his program without regard to a pre-existing socio-economic system. The natural resources were all his to develop under his specific set of biological and technical constraints. An individual who migrates into an established society, either by being born into it or by moving into it from outside, is in a very different position. He will at once find that the set of potentially possible actions is severely restricted by the presence of other people and by a maze of cultural and legal rules. In this way, the life paths become captured within a net of constraints, some of which are imposed by physiological and physical necessities and some imposed by private and common decisions. Constraints can become imposed by society and interact against the will of the individual. See Vining [11]. An individual can never free himself from such constraints. To migrate during a pressing situation involves substituting a known pattern of constraints for one which is largely unknown. And, being a forward-looking animal, the individual probably tries to compare not just the prevailing situation but the anticipated situation in the life-perspective of himself and members of his family.

Several different ways of investigating the socio-economic web come to mind. One is to sample life paths. Biologists found this to be useful a long time ago when they invented the world-wide system of bird-banding. In countries with a continuously up-dated population register, it would be feasible (after computerization) to sample paths between dwellings on a very broad scale. Some experiments in that direction have already been made. See Jakobsson [5]. But it would be difficult to dig deeply enough to unveil the really critical events. Similarly, the short-term paths, days and weeks, can be sampled by observation or by some diary method. In either case, one risks becoming lost in a description of how aggregate behavior develops as a sum total of actual individual behavior, without arriving at essential clues toward an understanding of how the system works as a whole. It seems to be more promising to try to define the time-space mechanics of constraints which determine how the paths are channeled or dammed up. Some authors believe that the study of negative determinants might be the safest kind of social science. In the following pages, I am going to look at the matter entirely from the point of view of constraints.

Even if many constraints are formulated as general and abstract rules of behavior we can give them a 'physical' shape in terms of location in space, areal extension, and duration in time. Even a universal rule such as, "thou shalt not kill," means that a set of configurations of paths are not permitted, except in war and in traffic. It would be impossible to offer a comprehensive taxonomy of constraints seen as time-space phenomena. But three large aggregations of constraints immediately present themselves. The first of these could be tentatively described as

'capability constraints,' the second as 'coupling constraints,' and the third as 'authority constraints.'

'Capability constraints' are those which limit the activities of the individual because of his biological construction and/or the tools he can command. Some have a predominant time orientation, and two circumstances are of overwhelming importance in this connection: the necessity of sleeping a minimum number of hours at regular intervals and the necessity of eating, also with a rather high degree of regularity. Both needs determine the bounds of other activities as continuous operations. Other constraints are predominantly distance oriented, and as a consequence, enable the time-space surrounding of an individual to be divided up into a series of 'concentric' tubes or rings of accessibility, the radii of which depend on his ability to move or communicate *and* on the conditions under which he is tied to a rest-place. The inner tube or ring covers the small volume which the individual can reach with his arms from a fixed place such as a position at a machine or desk. It follows him as a shadow when he moves. Two such tubes can never be brought to coincide completely but they have to be close to coincidence for procreation, nursing, and some kinds of playing and fighting. Handtools can enlarge this tube but normally not by very much. Food has somehow to be brought inside the tube at regular intervals.

The second tube is defined by the range of the voice and the eye as combined instruments of communication. The boundary is by no means sharp but it is clear that the convenient spatial size of this entity varies between the normal living room and the assembly hall or its outdoor counterpart, the agora of the Greek city, for example. Historically, this uninstrumented tube has had a tremendous significance for the chosen forms of social, political, military and industrial organization. It was only after the introduction of the loudspeaker that really big outdoor political rallies became practicable. I am sure that we are still far from understanding the locational implications of the next enlargement of the range of this tube (i.e., telecommunications), which have entirely broken up this once so narrow spatial boundary. One hears the most divergent opinions about future possibilities of having television screens substitute for face-to-face meetings around a table. The amount of travelling undertaken by functionaries these days indicates that a breakthrough in terms of new behavior patterns is still on the waiting list. The two kinds of time-space compartments just mentioned have, to a small extent, been systematically studied by biologists, psychologists, and sociologists. But mostly they have remained the practical concern of architects, engineers, and time-and-motion experts.

