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THE LINEAR NEW CITY--A PATTERN FOR NEW CITIES BASED ON
EFFICIENCY OF TRANSPORTATION, PUBLIC SERVICES, AND LAND USE

BY

ELBRIDGE WESLEY BARTLEY, III, 1947-

A THESIS

Presented to the Faculty of the Graduate School of the

UNIVERSITY OF MISSOURI-ROLLA

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ABSTRACT

The linear new city is defined as a city consisting of some arrangement of relatively narrow, high-density strips, served by various mass transportation systems. Such a new city would be ideally suited to the implementation of the latest technology. The concentration of development along the transportation route would allow certain economies in the supply of utilities and services, as well as insuring that open space would be readily available around and throughout the city. The provisions for transportation, housing, and governmental control should combine to produce a better quality of life for the inhabitants of the linear new city.

DEDICATION

This thesis is dedicated to the memory of Sir Ebenezer Howard,
the first and foremost proponent of the "new city" movement.

ACKNOWLEDGEMENT

The author wishes to thank his advisor, Dr. Lawrence K. Sieck, and Dr's. James L. Josey and Robert C. Waters for their assistance in the preparation of this manuscript.

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I. INTRODUCTION

A. PROBLEMS OF TODAY'S CITIES

The problems associated with the cities of today are many and varied. One need only examine any large-city newspaper to obtain some idea as to the scope and intensity of those problems. Racial violence; traffic congestion; deteriorated, dilapidated dwelling units; oppressive air pollution; organized crime--these problems are representative of those faced by many large cities. Cities around the world are faced with these problems and others, but their solutions have thus far been elusive. It is evident that cities of the present era are in a time of crisis. Plagued by a multitude of problems, the cities are failing to meet the needs of their inhabitants. Whereas the development of technology was responsible for the alleviation of city problems in the past (better methods of agriculture, sanitation, medicine, and transportation), some of this modern technology may be the cause of many problems in today's cities; for it is our modern technology which fills the urban atmosphere with raucous noises and noxious exhaust emissions, and fills the streets and highways with more and more traffic congestion.

B. SOCIETY'S NEED FOR HEALTHY CITIES

A quick mental review of world history shows that most advances in the realm of scientific knowledge and accomplishment have occurred

in societies which also possessed a fairly well developed city form. Mayans, Aztecs, Egyptians, Babylonians, Greeks, and Romans--these societies stand apart from the rest of the ancient world, not only because of their scientific accomplishments, but also because of the cities they developed. Without attempting to analyze the cause and effect relationship between the development of cities and the development of scientific achievement, it seems reasonable to say that there has been some correlation between them. Whether this correlation will continue to hold in the future is not readily apparent. However, on the basis of the historical relationship between the development of the city and the level of advancement of society, the present problems of cities should be a matter of concern because of the possible implications for the future of society.

Two hundred years ago, "life, liberty, and the pursuit of happiness" were considered to be the inalienable rights of every man. Today, the concerned man might also claim the right to breathe clean air, the right of access to clean water for recreational purposes, and the right to live and work in quiet surroundings. However, a tour of the United States would reveal that many people are not able to enjoy clean air, clean water, and quiet surroundings. In many of America's larger cities, the polluted air is almost intolerably irritating to the delicate tissues of the eyes, nose, and throat. Several natural waterways now carry such concentrations of untreated or partially treated wastes that the natural aquatic life is being destroyed. Whereas the "time and temperature" display is common in American cities, the city of Tokyo, Japan, has also added a display

which monitors the noise intensity (in decibels) at street level for various locations across the city. If a display for air pollution (in parts per million of pollutants) were included, then a citizen could tell at a glance whether he should wear his ear plugs or his gas mask--or both. Thus, in a historical sense as well as the contemporary sense, society has a need for healthy cities.

C. REASONS FOR SELECTING THIS TOPIC

As if these problems weren't sufficiently stimulating and urgent, the world is also in the midst of a population explosion. In the more highly developed countries, the majority of the population is concentrated within a few large urban areas; and most of the projected population increase is expected to occur in these same areas. This will tend to compound the problems of the cities, making them less desirable places in which to live. Thus, the selection of this topic came as a result of the author's dissatisfaction with the state of affairs in today's large urban areas, a pessimistic outlook on the future of the city unless new programs for its revival are initiated and adequately supported, and a desire to contribute to the solution of urban problems.

D. GOAL--TO PRESENT THE LINEAR NEW CITY AS A PARTIAL SOLUTION TO THE CITY'S PROBLEMS

Population increase is probably the factor which most aggravates

the problems of the city. Cities may try to correct their faults and improve their facilities, but such efforts usually fail to keep pace with the needs of the growing population. It seems evident that, barring unexpected developments, during the next few decades the cities will have to make accommodations for a large number of new inhabitants. The question arises as to the ability of any given city to expand sufficiently to accommodate this additional population. Some cities will possess this ability, but part of the solution to the population increase will be the construction of new towns and cities. Therefore, the goal of this study is to present the linear new city as a possible solution to some of the physical problems of contemporary cities in a populous, technologically advanced country.

E. OBJECTIVE

The objective of this study is to examine the linear new city with respect to its economy of operation in the following areas:

1. Public Services

a. Transportation

Investigate the hypothesis that the transportation needs of a city could best be met through a system of transportation devices capable of handling mass transit, personal rapid transit, and merchandise and freight delivery, along with a secondary system of roads for emergency services and for those who prefer other means of transportation.

b. Utilities

Establish that the various public utilities and services could be more efficiently supplied along the lines of high population and development density which are characteristic of the linear city.

