The journey to work is a basic fact of urban living. As such, it constitutes one of the basic problems in city planning. A proper study of this journey to work can give us insight into the organization of the city, since the journey to work involves the major element of city planning - that is, the separation and relation between various types of urban land use. In addition, a properly designed study can provide us with a measure of a city's efficiency. Kate Liepmann, in her book, "The Journey to Work," states:

"The journey to work is a test of the urban lay-out; excessive costs and hardships of daily traveling can be taken as a symptom that something is wrong with the form of the town or conurbation." (1)

There are few cities which can pass this test with a good grade, and yet, one of our goals in city planning is to evolve a pattern which will minimize these excessive costs and hardships without sacrificing the desirable separation between land uses having conflicting demands.

An adequate study of the journey to work can not only point out the imbalances and inefficiencies of the existing city pattern but can also serve as an invaluable guide for future policy decisions. Policy decisions must be made as to whether or not to extend a transportation system, in what direction to expand it, what to do about new industrial districts, where to place new housing projects, etc. These decisions should be based, in part, on an understanding of daily travel patterns.

(1) Liepmann, Kate K., Journey to Work, Oxford University Press, New York: 1944, p.35.

*Copyright, American Society of Planning Officials, May, 1951.*
For example, if a new housing project site is under consideration, one of the factors in the deliberation should be the location of the site with relation to centers of employment. We will want to ask: What type of people will live in this project? Where do they work now? In what area of the city will job opportunities be open to them? What means of transportation to work do they usually employ? How far and how long will they be willing to travel to work?

The problem is, thus, not only one of relating various land uses, but also the even more complicated one of relating specific persons with specific skills and job opportunities to places of employment which, in turn, require these skills and capacities.

Looked at from the other side, there is the problem of locating a new industrial plant. In deciding on a location, not only are site, environment, taxes, etc., important, but also the plant must be within a "journey-to-work" distance of a labor pool with the requisite skills and wage requirements. If the journey to work is excessive, the plant will find it difficult to obtain its labor force, unless it chooses to offer wages which are high enough to compensate for the hardships of commutation. There is a limit, too, beyond which no wage is sufficient compensation.

These are problems which have significance in the normal or peace-time operations of the city. They become even more important during periods of economic expansion for war production, during periods of increasing competition for the means of production—labor, materials, etc. If we think back to the previous war, we can recall instances in which industrial plants were located with little or no reference to the source of labor. This resulted in serious losses of time which, instead of being used for commuting, could have been utilized productively in the war effort. It resulted in either inadequate transportation facilities or in the unnecessary extra cost of expanding or extending existing lines of transportation; sometimes it resulted in the enforced construction of temporary and often inadequate housing projects. In any case, the results were far from desirable. If we think ahead and consider that once again we may be faced, as some communities are already being faced, with an expansion of industrial potential for defense, with all of its attendant problems, we realize that an understanding of the journey to work is essential for our planning.

This bulletin is not oriented specifically toward planning for defense. Instead, it focuses on the problems which are relevant both for a peace-time and a war-time economy. Certain changes of emphasis may be required in the case of a national emergency, but the approach will be basically the same.
Thus far, we have avoided any definition of the journey to work. Clearly, the journey to work relates to the problems of "dormitory" or "night-time" communities and to the peak day-time population of the central areas, to the movement of people toward the centers of employment in the morning and their dispersal toward home in the evening. In addition to this main tide of centralization and decentralization, there are cross-currents of movement - the movement out from the central slum areas to industry on the periphery, the movements across town and within sections of the city and within neighborhoods. It might be well to spell out some of the causes and implications of this daily migration.

The journey to work has arisen out of the separation of places of residence from places of employment. Why has the separation evolved? How much of the separation is necessary, and how much is compatible with the goals of convenience? How can we compromise between the incompatible goals of:

1. Maximizing job mobility and the separation of incompatible land uses (both of which require a longer journey to work);

2. Minimizing the price we must pay in terms of time, cost, convenience, and efficiency for such land use differentiation and such labor mobility.