The next tube in the hierarchy bring us directly into the business of regional science. People need to have some kind of home base, if only temporary, at which they can rest at regular intervals, keep personal belongings and be reached for receiving messages. And once a place of this sort has been introduced, one can no longer avoid considering more closely how time mixes with space in a non-divisible time-space. Assume that each person needs a regular minimum number of hours a day for sleep and for attending to business at his home base. When he moves away

from it, there exists a definite boundary line beyond which he cannot go if he has to return before a deadline. Thus, in his daily life everybody has to exist spatially on an island. Of course, the actual size of the island depends on the available means of transportation, but this does not alter the principle.

Improvements in transport technology have enlarged the size of the island considerably over the centuries. The difference in range between the walker and the motorist is tremendous. For the flyer the entity has been broken up into an archipelago of smaller islands around the airports which are within reach. While in the air, he is imprisoned in a narrow time-space tube without openings and he does not therefore effectively exist in the geographic locations over which he is flying. During the era of more primitive transport technology, the population was nearly homogenous with respect to daily range. Today differences between groups within the same area and differences between areas can be very great. On most days the effective size of an individual's island is much smaller than the potential size which is delineated by his ability to move. The purposes of movement from the home base
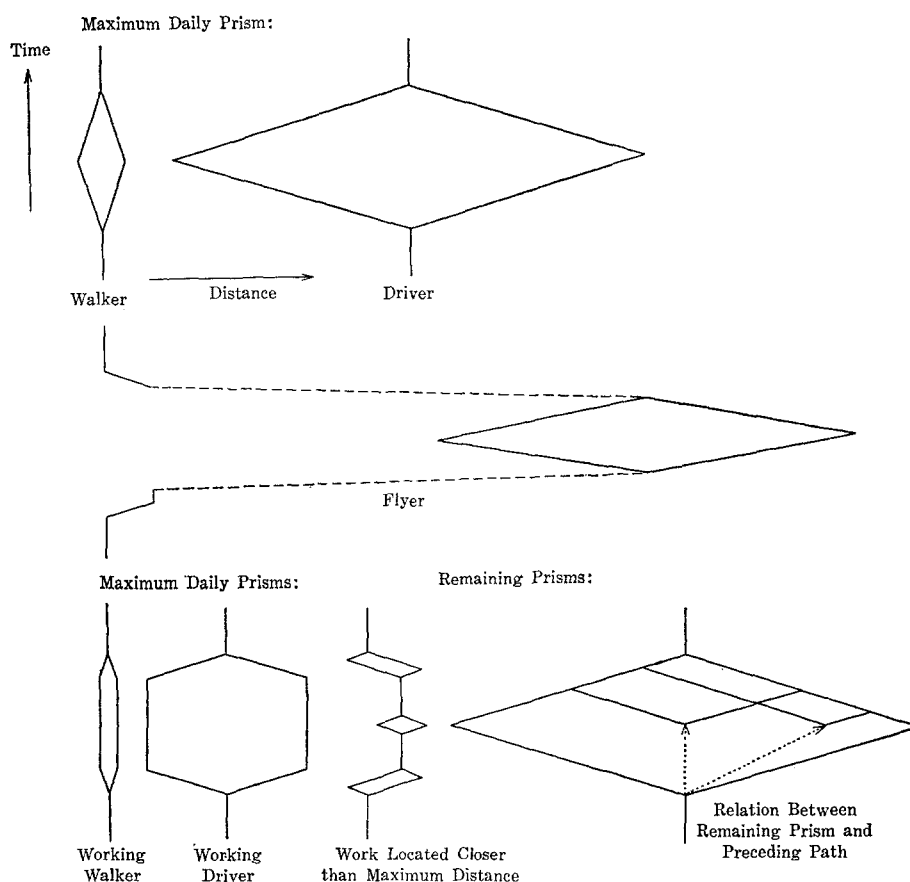

FIGURE 1. Daily Prisms

include going to work, collecting goods, meeting other people, etc. If we look closer at the time-space volume within reach, it turns out to be not a cylinder but a prism. It not only has a geographical boundary; it has time-space walls on all sides. See Figure 1. Depending on where the stops are located and how long they last, the walls of the prism might change from day to day. However, it is impossible for the individual to appear outside the walls. Every stay at some station means that the remaining prism is shrinking in a certain proportion to the length of the stay. A stay at a work place for eight hours might cause the remaining prism to disappear entirely if the stopping point lies at a maximum distance from the home base. A more normal situation for a week day in a Western society would be one in which the remaining prism breaks up into three portions, one in the morning before work, one at the lunch hour, and one in the evening after work.