2. Land Use

Establish that a mixture of high-rise and low-rise apartments and individual family dwellings, located near the transportation system, and with convenient access to various types of open space and recreational facilities, would be satisfactory and beneficial to the inhabitants of a city, and would constitute esthetic and efficient land usage.

F. SCOPE

The term "linear new city" will be used to describe a new city which is linear in function, though not necessarily in form; that is, a linear city is one which consists of some arrangement of densely developed strips which are connected with a minimum of intersections. With this in mind, the present study will not attempt to specify a desired shape for the linear new city. Rather, the location and general shape of the city would be indicated from the results of a detailed regional analysis which would include such considerations as soil and drainage characteristics, various social values, and water resources. (See section III.3.b.--"Where to Build the Linear City")

There will be no discussion of the magnitude and intricacy of the financial arrangements necessary for the construction of the proposed linear city.

This study will not attempt to specify every business and service to be included in the linear new city. Naturally, every essential service would be provided initially, but the citizenry would be free to establish additional services as soon as the need was perceived. The city would have to have some economic basis for existing, but it is not the purpose of this study to suggest any particular economic configuration for the linear city.

The proposed linear new city is not intended to exist in an isolated condition. Therefore, no attempt will be made to provide for self-sufficiency with respect to any particular service or commodity.

It is hoped that the size of the proposed city would be such as to be large enough to support its facilities, but not so large as to be cumbersome in its administration or excessive in its physical dimensions. This size would depend upon the reason for the city's existence; that is, whether the city was designed to relieve the congestion of an existing large city, or as one city in a regional cluster of new towns.

II. LITERATURE SURVEY

A. HISTORICAL DEVELOPMENT

The history of town planning goes back to the very beginnings of recorded history. Lewis Mumford, in his book, The City In History, (1) put forth an intensive analysis of those factors which, in his opinion, led to the establishment of the first cities. Those first cities were planned around a central group of religious structures, and were later contained within a surrounding protective wall. James Michener's novel, The Source, (2) gives a most interesting account of this early evolution of the city.

Mumford continued his analysis of the city as he traced it through history, from the ancient civilizations of Egypt and Mesopotamia, to the accomplishments in Greece and Rome, and on into more recent times. However, for the purposes of this study, it is not necessary to go back any further than the Middle Ages to pick up the principles of town planning.

Town planning was an established practice in that era, and was consciously and conscientiously applied in the building of the medieval city. Modern writers look with nostalgia at these fine old burghs and question why modern cities can't be planned accordingly. Perhaps the question is valid, for all too often, modern construction and development seems to be characterized by the imposition of a predetermined pattern on the land. Town builders of the Middle Ages must have had an appreciation for the architectural elements of

mass, space, form, color, texture, and harmony; but certain things must be understood about the conditions of that era. The primary advantage of town planners of that age was that they did not have to be concerned with such a demanding transportation system as the automobile.

Victor Gruen, in The Heart of Our Cities, (3, p. 79) stated that fully two-thirds of the surface area of the central core of Los Angeles was devoted to such structures as streets and highways, parking garages, gas stations, etc.--all for the purpose of accommodating the automobile. Builders of the Middle Ages were also not pressured by a rapidly growing population and the frantic, frenzied pace of living which marks the present age. Structures were built over a sufficient length of time--sometimes generations--so that the craftsmen had ample opportunity to bestow their fullest attention and talent upon their work. In contrast, Mumford illustrated the frenzy of modern building activity: (1, p. 449)

"...vast structures were erected almost overnight. Men built in haste, and had hardly time to repent of their mistakes before they tore down their original structures and built again, just as heedlessly."

In addition, there were certain inherent engineering and materials limitations which tended to impart a sense of harmony and similarity to the medieval town. The state-of-the-art in building construction limited the size of buildings to rather uniform dimensions, while the lack of modern structural materials such as steel, chrome, glass, etc., established a similarity of material, color, and texture. (3, pp. 38-39) But towns were built in that period

which seemed to possess some qualities which were pleasing to their inhabitants. Built on the human, as opposed to the modern automotive scale, the towns were designed to fulfill human needs, as attested by the fact that they endured through several centuries.

B. RECENT (TWENTIETH CENTURY) WORK

Perhaps the most influential of all town planners was Sir Ebenezer Howard, a stenographer by trade, who published his ideas in the book Garden Cities of Tomorrow. (4) Howard was a farsighted and perceptive man, who was very concerned with the problems associated with the increasing congestion in the large cities of his time. In order to alleviate this congestion, Howard proposed the establishment of "Garden Cities," (4, p. 26) which were towns

"....designed for healthy living and industry; of a size that makes possible a full measure of social life, but not larger; surrounded by a rural belt; the whole of the land being in public ownership or held in trust for the community."

As the world has gradually become aware of the problem of taking care of the fast-increasing population, controversy has arisen as to how this should be done. Howard examined this problem and concluded that: (4, p. 146)

"The simple issue to be faced, and faced resolutely, is: Can better results be obtained by starting on a bold plan on comparatively virgin soil than by attempting to adapt our old cities to our newer and higher needs?"