"In the good old days," so we are told, the problem of the journey to work did not exist. People lived and worked, if not in the same building, in the same section of town. In the Middle Ages, weavers kept their looms in their homes, often in the same room in which they slept. Shopkeepers had not far to go to reach their street stalls. There is still some residual of this previously widespread pattern. In rural and farm communities, the place of employment is still usually on the premises. In the so-called customary home occupation, no separation has yet been effected. Also, there are still many proprietors of small businesses who reside in apartments above or behind their stores. But their number is decreasing. For the most part, our cities are so organized and our industrial and commercial processes so established as to encourage a separation. Our legislation and zoning ordinances have been designed to enforce this separation.

There are good reasons for this separation. We have helped to bring it about because it did have certain advantages. Commercial and industrial uses have certain characteristics - traffic, noise, population congestion, smoke, vibration, odors, unattractive appearance - which we find in conflict with our goals for residential amenity. In addition, many persons welcome the psychological value of a separation between work and home. Especially where job satisfaction is low, there is value in being able to leave and forget about work for a few hours. Another not-to-be-forgotten fact is that modern industrial requirements
for large labor pools from which to select personnel make inevitable a certain amount of mobility. This mobility would be possible without a lengthy journey to work if workers made a change in residence with every change in job location. Since people are often reluctant to do this, mobility is alternatively achieved through a daily journey to work.

TRENDS IN THE RELATIONSHIP BETWEEN HOME AND WORK

We are now witnessing what may well be a partial reversal of this trend toward increasing separation of places of living and employment. There are at least three forces operating in this direction. First, the need for more land for industry (one-story factory buildings, etc.) has led to their location in outlying districts, close to either existing or company-constructed residential communities. Secondly, due to technological advances, industries are finding more and more ways to control and alleviate the nuisance aspects of their operation which formerly made them undesirable neighbors. Thirdly, there has been a trend in some new zoning ordinances toward permitting certain kinds of "light" industries to locate in more restricted zones if properly constructed and controlled as to size and type of operation. (The reverse of this trend may be seen in the equally recent zoning ordinance provisions to exclude residential uses from industrial districts.)

Similar trends are operating with respect to commercial uses of land. We have seen a partial reversal of the tendency toward commercial centralization (and, therefore, distance from home in many instances) in the development of both neighborhood shopping centers offering limited services to residents of the nearby area and in the increasing popularity of outlying shopping districts for a regional market.

That these trends are closely interrelated is clear. Decentralization is, in part at least, a function of an improved technology which permits the coverage of greater distance with less expenditure of time - both for employees and customers. Decentralization is limited, however, by the industrial and commercial requirements for a large labor pool. It can only proceed at a pace commensurate with a decrease in the "price" of the journey to work.

THE "PRICE" OF THE JOURNEY TO WORK

Distance

It would be naive to assume that the magnitude of the journey to work can be measured by geographical distance alone. Although this is obviously not the case, studies are still being made which utilize the dimension of distance to measure commuting patterns. We still see the somewhat meaningless statement that "stores or factories should be located one-half mile from residences," without any qualifications being made as to the mode of transportation.

Time

In an effort to evolve a more realistic measure of the real cost (i.e., sacrifice) of the journey to work, in many recent studies the
dimension of time has been added. Thus, an individual traveling fifteen minutes by automobile pays the same "price" (sacrifices the same amount of time) as another individual traveling fifteen minutes on foot, other things being equal.

But other things are never equal, which leads us to the realization that other dimensions must be added to our measurement of the journey to work. First, the man who uses an automobile obviously has to pay for the gasoline and depreciation of his car, whereas the walker has no such expense. Therefore, we will want to include the measure of monetary cost in our analysis.

In addition to these tangible costs, however, such as time and money, there are additional and often hidden costs. There is usually no exact measure available for these costs, but they are none the less important. For example, let us consider the pleasantness of the journey. Compare the "sacrifice" of a half-hour trip in a convertible on a sunny day through green countryside with the "sacrifice" of an equally time-consuming trip in an overheated, overcrowded, noisy, swaying street car. Are the costs equal? Which would you choose? There is also convenience. For example, a train may be inconvenient, no matter how fast it travels, if it leaves at the wrong time.

Complicating the picture still further is the fact that there may be hidden benefits as well as costs in the journey to work. For example, walking or bicycling to work may contribute to good health. Certain journeys may be positively pleasurable in addition to being "not uncomfortable."