Wherever the location and duration of stops inside the daily prism, the path of the individual will always form an unbroken line inside the prism without backward loops. He cannot pass a certain point in time-space more than once but he always has to be at some point. Over a lifetime he steers his path through a string of daily prisms, growing in radius during earlier years of his life and shrinking at an advanced age. Life becomes an astronomically large series of small events, most of which are routine and some of which represent very critical gates.

The path inside the daily prism is to a pronounced degree ruled by 'coupling constraints.' These define where, when, and for how long, the individual has to join other individuals, tools, and materials in order to produce, consume, and transact. Here, of course, the clock and the calendar are the supreme anti-disorder devices. We may refer to a grouping of several paths as a 'bundle.' See Figure 2. In the factory, men, machines, and materials form bundles by which components are connected and disconnected. In the office, similar bundles connect and disconnect information and channel messages. In the shop, the salesmen and the
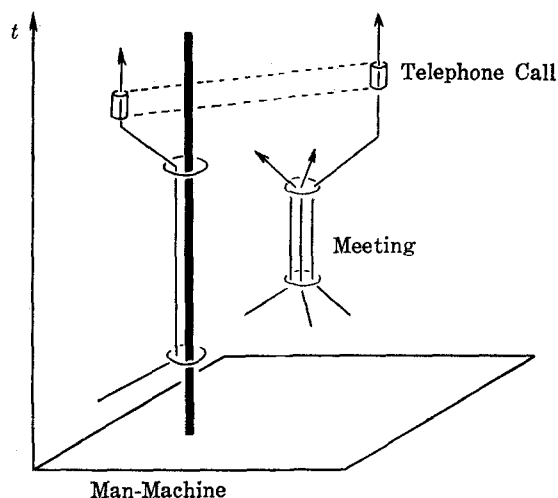

FIGURE 2.　Grouping of Several Paths

customer form a bundle to transfer articles and in the classroom, students and teachers form a bundle to transfer information and ideas. Bundles are formed according to various principles. Many follow predetermined time-tables, often the same, weekday after weekday. This principle, which exists in the factory and the school, generally operates over the head of the participating individual. His freedom lies in his choice of work or place of work. After that, he has to obey the choreography of his superior, as long as he wants to maintain this contractual arrangement. The schoolchild, however, does not have the freedom to select in most cases. And always, families have to adjust to compulsory timetables.

Shops, banks, doctors and barbers permit random access between given hours. In many functions, particularly the managerial ones in firms and organizations, bundles have to be formed and located some time in advance in a kind of trial-and-error fashion. Today, hoards of administrators and secretaries spend their regular working hours trying to get other people together for future meetings. The more principles of participation come into fashion, the more this business will expand. Appointments seem to be moving more and more into the future, indicating a growing congestion. A person, who wants great freedom to maneuver, now has to extend his programming ahead by a year to eighteen months. The bundles formed with family members and friends are subject to private administration during the time remaining after outside demands and associated transport requirements. Private administration does not mean that the bundles are entirely outside the general social and legal control.

The bundles tend to be closely interdependent because individuals, materials, and bits of information have to move from one to the other in an orderly way. (The principles of maximum packing would be an interesting area of research related to critical path analysis.) An individual, bound to his home base, can participate only in bundles which have both ends inside his daily prism and which are so located in space that he has time to move from the end of one to the beginning of the following one. This means, for example, that if a doctor holds his clinic during the working hours of his patient, the latter cannot see the doctor except by obtaining permission to be absent from work. It is also clear that the car-owner, because of his random access to transport, has a much greater freedom to combine distant bundles than the person who has to walk or travel by public transportation. The difference is not so much a matter of speed as one of loss of time at terminals and junctions. See Figure 3.

A further kind of bundle deserves some passing comment. Telecommunication allows people to form bundles without (or nearly without) loss of time in transportation. Radio and television are of interest in this connection mostly because they take time from alternative activities. Everyone can jump on and off the bundle as he likes. But the telephone has a great significance from the point of view of social organization. It is true that a call may save much time, especially when it concerns the arrangement of future meetings. But at the same time, it is an outstanding instrument for breaking other activities. So one may sometimes wonder about the net outcome. In this regard, a world-wide dialing

system seems to be a mixed blessing, since all too often people may forget differences in local time around the globe.