In proposing his Garden City, Howard obviously favored the former. However, even in his day, when undeveloped land was more plentiful

than now, there was opposition and ridicule for his ideas, as evidenced by the following article which appeared in the Fabian News in December, 1898: (4, p. 11)

"His (Howard's) plans would have been in time if they had been submitted to the Romans when they conquered Britain. They set about laying out cities, and our forefathers have dwelt in them to this day. Now Mr. Howard proposes to pull them all down and substitute garden cities, each duly built according to pretty coloured plans, nicely designed with a ruler and compass. The author has read many learned and interesting writers, and the extracts he makes from their books are like plums in the unpalatable dough of his Utopian scheming. We have got to make the best of our existing cities, and proposals for building new ones are about as useful as would be arrangements for protection against Mr. Wells' Martians."

Still, the fact remains that Howard and his associates were successful in building two garden cities according to the plans he proposed. The first was Letchworth (1903), located about 40 miles north of London, and designed for an ultimate population of 32,000. The second was Welwyn Garden City (1920), located about 20 miles north of London, with a projected population of 50,000. It was here that Howard died in 1928.

Following Ebenezer Howard, a prominent figure in the field of architecture and city planning was the Frenchman, Le Corbusier (a pseudonym for Charles Edouard Jeanneret). His most important work was done after World War II, but as early as 1929, he had published a book, The City of Tomorrow, (5) in which he put forth plans for a new city of three million inhabitants. His proposed city was characterized by the use of tremendous towers and mass housing complexes, along with a mass transit system. Even in the 1920's, before the automobile had achieved the widespread use it has enjoyed in the

past two decades, Le Corbusier was aware of the problems that cities would be having with their systems of automobile transportation:

(5, p. 119)

"Now, all modern motor vehicles are constructed for speed. But in the actual state of our streets, the highest speed obtainable by motor cars in the city of today is about ten miles an hour!!!"

A contemporary of Le Corbusier was Eliel Saarinen, a Finnish-born architect, whose son, Eero, designed the well-known Gateway Arch in St. Louis. Perhaps Eliel viewed city planning more from an architect's standpoint than a planner's standpoint, but he understood the importance of planning cities for the needs of the future:

(6, p. 143)

"Not so far in the past, the big cities could be counted on the ten fingers of one's hands; but since the rapid growth of cities finally has begun as to number and size, it is this very age of ours that now has to deal with the dire consequences of this growth. Therefore, when we speak about proper counsel, this cannot be had through earlier experiences and by using past methods of town-building. Such an approach would constitute a grave error. Indeed, it is most important to understand more than has been so far understood, that past methods of town-building are not valid anymore, and that present and future methods must be based on entirely new premises. And these new premises can and must be found only in and through the existing difficulties."

C. TYPES OF PROPOSALS FOR FUTURE CITIES

In addition to Howard's original garden city proposal, several other plans have been put forth for new cities of the future. One such plan was authored by Victor Gruen in The Heart of Our Cities.

He proposed a regional development, a "cellular metropolis," containing some 3.3 million inhabitants. (3, p. 273) It contained a central metropolitan core, surrounded by ten satellite cities, each having ten suburban town units, with four communities to each town, and five neighborhoods to each community. The entire arrangement was circular in form, rather like a model of the solar system: a large central body surrounded by a system of planets and their own moons and satellites. A high speed road system linked each city with its neighboring city and with the regional core.

Others have proposed building cities under the ground. (7,8) This would give several advantages, although the cost of construction would be increased enormously. An underground city would have the advantage of a controlled climate, as well as some degree of protection against an air attack, an unfortunate, but apparently ever-present possibility. In addition, a much larger portion of the surface would be available for purposes of recreation and agriculture--and at no great distance from the city's inhabitants. The Cheyenne Mountain complex, which houses the North American Air Defense Command and the U.S. Army Air Defense Command, is an underground city which was built specifically for the protection provided.

Another proposal is for cities to be built floating upon, or anchored beneath, the ocean. (9) Recent work in fish farming and aquatic vegetation has made this proposal more feasible, while recent interest in undersea mineral resources may make such a proposal financially practical. These cities on the sea would have the advantage of movement to any desired location, while they would have

the disadvantage of increased vulnerability to weather and tidal conditions. The city of Tokyo has studied the application of such a proposal for the extension of that city into the surrounding bay area. (10, p. 46)

Though many new towns and cities have been built in the past fifty years, the application of fundamentally new ideas has not been so great. In the Western countries, especially, new towns are typically planned on the basis of automotive transportation. Existing cities are, for the most part, limited to this modus transportandi because it is the only workable solution for the low density housing situations of the typical suburban development. (11, p. 56) However, more efficient means of transportation are possible, and new towns of the future should be built around these better transportation systems.

D. THE LINEAR CITY

The linear city has been proposed by several men, including: Soria y Mata, who in 1882 proposed a city which consisted of a development one block wide on either side of his main roadway (10, p. 32); Edgar Chambless, who in 1910 suggested an underground rapid transit system with a row of two-story houses over it; and Le Corbusier, who in 1929 proposed a 14 mile long, serpentine building for the city of Rio de Janeiro, with a highway built on the roof. (12, p. 162) The linear city proposal was revived again in 1968 for a "linear corridor" application in the New York metropolitan area, but the project was

abandoned. The draft text on the proposal said, in part: (13, p. 9)

"The overriding goal is to create, through Linear City, a totally new and prototypical urban environment. Innovation per se is an objective that is self-validating in the light of the failure of existing social and physical institutions to adjust thus far to the volcanic forces that are shaking our society."

However, for all the linear city proposals, there have been no linear cities built in the Western world to date.