**HOW DOES THE PRICE OF THE JOURNEY TO WORK INFLUENCE JOB CHOICE?**

The relative cost of the journey to work (measured in the above-mentioned dimensions) is one of the factors influencing where people will work. Its importance will, of course, vary considerably with different people and under differing conditions of the economy. In a contracting labor market, greater sacrifices in terms of the journey to work will probably be accepted than in periods of an expanding labor market where job opportunities are more plentiful. A sufficiently attractive wage may compensate for an additional journey to work. This wage differential need not necessarily be a monetary one; it may be in terms of pleasant working conditions, retirement benefits, and the numerous factors which make up "job satisfaction."

The value which a worker places on time, and the degree to which he is willing to make a specified journey to work will depend upon many variables. Age, sex, race, occupation, economic class, cultural group, reason for working, will all be important determinants of the evaluation of the journey to work by individuals. No gross generalizations can be made as to the "optimum" journey to work, nor can generalizations be made as to how far employees as a whole are willing to journey to their jobs. More important for projection purposes than the similarities in journey-to-work patterns are the dissimilarities or differentials between these various groups.
As pointed out earlier, if the journey-to-work price is excessive, according to the individual’s evaluation, he may choose either to change his job or his place of residence. Which he changes will depend on the relative availability of housing as compared with employment opportunities. Again, the important differentials of age, sex, marital status and motivation for working will enter in as crucial determinants. An example of the operation of these variables may be seen in the case of a family in which there is more than one wage earner. In this case, only one member of the family, in the last analysis, can solve the problem of the journey to work by moving closer to his job. The remainder may choose either to select a job close to home or pay the price of the journey to work. A distinction in this case is usually made between the “primary wage earner” and the “secondary wage earner.” Decisions as to choice of residence are usually, although not always, made by the primary wage earner, whereas decisions as to selection of alternative job possibilities are generally made by secondary wage earners.

A STUDY OF THIS PHENOMENON

In 1950, the Chicago Housing Authority made a survey of journey-to-work patterns of tenants in the low-rent public housing projects in Chicago in order to determine what adjustments were made in terms of employment when families were provided with housing in areas distant from their previous place of residence. (2) Here was a situation in which persons whose housing location was determined were faced with the problem of choosing between a journey to work to the old place of employment and changing their jobs.

Some of the results of this study are significant, and point out the various factors, such as those described above, which affected the choice between these alternatives. The most important finding of the study was that people were, for one reason or another, reluctant to move any great distance from their previous place of residence. Due to the proximity of these two, in general, not many job shifts were required. However, there was a discernible trend or tendency to bring home and job closer - usually not though a voluntary job transfer, but through the seeking of a new job closer to home after the loss of the first job. This lack of widespread job mobility may be explained in part by the fact that these are people whose job and home opportunities are very circumscribed, and, therefore, cannot be very particular or demanding in either area. This is further substantiated by the fact that the Negro low-rent tenants, whose housing and job opportunities are even less than those of the white tenants, traveled consistently greater distances to work and tended to adjust their jobs to their new residences even less than did the white tenants.

(2) J. S. Fuerst and Shirley Hillmer, Home-To-Work, Chicago: Chicago Housing Authority, to be published soon.
On the average, it was found that people in the low-rent projects traveled three to three and one-half miles to work. This distance traveled was significantly greater for the Negro population. One-fourth of the workers lived within walking distance of their jobs (two miles or less) but there were wide differentials between white and Negro tenants. This is illustrated by a comparison of two housing projects located across the street from one another in a central slum area, one of which has white occupancy and the other Negro occupancy. In the white-occupied project, 29 per cent of the workers walked to work, and this percentage was raised to 36 per cent as adjustments in places of employment were made. In the Negro-occupied project, only 12 per cent of the workers were within walking distance to their jobs originally, and after job location adjustments were made, still only 20 per cent were able to walk to work. In the large outlying project tenanted completely by Negroes, 66 per cent of the workers traveled more than 6 miles to their places of employment. Another discernible pattern was that the lower paid workers lived closer to their places of employment than did the higher paid workers.

JOURNEY TO WORK STUDIES - A CRITICAL REVIEW

In the light of the goals or potential uses of a journey-to-work study, let us take a brief look at the studies which have been made to determine how much they can reveal about the phenomenon and where such studies are in need of expansion and refinement and even new techniques of research in order to yield the maximum usefulness for city planning purposes.