The third family of constraints, which I would like to discuss, relates to the time-space aspects of authority. The world is filled with a device which we may call the 'control area' or 'domain.' These words are essentially spatial. However, I would suggest that the concept of a domain be redefined to refer to a time-space entity within which things and events are under the control of a given individual or a given group. The purpose of domains (they are almost natural phenomena and many animals have them) seems to be to protect resources, natural as well as artificial, to hold down population density, and to form containers which protect an efficient arrangement of bundles, seen from the inside point of view of the principal. In time-space, domains appear as cylinders the insides of which are either not accessible at all or are accessible only upon invitation or after some kind of payment, ceremony, or fight. Some smaller domains are protected only through immediate power or custom, e.g., a favorite chair, a sand cave on the beach, or a place in a queue. Others, of varying size, have a very strong legal status: the home, land property, the premises of a firm or institute, the township, county, state, and nation. Many of these have a long, almost permanent duration, such as nations, British universities, and Japanese companies. Others are only temporary such as a seat in the theater or a telephone booth at the roadside.

Thus, there exists a hierarchy of domains (see Figure 4) and certain kinds are beyond escape. Those who have access to power in a superior domain frequently use this to restrict the set of possible actions which are permitted inside subordinate domains. Sometimes they can also oblige the subordinate domains to remove constraints or to arrange for certain activities against their will. Decision-makers in domains on equal or nearly equal levels cannot command each other. They have to influence each other by trading, by negotiation, or (in primitive cases) by invasion and warfare. Gaining access to power within a domain is a problem that may be solved in a variety of ways, of which only some are economic in the ordinary sense.
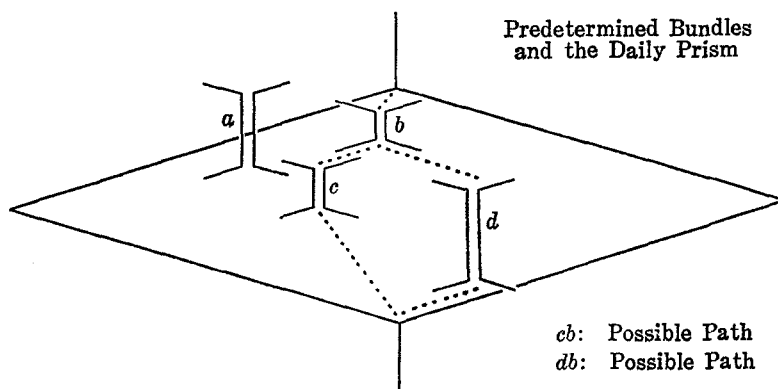

FIGURE 3.   Interaction of Constraints

The three aggregations of constraints (i.e., capability, coupling, authority) interact in many ways; in direct obvious ways, and in indirect ways which are less easily detectable. See Figure 4. A few cases are discussed as illustrations. It is obvious that a low-income job, compared to a higher income job, gives access to fewer or inferior domains. Inability to rent a dwelling close to a place of work may, in the first instance, directly lead to long commuting times but may also lead to more concealed repercussions such as incursions on the time available for other activities. It may well be that the low rate of participation in cultural activities by large groups of people has less to do with the lack of interest than the prohibitive time-space locations of dwelling, work, and cultural activities. Even in nations where medical care is free, considerable numbers of people do not get their intended share. The reasons for this could be similar.
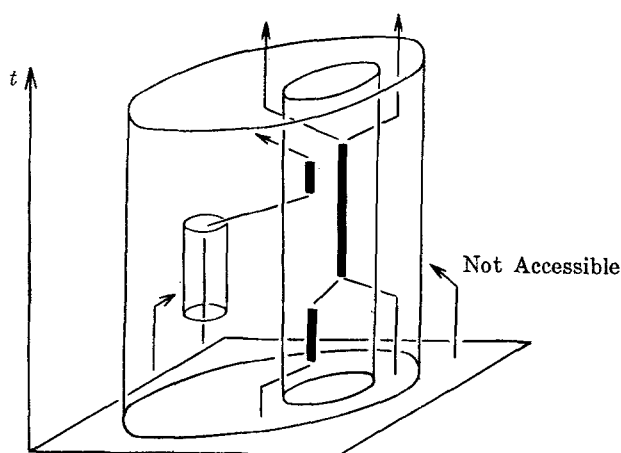

FIGURE 4. Hierarchy of Domains

Of special interest in terms of complicated interactions are the dependent members of families. The child has a small daily prism, unless a parent can spend a good deal of the day taking him from place to place. This means that the coverage and quality of the local training establishments and types of social contacts in the neighborhood will have very long-term effects on the life paths, since training as well as friendship ties provide the keys which open or close the gates to domains later in life. In all probability, the manner in which things are arranged for the child also affects the spatial structure of both the population composition and the labor market. Anderson [1], writing on location of residential neighborhoods, points out that, "if more satisfactory arrangements were devised for providing for the children of working mothers, then many larger families now suburban, might move into more central locations."