III. DISCUSSION

A. DEVELOPMENT OF CURRENT CITY FORMS

When men first began to build villages and towns, there were two basic forms for the town layout: the rectangular grid system and the circular form. These basic types of town formation were logical extensions of the two basic types of employment in that early age: farming; and tending herds of cattle, sheep, swine, etc. Farmers adopted the rectangular grid system because it fit the needs of their occupation. This system allowed men to specify the boundaries of their property with some precision. In the old river valley civilizations such as those of the Nile, the Tigris, and the Euphrates, this was very important. After the annual floods had obliterated their boundary lines, the farmers could re-establish the limits of their fields by a series of sightings on permanent reference points. By laying their villages out in the same type of grid system, the villagers enjoyed the same advantages of precision in recording property boundaries for use in land transactions and town planning.

(10, p. 2)

The herdsmen utilized the circular form of town layout because it characterized their occupational way of life. It had been discovered that a circular form would enclose the greatest number of animals, while requiring the minimum amount of fencing material. In addition, this circular enclosure was most easily defended from attack. Due to the nomadic nature of the herdsmen's life, the

precision of the rectangular system was not important in the village layout. The village chief had a compound in the center of the settlement, and each family built a hut along the perimeter. If people found that they needed more space for themselves, the village circle could easily be expanded after the next migration to fresh grazing grounds.

As time passed, society became more complex than the simple differentiation between farmer and herdsman. Likewise, man's cities and towns have become much more complex than the simple circular and rectangular layouts of long ago. In Paul Spreiregan's book, The Architecture of Towns and Cities, Kevin Lynch has described the various forms of the contemporary city: (10, p. 171)

"The first is the sheet form, akin to our spreading suburbs--like the shape of Los Angeles. It is a spread of undifferentiated growth without focal centers, without major routes or particular relief in form. Second is the core--a city as a dense and vital center with surrounding development. Most of our cities of a million population are such forms. Third, the galaxy is a series of cores arrayed in the landscape at functional distances from one another. The urbanized areas of our country delineated by the census are made up of such galaxies. The satellite form is a variation of the galaxy--a galaxy with a predominant central core. Most of our older cities that are spreading out and enveloping what were independent townships represent satellite forms. ... The star is a core city with linear radials. Boston, St. Louis, and San Antonio are, or have been at certain stages of growth, star forms. Finally, the polycentered net is a widely spread city with differentiated foci, dominant and minor routes, built-up and open spaces--the whole an articulated spread."

Lynch included the linear city in his listing, as well as the ring city, a special case of the linear city. However, from the examples he gave of each type--the "linear" Boston-to-Washington, D.C.,

megalopolis and the "ring" surrounding the San Francisco Bay--it is evident that he was describing a physical, spatial, regional form, and not a separate, functionally linear urban entity.

1. Manner of Previous City Development

Regardless of the type of city in question, nearly all cities have grown in the same laissez faire manner. Historically, cities have grown up along the routes of transportation, either at the junction of different modes of transportation, or as a convenient service point along one transportation line. (14, p. 1) The city of St. Louis, for example, which started as the junction of highway and waterway systems, now is a center for railway and airway systems as well. On the other hand, the little town of Newburg, Missouri, came into existence merely to serve the railway system between St. Louis and Springfield. But in most instances, little actual planning went into the growth and expansion of cities. City governments had no control over growth which took place outside their territorial limits, and for the most part failed to use their powers of control within the city limits. Thus, zoning ordinances were established to protect certain areas from certain types of development. However, in many cases, the basis for zoning and rezoning usually was the prospect of increased monetary profit, rather than a genuine concern for the welfare of the people or the composition of the city.

2. Method of This Approach

Here, then, lies the difference between the method of this approach and the usual process of city planning. Instead of aspiring toward ever-increasing growth, the proposed linear new city would be

designed with a maximum size and population in mind. Provisions would be made such that major changes in the land use of the surrounding area would be possible only if they would truly benefit the city. Ebenezer Howard had the same idea in mind when he proposed his garden city: (4, pp. 76-77)

"But it is essential, as we have said, that there should be a unity of design and purpose--that the town should be planned as a whole, and not left to grow up in a chaotic manner as has been the case with all English towns, and more or less so with the towns of all countries. A town, like a flower, or a tree, or an animal, should, at each stage of its growth, possess unity, symmetry, completeness, and the effect of growth should never be to destroy that unity, but to give it greater purpose, nor to mar that symmetry, but to make it more symmetrical; while the completeness of the early structure should be merged in the yet greater completeness of the later development."

B. DEVELOPMENT OF THE LINEAR NEW CITY

1. Why Build a New City?

Beginning the fabrication of this linear new city, the first question to be asked is this: Why build a new city?

a. Population Increase

As previously discussed, the expected population increase is a major factor in planning for new towns. If a country's population doubles over some period of time, it would appear that twice as many housing units would be needed, as well as all the other structures needed to support the increased population. Present cities have become saturated with people, but if no other outlets are provided for the growing population, the result would be the continued growth

of already sprawling suburban developments around the large cities. The problem is this: people want to live near a large city in order to benefit from its larger array of opportunities and services; for example, the employment and entertainment opportunities. (Ninety percent of all U.S. industries and jobs are concentrated in 200 metropolitan areas.) (15) However, rather than living within the city itself, they would prefer to live in the suburbs, where taxes are less, the air is cleaner, and open space is more plentiful. While this might be good for the individuals concerned, perhaps it is detrimental to the entire nation, since it is illogical to allow the housing density to decrease while the population density increases. As William H. Whyte stated, (16, p. 199)

"People have to live somewhere, as it is so often said, and if there is any hope of having open space in the future, there is going to have to be a more efficient pattern of building. The mathematics is inexorable."