During the last war, when the country was concerned with the dual problem of conserving manpower and resources such as automobile tires and gasoline, the journey to work became the subject of much research by state and local labor or employment departments and by several of the federal agencies concerned with manpower. This was particularly true in the large industrial areas. The goals of these surveys were somewhat circumscribed as they were oriented primarily toward an expeditious solution to the transportation problem; they were not basically concerned with the problems of industrial or residential location. They were not so much concerned with the laying out of new and long-range transportation systems as with making the best of the existing facilities. Thus, these studies of the origin and destination of industrial workers were designed to expedite such measures as car-pools, staggered-work hours, skip-stop systems in mass transit, etc. Because the goals of these studies were limited to "temporary" adjustment in a "temporary" crisis, the relevance of the data collected is also limited. However, it may form a basis for further research.

Typical of the method utilized in these journey-to-work studies was that of a survey conducted by the New Jersey War Transportation Committee under the direction of the planning engineer of the New Jersey State Planning Board. (3) The admitted objective of the study was to "avoid any reduction in or disruption of war production and vital ser-

(3) New Jersey War Transportation Committee, Arnold H. Vey, Chairman, Procedures For Mailing, Napping And Coding (mimeo), 1942.

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services due to inadequate worker transportation." The study included a survey of existing transportation facilities, their condition, capacity, etc.; a mapping of all major transportation lines classified as to type and amount of service provided and correlated with the major areas of industrial, commercial and residential land use; and an "origin-destination" survey conducted by means of questionnaires distributed to all employees in commercial and industrial establishments employing over one hundred persons. This schedule included questions on place of residence, mode of transportation to work, time of arrival at work, sex, and additional items designed to estimate the length of life of automobiles currently being used for the journey to work (usually in terms of tire life), and the alternate means of transportation available to workers when the cars could no longer be used.

At the same time that employees were questioned as to their method of transportation, etc., the plants were required to estimate the changes foreseen in their future utilization of the labor force. The questionnaire designed for plants and commercial firms included such items as (1) whether the firm expected either a substantial increase or decrease in the number of employees in the future; (2) an estimate of the total maximum (in case of an expansion) or minimum (in case of a contraction) number of employees the plant expected to have; (3) the approximate date at which the maximum or minimum employment of the plant was expected to occur; and (4) an estimate of the relative changes of employment in the several work shifts.

The results of a study such as this one are valuable in that they permit a graphic presentation of the magnitudes of the journey to work in terms of the travel distance, and permit a definition of labor market area from which labor for a particular plant may be recruited. If such a study is available in a community, it should be used - but there are several reservations governing the use of the results so obtained. One of the major reservations is that these studies were made during the war under the peculiar labor conditions and "psychology" of the times. Recruitment was not always on a monetary basis; there was a patriotic appeal as well. Certain industries had high priority with reference to draft deferment which undoubtedly influenced, in some measure, the journey to work to these particular industrial plants. The above factors may help explain the fact that the labor market area, defined in terms of the "permissible" or "accepted" journey-to-work cost, is, in general, geographically larger during war-time than it is under a prosperous peace-time economy. In addition, the characteristics of the labor force at that time, with its high proportion of women and adolescents, led to certain commuting patterns which do not obtain in a more "normal" labor force.

The New Jersey study made no attempt to evaluate the cost to the worker of his journey - either in time, money, or convenience. Several of the other studies made at that time, and for the same purpose, included more of these variables. For example, the survey technique evolved by the Traffic and Safety Bureau of Liberty Mutual Insurance Company included questions, not only on the distance from home to work
in miles, but also in travel time. And also, realizing that the travel time is not a constant factor, it included inquiries on the approximate length of time taken on the journey from work as well as to work. This study also attempted to investigate the attitudes of workers toward the alternative modes of transportation. This last-mentioned investigation is a crucial, and too often neglected, element of the picture.

An example of the use which can be made of data collected during the war is the study made by J. Douglas Carroll, Jr. (4) Using the information collected by the Massachusetts State Planning Board in 1942 on the journey to work of employees of manufacturing establishments, he was able, by processing and correlating the data, to discern patterns in the home-work relationship. In the Carroll study, questionnaires returned by employees were tabulated for the nature of the product manufactured, the location of the plant, the total number of employees, the place of residence of the respondent, the distance to work, the method of transportation, and whether the respondent would like to move closer to work. In this last item, despite the somewhat unrealistic nature of the hypothetical alternative, an attempt was made to ascertain attitudes toward the journey to work.