Important for interregional relations is the birth and death of jobs in relation to the effect of the life-path system on prism distance. First, as Self [8] has observed, "It is false to think of regional balance simply in terms of numbers of jobs, when a better index is the *range* of jobs . . . ." Thus, if training and the spectrum of jobs

do not match in a given time perspective then the need for migration inevitably arises. Migration, of course, is not necessarily a bad thing, unless it detracts from living standards in the exporting and/or importing areas. The timing of complementary events is also of importance here. One can find cases where there is a balance over the year in the number of new jobs available on one hand, and demand for jobs on the other, and still much outmigration occurs. Job opportunities may arise at times of the year other than exactly when a group of impatient young people are finishing school and are searching for jobs. Similar observations could be made with respect to dwellings. The influence of migration is not confined to the mover and his dependents: there is also an effect on the situation around him. An out-migrant partially breaks up an established network and removes some skills, information and purchasing power. This does not mean that the situation is always made worse by migration. It might improve the situation as would be the case when the remaining population has more elbow room in a formerly crowded rural area. Furthermore, the in-migrant may cause positive or negative external effects. There are surely cases where migration might assume forms which disorganize communities. We know very little, I suppose, about the convenient proportion between the stable and the moving parts of a population.

A society is not made up of a group of people which decides in common what to do a week ahead of time. It consists primarily of highly institutionalized power and activity systems. A majority of domains and bundles within them have a location in space, a duration over time, and a composition according to consciously or habitually preestablished programs of organization which are made up with no particular regard to the individuals who happen to enter these systems and play the needed roles for portions of their life-paths. A company, a university, and a government department are structured according to an arrangement which exists as a time-space pattern, even if the people are not there. The same is true of the multitude of barriers and channels formed by legislation, administration (e.g., taxation), entries to professions, maximum speeds on roads or building codes. In total, seen from the point of view of the individual, this is an enormous maze about which he personally can do very little. Of course, there is a slow response in the system to people's reactions and this means that the set of domains and bundles changes over long periods of time. One might perhaps say that technology, which changes the capability constraints, is the prime mover. Domains and bundles thus change position in time-space. New units are born, existing ones grow in size, dwindle, or die. However, because so many domains have a very strong legal status and consequently, a long life (as for example, units of land ownership or municipal boundaries) and because so much is constrained within buildings having typically long lives, reactions often seem (from a system-wide point of view) local and not very purposeful. It is sufficient to note that despite the new ranges created by improved transportation, local government units have tended to remain medieval in size. A farmstead attitude to the domain problem survives in political life, in strong contrast to the sophisticated conception of space which industry tends to possess.

Viewed in a time-space perspective, then, we have two diverse systems in interaction. One is the predominantly time-directed warp of individual life-paths, which make up the population of an area and the concomitant capability constraints. The other is the more space-oriented set of imposed constraints of domains and bundles to which the individual may or may not have access according to his needs and wants. The population forms a kind of traffic flow in a road net with generally rusty gates. Loose ends of life-paths either have to discover for themselves how to open new roads and domains, locally or after migration into more permissive regions, or they disappear. I think it is true to say that the system of domains is much better understood with respect to flows of goods and money than with respect to flows of people. Social scientists know very little about interactions of constraints, as seen from the point of the life-path of the individual. In the main, people are viewed as parts of activities to be perfomed within each domain in isolation, and not as entities who need to make sense out of their paths between and through domains. It may well be that the more we, as optimizers, estimate efficiency within domains in the use of bundles of people, machines, materials and information, the more loose ends, which do not know how to move on, will appear in the population flow. Extrapolated to the limits, the question of life-paths between domains has certain strange, even repulsive, aspects. If the transplantation of hearts becomes a standard surgical procedure, then a continued high rate of accidents in traffic and in industry will be necessary to maintain the balance.