b. Economic Considerations

Having established that a greater number of people will require a greater number of dwelling units, and that the preservation of open space requires a greater concentration and efficiency of building and land use, the economics of building new cities versus rebuilding old cities should be considered. In the rebuilding of cities, one is faced with the costs of acquiring property which has increased in price, if for no other reason than that it is located within the city; demolishing and removing whatever structure was previously there; and building the desired structure. In addition, there is the social cost--though perhaps not always directly

measurable in dollars and cents--of forcibly removing people from their homes and destroying the various small neighborhood businesses to make room for the urban renewal project. In contrast, in the case of the new city, the land costs could be as little as one thousandth of that for inner city land. (15) There would be only minor costs for demolition and site preparation; and there would be very little, if any, social disruption caused by the project. The application of new technology would also be much more easily accomplished in a new city than in an old city. Whereas changes in services in conventional cities usually requires long periods of disruption and inconvenience, the initial installation of these new services in a new city would present only minimal difficulties, while proper planning could make the utility systems easily accessible for future repairs or replacement. As the American Society of Planning Officials would say it, (17, p. 400) such planning is "a way of avoiding unnecessary expenditures."

2. Why Build a Linear City?

If the new city idea has been accepted as a means of accommodating a large population increase, the next question to be asked is this: Why build a linear city?

Of all the various forms of the contemporary city as identified by Kevin Lynch, the automobile is the understood basis of their transportation systems. However, in many respects, the automobile has been the cause of the cities' worst problems, as explained below.

a. Problems of the Automobile

One looks with mixed emotions at the problem of the automobile.

For several decades now, the automobile industry has been one of the major industries of this country, giving employment to millions of workers, and stimulating growth in a number of related areas, such as plastics, glass, metal, petroleum products, and rubber. In addition, the automobile has been so widely accepted that an overwhelming majority of Americans use it as their only means of transportation. This has been quite agreeable to the automotive industry, which has sought to equip its products with all the comforts of home: leather upholstery; carpeted floors; air conditioning; cushioned, variable position seats; stereo music systems; and an occasional television or telephone thrown in for good measure.

But what has the automobile done to society? It has contributed a large percentage of the urban air pollution problem. Nearly everyone uses the automobile, and its most frequent use is for transportation to and from work. Since the average automobile occupancy rate for such purposes is only 1.4 persons per vehicle, (18) the large number of automobiles involved in moving people about, combined with the poor efficiency of the auto at low speeds, results in great amounts of air pollution. The automobile has also contributed to our "disposability gap," which is the difference between what has been discarded and what has been effectively disposed of. The new automobile population in the United States has recently been increasing more rapidly than the new human population. But, while there are more people buying autos, and the number of cars per family is increasing, the older autos are ultimately replaced--and they have to go somewhere. While the steel industry utilizes a portion on this

scrap metal, another portion is simply deposited in the ubiquitous roadside junkyard.

The automobile has also taken over large portions of our cities. As previously mentioned, two-thirds of the surface area of Los Angeles is devoted to the "automobile" mode of transportation, and its related accessories. As far as the actual area of the streets and highways is concerned, this represents a loss of taxable property. It would also have a tendency to increase the distance between points in the city. Lastly, the automobile has not only taken over our cities, but our minds as well. Victor Gruen made this point in his book, The Heart of Our Cities: (3, p. 117)

"How far autocrazity has progressed is illustrated in a recent planning report for the rebuilding of downtown Los Angeles, which contains this remarkable statement: 'The pedestrian remains as the largest single obstacle to free traffic movement.' "

b. Advantages of Mass and Personal Rapid Transit

The linear city would attempt to alleviate these problems by taking steps to replace automotive transportation with public mass transportation and personal rapid transit. According to Gruen, (3, p. 130)

"As far as the hearts of our cities and surrounding urbanized areas are concerned, it can be proved that an optimal (transportation) system would have to be based to the largest degree on mass transportation instruments and media, with individualized transportation playing a very minor role."

and again, (3, p. 261)

"The 35th International Traffic Convention, which met in May, 1963, in Vienna, arrived at the following conclusions:

1. The private automobile cannot solve contemporary problems of transportation. Only public mass transportation will be effective.
2. Public transportation must be given separate routes, for complete separation from private transportation.
3. Governmental assistance is necessary in order to provide good mass transportation."

The linear city, which is based on a concentrated population lying along a well-defined corridor, is thus ideally suited to the implementation of mass transit and personal rapid transit systems. If the population and business district of a linear city were centered on the mass transit and personal rapid transit lines, then one could travel between any two points within the city with very few, if any, route changes. The personal rapid transit system would not be affected, since it is programmed for non-stop service from origin to destination; but the mass transit system could have one or more "nodes" at which several transit lines joined (depending on the actual shape of the city), and these nodes might require route changes at that point. The idealized linear city could be schematically drawn as one set of parallel, oppositely flowing, one-way transportation lines, with all developments spread equidistantly on both sides of the lines for their entire length.

c. Conservation of Energy

There is yet another area of concern which implies the need to replace the inefficient system of automobile transportation (as it is currently employed) with the more efficient mass transit and personal rapid transit systems made possible by the linear city, and that is the question of an impending energy crisis. (The particular

set of military and political developments in the latter part of 1973 have accentuated this point.) In a world which is so utterly dependent on petroleum products, natural or "man-made" shortages of this resource have caused price increases, as well as curtailments and reductions in a number of related business activities. As the supply of this scarce resource becomes even more diminished, the law of supply and demand will drive the price of petroleum products even higher than those prices already experienced (assuming that an alternate fuel source has not been found and developed.) For the transportation systems of the linear new city, the power could be supplied from a central station or a series of substations, and from a variety of fuels (nuclear, coal, or petroleum); but either way would be more economical from the standpoint of money spent and energy consumed than the present "one man, one car" system.