As Carroll points out, there were some inadequacies in the data which had to be compensated for and some for which no compensation could be made. For example, as the place of residence was recorded in terms of a general geographic area, rather than a specific address, the measure of the distance from work was inaccurate. (This is the same inadequacy as is found in the Indiana study, a discussion of which follows.)

A tabulation of these data revealed that the bulk of factory workers studied here lived fairly close to the plant at which they worked, and that the proportion of workers from an area decreased as the distance from the plant increased. Contrary to expectation, there was no discernible pattern found which would support the often-suggested hypothesis that the larger the plant, the greater commutation required. Until a plant size of over 10,000 employees was reached, there was little evidence that the size of plant influenced the range of the commuting pattern. Another fairly significant conclusion of the study was that the industries located within the metropolitan district of Boston (Census definition) employed workers from much wider areas - much greater commuting distance - than did the plants located outside of this region. The author suggests that this may be due to the better transportation facilities available to Boston residents. This seems extremely probable, and emphasizes our former statement that it is travel cost, in time, money and effort, which is the crucial determinant, and not geographic distance.

When correlations were made between distance from home to job and size of residence-city, some rather interesting results were obtained. It was found that for workers residing in Boston itself, the median journey-to-work distance was 3.1 miles. This distance decreased with the size of the city until in cities in the population class of 10,000 to 24,999, workers traveled a median distance of only 1.6 miles to work. However, in the still smaller-sized cities, the median journey-to-work distance increased to 2.3 miles in towns of from 5,000 to 9,999, and to 2.6 miles in communities with less than 5,000 population.

A similar pattern became evident when the journey-to-work distance was correlated with the size of the city in which the plant was located. For plants located in Boston itself, the median mileage traveled by workers was 4.7 miles. This mileage decreased with the decreasing size of city, until the population class of 10,000 to 24,999, where a median distance of 1.7 miles was found. In towns of 5,000 to 9,999, the median distance was 2.2, and in towns of less than 5,000, the mileage was 3.8. Plants located in cities of from 10,000 to 24,999 population also has the largest number of employees who walked to work - some 34 per cent.

Comparisons between the average journey-to-work distances of employees in the textile, leather, paper, machine tools and machinery industries revealed that workers in the first three mentioned industries traveled the shortest distances to work, whereas workers in the machinery industry traveled the greatest distance. This journey-to-work distance for workers in the various industries was closely paralleled by the wage scales of these industries, since the workers in the textile, leather and paper industries had an average wage considerably lower than that received by workers in the machine tools and machinery industries. A correlation between type of industry and size of community in which it is located should have been made here to determine whether this was an important variable in the situation.

The final tabulation made in this study was of the attitude of workers toward their daily journey. In response to the question, "Would you move closer to work?", a little over 9 per cent of the total sample answered affirmatively. Of those workers living within five miles of their jobs, about 7 per cent answered in the affirmative, whereas 24 per cent of these workers traveling between 20 and 25 miles stated that they wanted to live closer to work.

In addition to these studies made during the war, there have been many studies made by state labor departments which have been oriented toward the slightly broader goal of determining how people get to work, and how this affects the labor market and prevailing wages in various communities and regions. Such a study was made by the Indiana Employment Security Division, Research and Statistics Section in 1947, with a follow-up study in 1950. (5) This survey attempted to measure the

(5) The following material was made available through the courtesy of Mr. Dwight D. Kelley, Supervisor of the Research and Statistics Section of the Indiana Employment Security Division, who kindly reviewed this summary of the Indiana study to see that it was substantially correct.
extent to which workers commute across county lines in twenty-six selected counties in Indiana as an index of the extent of the journey to work. Data on the county of residence and county of employment of employees were gathered from industrial and non-manufacturing establishments covering about 70 per cent of the employees in manufacturing establishments and about 10 per cent of the non-manufacturing establishment employees.