When asked about the concept of livability, people would express very different opinions. Nevertheless, I do not think it would be an entirely impossible task to make up a widely acceptable list of items which are fundamental for survival, comfort, and satisfaction. The individual who saw his life-path as an eighty year scheme, would need these items to be distributed along the time axis in characteristic ways. Thus, to consider the simplest items, it would be necessary or desirable, as the case may be, to have access: to air and a dwelling continuously, to food several times a day, to some daily and weekly recreation, to play and training during early years, to security of work and continuity of education at irregular intervals during a career, to assistance at an advanced age, and at all times random access to means of transportation, relevant information, and medical care. However, access involves much more than the simple juxtaposition of supplies in regions of arbitrary size. It involves a time-space location which really allows the life-path to make the required detours. It further involves the construction of barriers, physical, legal, economic and political, which serve to give to everyone his full share of the fundamental requirement listed. The study of livability would need a large political science component, but one which does not hesitate to look into the micro-manifestations of power. In this latter area exist the direct links between the macro and micro realms, links which have been largely unexplored by regional scientists. As mentioned before, those who have access to power in domains use much of their energy within their area of competence to superimpose (or sometimes remove) constraints on activities in lower level domains. At least such upper echelons as national, regional, and municipal governments and sometimes big organizations tend to do this in a

formalistic way without much understanding in terms of time-space interactions for the population involved. Therefore, even with the best of intentions, outcomes are often questionable.

Given the list of needs and their statistical biography, it would be the task of the analyst to try to find out how much of various kinds of livability items would be simultaneously attainable under various assumptions of technical, economic and social organization. And since, once born, everybody has to be somewhere, everybody should be included in the picture, the child as well as the entrepreneur. This means, for example, that calculations of the demand for medical care must be seen as a function of the total population's state of health and not as a function of revealed demand. A time-space web model in the sense of a flow of life-paths, controlled by given capabilities and moving through a system of outside constraints which together yield certain probability distributions of situations for individuals, should, in principle, be applicable to all aspects of biology, from plants to animals to men. However, although some animals make buildings, defend domains, and believe in social rank, it is only man who can to a large extent choose between different constraints and, by restricting the number of offspring, even control the size of the population flow. The choice of constraints has always been a very piecemeal affair, more like a natural process than conscious planning. History and cultural anthropology show that it is possible to live under a tremendous variety of constraint systems, even if all have specific drawbacks, as seen from the viewpoint of individual survival and welfare.

The striking drawback of the so-called developed industrial society has been, and perhaps still is, the poverty problem, i.e., the fact that large groups of people have continued to live at the margin of famine or at least below what to people with a sense of fairness seems to be an acceptable standard. Systematic studies of poverty, started in Britain toward the end of the nineteenth century, eventually led to the concept of the Welfare State. Perhaps because of the initial limitations of their goals, even the best conceived versions of the Welfare State are not well prepared to cope with the new forms of poverty problems which are tending to affect everybody, e.g., ugly landscapes, simultaneous overcrowding and loneliness, alienation from crucial decision-making in work and society, etc. It seems that the main focus of our practical problems are moving away from the allocation of money towards the physical allocation of the uses of space and time.

Neurath [7] suggested some decades ago that we should be looking at, "markets and finance and at the whole reckoning in money as an institution like any other, such as funeral rites, golf, rowing, and hunting. To regard money as a historically given institution does not involve any objection to its use—though there may be such objections—but an objection to the application of arguments, valid in the field of higher bookeeping, to the analysis of social problems and human happiness in general." Now, when looking at the other methodological extreme, we also do not get very far by running around and questioning people about their likes and dislikes. First of all, we need some way of finding out the workings of large socio-environmental mechanisms. To me, a physical approach involving the study of

how events occur in a time-space framework is bound to yield results in this regard. In order to be realistic, our models would have to recognize the fact that the individual is indivisible and that his time is limited. Further, we would have to note that the individual in dealing with space not only considers distance, but also has a strong (and perhaps logically necessary) drive towards organizing space in sharply bounded territories.

It was said before that the choice of constraints has always been a piecemeal affair. Even in theoretical studies, social scientists have tended to take most of them for granted according to available experience. With a suitable technique for grouping constraints in time-space terms, one could perhaps hope to be able to boil down their seemingly tremendous variety into a tractable number. Simulation comes to mind as a way of analysis until more general mathematical tools become available. Reasonably good simulations should improve our ability to survey whole systems and help to reduce the considerable trial and error component in applications. A purely theoretical, even artistic, satisfaction for the regional scientist would then be the ability to invent entirely fictitious societies which were still founded on realistic first principles. The technological forecasts which edify us these days and often seem so promising, at least superficially, cry out for instruments which could help us to judge the impacts on social organization and thereby the impact on the ordinary day of the ordinary person.

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