3. Where to Build the Linear City

The third question to be asked, now that the linear new city is probably the optimum new city pattern, is this: Where should the city be built? This question must be asked both on a national scale and at the local scale.

a. National Scale

At the national level, for example, planners may have determined that some number of new cities is required in each of several states spread across the whole nation. The decision to be made next would be the determination of whether these cities are to function as population sponges for an overpopulated urban area, or as new regional population centers in themselves.

b. Local Scale

Then the question of location must be asked at the local level. Precisely where will this city be built? The answer to this question is best obtained through a detailed analysis of the type developed by Ian McHarg. (19, pp. 31-41) For a given region, McHarg considered such physiographic elements as slope, surface drainage, soil drainage, bedrock formation, soil foundation, and susceptibility to erosion; and such social considerations as land values, historic values, scenic values, recreational values, residential values, tidal inundation and/or flood potential, water resource values, forest values, wildlife values, and institutional values. When the entire region has been evaluated on the basis of each of these criteria and ranked on some numerical scale from most desirable to least desirable, and each criterion has been weighted as to its relative importance, then the results may be physically mapped out or computer plotted. The final output will be a map or chart which shows those areas whose development would incur the least social cost, and which are physiographically best situated. Such an analysis is of unquestionable importance if the nation, and each state individually, is to receive the most benefit, for the least cost, from its natural and human resources.

C. PLANNING THE LINEAR NEW CITY--BASIC PREMISES

The last question to be asked is this: What provisions can be made to increase the attractiveness of the new city, thus helping to

ensure its success? Several courses of action could be taken, ranging in scope from legal and administrative aspects to the planned character and economic base of the city.

1. The Automobile--Allowed, but Discouraged

Once again, the problem of the automobile must be considered. Though the automobile has been pictured as a noisy, air polluting, space consuming monster, it is difficult to argue with the experience of the past several decades--the demand for this product is apparently insatiable. With this in mind, the linear new city must realistically make some provisions for the automobile. After all, some people will probably find themselves having to commute to jobs some distance away from the city, and systems of inter-city mass transit might not exist. As far as intra-city use, though, the policy would be to make allowances for the auto, but to discourage its use. A road system would surround the city, parallel to, but some distance away from, the mass transit/personal rapid transit lines. One would always be free to own and operate an automobile, but always at a disadvantage in terms of money, time, and convenience. Such disadvantages as exorbitant vehicle registration fees, absolutely outrageous parking fees, etc., could easily be devised, while long walks to and from the parking lots would be further discouraging.

2. Passive Population Control

Population is another factor of concern. Every population forecast predicts great increases in population during the remainder of this century. Lewis Mumford, in his review of Albert Mayer's book, The Urgent Future, (20) says that "trend is not destiny;"

"the probable is not necessarily inevitable." However, this is meager comfort when confronted with the Malthusian theory of growth, which states that the population will tend to increase geometrically, while the food supply will tend to increase arithmetically. In the linear new city, no attempt would be made at legislatively or coercively limiting family size, but passive restraints could be employed. For instance, a decreasing tax deduction for the third and each subsequent child might be used, or even outright payments made for not having children. Though such maneuvering and manipulating may seem repulsive at first glance, serious thought will reveal that a very serious potential problem does exist. John Steinbeck, in his book, Travels With Charley, (21, p. 20) maintained that he could never sacrifice quality for quantity in his personal life. This statement may likewise be applied to the situation now in question, where now the trade-off is between the quantity of people and the quality of life.

3. Types of Housing

The types of dwelling units to be provided must also be considered. While the linear new city's mass transit/personal rapid transit systems would best serve a strictly mass housing arrangement, such an arrangement would not actually be likely to exist. High-rise buildings would be provided for those who, like the elderly, either do not mind, or seem to rather enjoy the great numbers of people who inhabit these high-density developments. (22) Low-rise apartments, which could be made quite appealing, would probably be satisfactory to most, while there would always be some number of citizens who would be willing to pay great amounts of money for the privilege of

living in separate, single-family dwellings. To some degree, this is not only inevitable, but also desirable from an architectural standpoint. The mixture of high-rise, low-rise, and single-family dwellings, with an occasional tower (a la Le Corbusier) thrown in, would satisfy the architectural principles of air, light, space, form, similarity, and variety.

4. Legal and Administrative Reform

The linear new city, quite possibly a federally sponsored development, and perhaps even located on federally owned land, could be in a position to institute, revise, or abolish such laws as the founding population deemed appropriate. If the state in which the new city was located had not yet acted on various matters of widespread public concern, the new city or new regional government could adopt its own set of laws and amendments. The current controversies over the legal age for voting, drinking, and marriage, as well as the debatable legality of abortion and drugs, are some of the areas in which legal reforms might be desired. It is hoped that the opportunity for closer participation in such matters will be an important attraction for progressive-thinking people, who would impart the same characteristic to the city itself.

D. THE COMPLETED LINEAR NEW CITY

Now that some of the groundwork for the linear new city has been reviewed, the finished product will be examined. The actual shape of the linear city may be straight, curved, circular, spiral, square,

or star shaped, but because of the concentrated lines of development, and the unifying nature of the mass transit/personal rapid transit systems, the city would be linear in function.