In 1947, it was found that approximately 11 per cent of the employees crossed county lines to go to work, whereas in 1950, 13 per cent worked in counties other than those in which they lived. (The sample for 1947 differed from that of 1950, and rigid comparisons are, unfortunately, not valid.) Some of the other findings were that most workers lived within a few miles of their work, but that the amount of commuting increased with the size of the industrial center; that the drawing power of higher wages diminished rapidly as the distance from the job increased; and that "excessive" commuting from points beyond a range of fifteen to twenty miles occurred only when jobs were not available in the home community. Some of the more specific conclusions of this study were:

Employers in nearly all of the industrial areas in which a major city is located reported in 1950 that more than 10 per cent of their employees travel daily from another county. In the Calumet Area (Cary-Ramond-East Chicago), employers reported that 14.5 per cent of their employees live outside Lake County. Fort Wayne employers reported 14.4 per cent are drawn from outside their home county; South Bend, 13.1 per cent; Evansville, 12.1 per cent; and Terre Haute, 10.6 per cent. In all, employers in sixteen out of the twenty-six selected counties included in the survey reported that over 10 per cent of their workers live beyond the county lines of the home county.

While there is variation in the amount of commuting among different employers as well as different areas, the 1950 survey again showed that employers in smaller cities generally are more dependent upon residents of the home county. Employers in the small communities of Linton and Peru, for example, reported that only 4.6 per cent of their workers commute from out-counties. Vincennes, which ranks high as a center of agricultural activities, showed the lowest per cent (3.0) of workers traveling to work from beyond the county lines.

In 1950, as in 1947, establishments in Connersville and Jeffersonville reported a heavy volume of commuting workers with over one-third of their employees residing outside the home county. Lawrenceburg, which was not included in the 1947 study, also draws more than a third of its workers from beyond the margins of Dearborn County. In fourth position was New Albany, where employers reported more than a fourth of their workers commute from points outside Floyd County. With the exception of Connersville, these cities are located near the county border and, therefore, the traveling distance of commuters is not necessarily great. It is also interesting to note that all three
cities are located on the Ohio River and are drawing a substantial num-
ber of workers from adjoining states.

Somewhat at variance with the conclusions of the Carroll study
noted above was the fact that long journeys to work were found to be
more extensive in the larger firms. Among all manufacturing establish-
ments included in the sample, it was found that those with less than
fifty employees obtained only 6.8 per cent of their workers from across
county lines, whereas firms employing 1,000 or more workers obtained
15.9 per cent of their employees from outside their home counties.

Conferring Carroll's conclusions, it was found that the commuting
patterns varied quite decidedly among different industries. For in-
stance, firms in transportation equipment manufacturing obtained 17.3
per cent of their employees outside their home counties, whereas firms
in the stone, clay and glass industry obtained only 7.6 per cent of
their employees outside of their home counties. The transportation
equipment industry is characterized by large establishments.

There are undoubtedly other variables contributing to the differ-
entials between various sizes of plant and between industries. Large
plants require, very often, large quantities of land, very often un-
available in the centers of cities. Each industry requires a different
type of labor force, with unique characteristics of skill, sex, etc.,
al of which would indirectly affect the type of commuting patterns
which obtained for workers in the industry.

The use of the county line as a means for classifying commuting
patterns, while desirable for some purposes (for example, when consid-
ering the possibility of imposing an income tax by a central city on
workers deriving income from that city), is not an adequate one for the
purposes of city planning as we have outlined them. Obviously, a manu-
facturing plant located just to one side of the county line will employ
more workers from outside the home county than will a plant located
right in the geographic center of a county. Likewise, two workers who
live across the street from one another and who work at the same plant
may have different journey-to-work classifications if the county line
happens to run down the center of the street. These are extreme cases,
but they do point up the inadequacy for planning purposes of the use of
such completely arbitrary jurisdictional boundaries. This study also
lacks data on either the length of travel time or the mode of transpor-
tation used, but since automobile was the overwhelming means of trans-
portation, this deficiency is not as serious as it would have been where
many different means of transportation were employed.

Still another type of journey-to-work study is that generally per-
formed by the traffic engineer or the city planner. These studies are,
in most cases, oriented primarily toward the traffic problem, and they
concentrate on the journey to work only in so far as it contributes to
traffic congestion on streets and highways. It is basically a study in
motor vehicle transportation. If the studies by labor departments are
numerous, the traffic studies are innumerable. There are few cities
which have not done some form of traffic count, cordon count or origin-destination interviewing at some time. During the thirties, much data on traffic movements was collected by the WPA in various cities.

Despite the fact that these traffic surveys have not been oriented specifically toward an understanding of commuting patterns, some of the data which have been collected in such studies will be useful to the planning commission in an analysis of the home-work relationship. And, certainly, some of the techniques which have been devised by the traffic engineers for these studies can, if properly adapted and modified, be utilized very effectively as a part of a complete and balanced journey-to-work study.