1. Transportation Provided

The transportation system would be comprised of several modes of transportation, including: mass transit lines, perhaps similar to those now operating in Chicago and the San Francisco Bay area, which carry large numbers of people in relatively large cars, operating much like a railroad train; personal rapid transit of the type developed by J. Edward Anderson (23) of the University of Minnesota, which is characterized by smaller, more exclusive, detached vehicles, operating like a taxi cab service, though in a fixed guideway; and various "people moving" devices, such as elevators, escalators, and moving sidewalks of the type currently being developed by Dunlop and the Battelle Institute. (24) Freight delivery, and perhaps solid waste removal, could be made via a pneumatic conduit system such as the TUBEXPRESS. (25) In addition, there would be the peripheral highway system, as previously explained.

2. Utilities and Services

The housing and business districts of the linear new city, being concentrated along the transportation corridor, would be well situated in terms of the utilities and services to be supplied. The concentration of development would result in more economical utility systems, since the amount of pipe or wire required would be less than for a widespread, less concentrated city. Large, high-capacity main lines for each type of utility (water supply, sewer system, electricity,

etc.) could be located between the parallel, one-way transportation lines, or a dual set could be placed on each side of the transportation line. Either way, the utility lines would be easily accessible, since they wouldn't be buried beneath the streets, as is now the case. And due to the linearity of the city, there would be no intersections and complicated grid arrangements for any of the service lines, for simplicity of design, construction, and maintenance.

3. Legislative Reform

The legal and administrative environment of the city would be such as to allow a greater degree of personal liberty, except in those areas where regulation is necessary to preserve the identity and function of the linear new city. To some extent, this could be accomplished through a more thorough application of the principle of separation of Church and State. Those laws whose existence is due primarily to the religious and moral influence of earlier times should be re-evaluated in terms of the present situation. There should also be some attempt to re-evaluate those laws, codes, and regulations which are biased in favor of some particular group because of political pressure exerted by lobbies. The author recognizes a need for the "Ralph Nader" approach--the vocal minority which seeks to protect the interests of the silent majority--but there should exist a review mechanism in order to ensure that what was once a boon does not become a burden.

4. Quality of Life

Psychologically, man first strives to achieve fulfillment of his basic or physical needs--food, clothing, and shelter. As these

needs become easier to meet, man then turns his attention to fulfilling his higher-order or psychological needs. It is widely accepted that the constructive use of one's leisure time--the opportunity for the fulfillment of those psychological needs--is an important factor in one's work efficiency and productivity. Thus, an important consideration for the linear new city will be the provision of adequate recreational activities to accommodate the trend toward increased personal leisure time. The layout of the linear city--a concentrated strip of development surrounded by open space--would make possible a string of parks and recreational areas adjacent to the housing areas. Every housing area would have some variety of recreational facilities, while the transportation systems would make it a simple matter to travel to the particular type of recreation desired. The ease with which one's recreational desires may be satisfied, along with all the other advantages inherent in the linear new city, should result in an improvement in the quality of life for the city's inhabitants.

5. Overview

An attempt has been made to support, by logical argument, the hypothesis that transportation by means of an arrangement of mass transit and personal rapid transit is more efficient, less space-consuming, and less hazardous than the current system of automotive transportation. Such a system of mass transport is ideally suited to the linear city. The concentration of population along the transportation route, by means of high-density housing such as high-rise apartments and Le Corbusier's towers, is logically the best way to

take advantage of the benefits of the linear transportation system, and is in itself a good method of conserving ground space--which is to say that this concentration represents a more efficient land use. This efficiency of land use will make more open space possible throughout the city, the use and enjoyment of which will be beneficial to the citizens. The possibility of special legal and administrative reforms for the new city, along with the benefits derived from the transportation system, the application of new technology, and the efficient use of land, should all contribute toward an improvement in the quality of life of the city's inhabitants.

IV. SUMMARY AND CONCLUSIONS

A. SUMMARY

In summary, it has been shown that the larger cities of today are in a period of crisis. Many of the people who live in the cities are not able to pay for all the services rendered by the city, while many of those who are able to pay have moved out to the suburbs. And though the cities are extensively laced with streets and highways, traffic congestion has become a major problem. The problems of the city are of great concern to society, because of the large part the city has historically played in human affairs, and because of the presumed continued importance of the city in the future. The entire array of problems facing the cities will be intensified by the large increase in population during the next few decades. Therefore it seems evident that some plan of action must be initiated to provide accommodations for this added number of people.

The new city is not the entire answer--certainly there are many small cities that have not yet reached their full growth potential, and into these cities a good portion of the added population could be placed without great difficulty. Likewise, the larger, more crowded cities, having so far shown a remarkable degree of elasticity, will stretch themselves a little more and absorb another portion of the population increase. But this study has attempted to present a logical argument supporting the contention that new cities may be built more economically, with better, more efficient transportation

systems, with the innovations of new technology more easily implemented--all combining to improve the quality of life for the inhabitants of the new city.

The history of town planning has been traced from the time of men's first cities up to the present day. Lewis Mumford provided much of this chronology in his book, The City In History. Sir Ebenezer Howard, the most influential of the town planners, shaped much of the twentieth century thought in this field with his book, Garden Cities of Tomorrow. In it, Howard gave a detailed analysis of how his new cities were to be established. The validity of his ideas has been proven by the success of the two new cities he built: Letchworth and Welwyn Garden City. His book is a classic in the city planning literature.

Various proposals have been put forth for cities of the future, including Le Corbusier's city contained in one tremendous tower; cities built entirely under the ground; and cities to be built floating upon, or anchored beneath, the ocean. While each of these ideas would have the advantage of conserving land space, the difficulties of construction and the lack of convenience would tend to make these approaches impractical, except in special cases.

The linear new city has been developed as a high-density development built astride a system of mass transit/personal rapid transit. The efficiency of this transportation system and the high population density alongside it would have the effect of creating large amounts of open space around and throughout the city for recreational purposes and city parks. Utilities and services would be easily

supplied because of the lines of high-density development existing in the linear city. The linear new city would also represent a convenient means of applying the latest innovations of our modern technology, and of accelerating reforms in government and legislature.

B. CONCLUSIONS

In conclusion, the author has attempted to present a logical argument supporting the hypothesis that the linear new city is a possible solution to the problem of providing adequate accommodations for a growing population. It is suggested that further study be done in the areas of primary employment for the proposed linear new city, and the financial arrangements under which it should be built. In view of the problems of the past and the anticipated problems of the future, the linear new city should be thoughtfully considered as part of their solution. In the words of Constantine A. Doxiadis, (26, p. 171)

"It is time for us to understand that the way we are going to live in the cities of the future ten, twenty, fifty, one hundred years from now-- we, ourselves, our children, and our grandchildren-- depends on the decisions we take now. We cannot only predict; we have to decide. We cannot only complain; we have to build."

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HYPOTHETICAL LINEAR NEW CITY, SCHEMATIC DRAWING

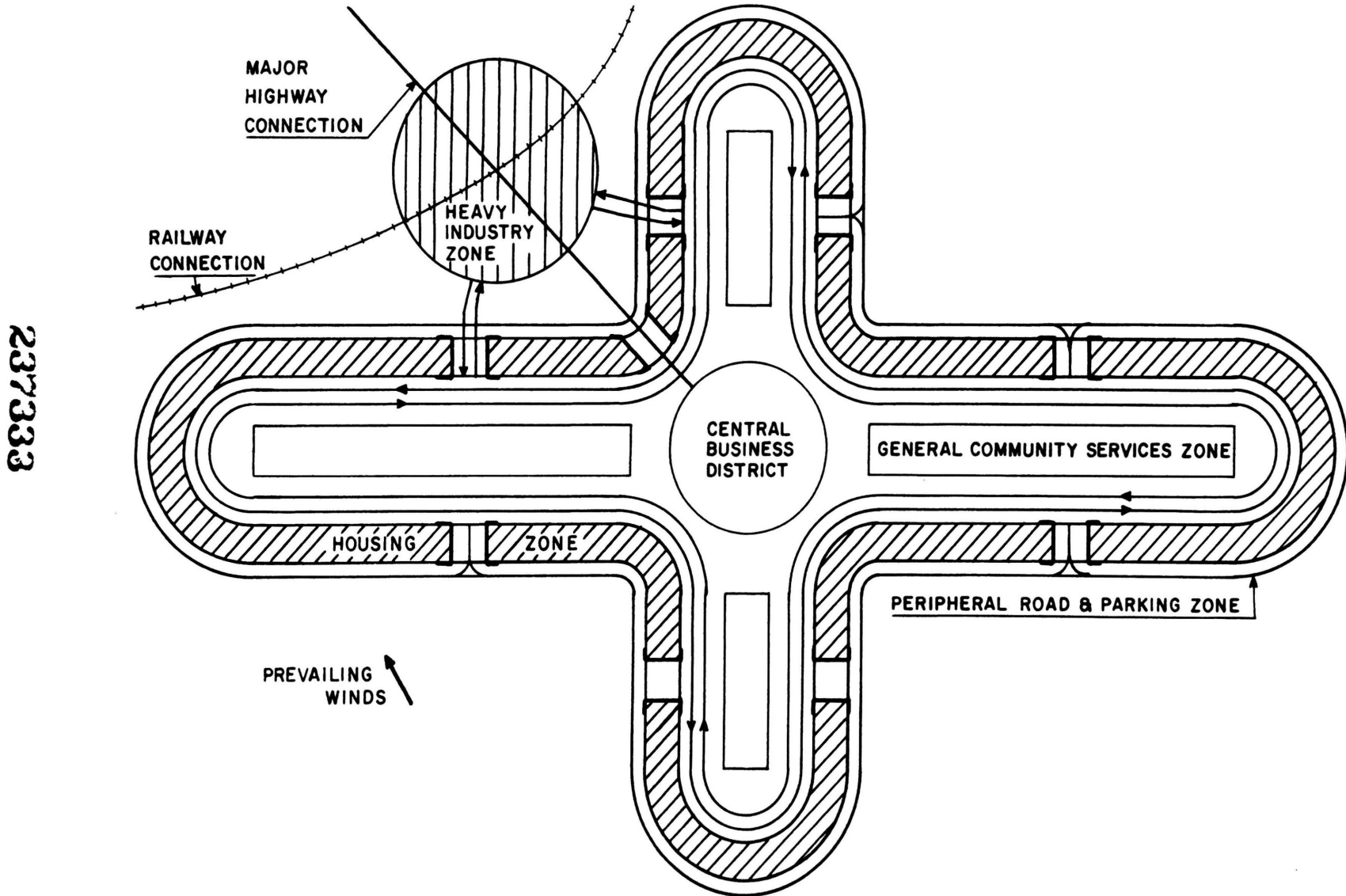


Figure 1. Schematic Drawing of Hypothetical Linear New City