Some of these techniques which will be useful are: (1) the analysis of motor vehicle ownership and use, (2) the origin and destination analysis, (3) the cordon count method and (4) the parking demand analysis.

The importance of the first of these will be recognized without amplification. In making such an analysis, however, care should be exercised to include as many important variables in the projection as possible. Some of these variables will be income and its distribution, availability of alternative transportation facilities and their level of service and degree of coverage, etc. Also, it should not be forgotten that changes in the road system may have a decided effect upon motor vehicle use. Many cities have discovered, much to their despair, that when they have constructed superhighways with a capacity adequate for the previous demand, the very existence of these good roads has stimulated more traffic on them - resulting in congestion as great or greater than before. In like manner, improvements in mass transportation facilities create incentives for its use which may significantly change the patterns of transportation.

The origin-destination study will be most useful in determining the location and the capacity of new traffic routes. These studies, if performed at particular times of day when the destination of the traffic is primarily to places of employment, can give valuable information on the journey to work. We will not discuss the details of this method. However, if such a study is contemplated, valuable assistance on methodology is available from the Public Roads Administration. This organization, together with the U. S. Census Bureau, has developed a sampling method for origin-destination studies which permits a substantial reduction in cost over the older methods of conducting such a survey.

A cordon count may be made in conjunction with the origin-destination study at points of particular interest. Although cordon counts are employed primarily with reference to the central business district, a count made in major areas of industrial concentration will be of particular help in obtaining data on the proportion of employees in industrial districts utilizing motor vehicles as the mode of transportation to work. These data will also be relevant for estimating the de-
mands for parking facilities for workers, another facet of the journey-to-work problem.

If these traffic counts are combined with survey information obtained through questionnaires of employees, it will be possible to construct traffic flow diagrams and maps for the large centers of employment.

SAGINAW, MICHIGAN

A fairly good study, methodologically, was that done by the Works Progress Administration in 1939 for the City of Saginaw, Michigan. Although the conclusions may no longer be valid, the method employed can serve as a guide for other cities desiring to make such studies. (6)

Some interesting patterns of the journey to work were discovered in this study. Employees were queried as to their means of transportation and their transportation time. A tabulation of these data showed that, of those employees who walked to work, the average time so spent ranged from eleven to sixteen minutes. Those workers who either drove themselves or rode with other workers spent an average of 13.5 to 19.9 minutes in traveling. Employees using the bus lines spent the longest time in getting to work — an average of between twenty-five and thirty-five minutes. The interesting fact here is that, in terms of time, persons who walked to work and persons who rode automobiles to work paid approximately the same price in time for their journey to work. Workers utilizing bus lines paid a considerably greater price. What factors account for this? These are problems which will bear further investigation. In a study of the journey to work, one should always be sensitive to such discrepancies.

CRITICISM: A basic criticism which can be leveled against all of these methods for studying the journey to work is that they are static. By this we mean that they accept the present labor force and the present job distribution, and are concerned with describing it and with finding the solution to any problems which result from this present situation. Knowledge of the present situation is undeniably important, but it is not the entire story. An adequate study will have to utilize this descriptive material in order to project or predict potential problems which will result from changes in the existing situation. These changes may be in the labor force itself, in the industrial base of the community, location of residential areas and of new industries, or in the transportation system.

A SUGGESTED METHODOLOGY FOR STUDYING THE JOURNEY TO WORK

One of the first steps in setting up a methodology for studying any phenomenon is to clearly define the objectives of the study. Only after we have done this can we design a research method which will yield the desired results.

The three goals of the research are:

1. To obtain an accurate picture of the present journey-to-work pattern of the community in terms of the present relationship between places of residence and places of employment, the present transportation facilities and their adequacies and inadequacies. (This is the "test" of the city's efficiency stressed by Kate Liepmann.)

2. To obtain a basis for predicting future requirements in the transportation system which would result from changes in either (1) the labor force, (2) the industrial base of the community, or (3) locational trends in residence and industry.

3. To obtain a basis for predicting changes in the labor force, the labor pool of specific industries and commercial establishments, and the journey-to-work patterns which would result from changes in the transportation system.

The chart on pages 16, 17 and 18 summarizes in outline form the design of a total research program oriented toward the three goals stated above.

Most of the studies described in the preceding sections were oriented primarily toward the first goal, i.e., a description of the present journey-to-work patterns of the community. The techniques of research used to obtain and analyze data for such studies have been explained extensively in other sources and require no restatement here. In addition, since these techniques are used primarily for other purposes and only incidentally for journey-to-work studies, they will have requirements and specifications not dictated solely by the needs of the journey-to-work study.

There are several techniques which are not so widely known or used with which we will deal in more detail here. These techniques will be useful primarily in studies oriented toward the second and third goals as outlined above, and their specifications will be directly controlled by the needs of the journey-to-work study.

The three techniques which will be discussed here are (1) the establishment of zones of equal distance in time which may be used as a basis for classifying journey-to-work "costs"; (2) the setting up of questionnaires designed to obtain information on the relation between characteristics of the labor force and the journey-to-work price workers are willing to pay; and (3) the setting up of an interview schedule designed to obtain insights into the attitudes of workers toward the journey to work which underlie job and residence choices.
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<th>METHODOLOGY OR SOURCE OF DATA</th>
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<td>An inventory of:</td>
<td>Transportation and Traffic Studies such as:</td>
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<td>1. Classified as to form, i.e., railroad, streetcar, bus, highway, pedestrian, parking, etc.</td>
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<td>2. Classified as to capacity, i.e., number of vehicles, number of persons accommodated during average and peak-load periods.</td>
<td>Car ownership</td>
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<td>b. Present uses of these facilities.</td>
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<td>c. The structure of the labor force.</td>
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<td>1. Age, sex, race, occupation, skill, marital status, etc.</td>
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<td>d. The structure of the employment base of the community.</td>
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<td>c. Present transportation requirements compared with present facilities (for use in determining inadequacies in the transportation system and disequilibriums in the location of residential/commercial/industrial areas.)</td>
<td>e. Present pattern of journey to work. 1. Mode of transportation. 2. Time spent in travel. 3. General appraisal of hidden costs of travel.</td>
<td>Factual questionnaire for interviewing employees at plants and commercial establishments.</td>
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<td>2. A basis for predicting future requirements in the transportation system which would result from changes in:</td>
<td>Estimating</td>
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<td>Population projections for the region and city. Projections based upon discernible trends in labor force participation. Projections based upon past experience and population projections of age and sex. Projections based on gross trends combined with analysis of economic opportunities available to groups in the community.</td>
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<td>c. changes in density which are taking place due to demolitions, conversions, etc.</td>
<td></td>
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<tr>
<td>d. Attitudes of workers toward the journey to work.</td>
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<td>see below</td>
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</table>

3. A basis for predicting changes in the labor force, the pool available to specific industrial and commercial establishments, and the journey-to-work patterns which would result from changes in the transportation system.

The data required for this type of analysis has already been enumerated above. It includes the use-of-transportation inventory, the economic and social characteristics of the labor force by residential districts, attitudes toward the journey to work held by various groups of workers, broken down into the following classifications:

- **Males** - by age group, race, occupation, marital status, income, level of education, occupation, level of skill, car ownership, etc.
- **Females** - by above plus age of children, primary or secondary wage-earners, etc.

No existing methodology has yet been evolved. An attempt to develop this methodology follows.

The attempt will have to be made here to determine correlations between these variables and the length of time people are willing to travel to work. Factual and attitude questionnaires.
Most studies classify journeys to work according to the criteria of geographic distance or the crossing of somewhat arbitrarily chosen boundaries (such as county lines, postal zone boundaries, etc.). Because of this "unrealistic" classification system, the relationship between worker characteristics and journey-to-work "costs" are often obscured or falsely represented. Since time is a more important measure of the journey to work than is distance, a technique which classifies journeys to work according to the time spent in traveling is required. In addition, the mode of travel, since it is the link between time and distance and is directly related to other measures of the journey-to-work "cost" such as satisfaction and convenience, should also be included in determining the zones of classification.

The means for graphically presenting this classification system is through iso-times, i.e., a belt or zone boundary constructed by connecting all points surrounding any given employment center which are separated from that center by the same travel time by the same mode of transportation. Iso-times, or time zones, have been used in traffic and transit studies for many years, but their application to the analysis of journey-to-work patterns has not been extensive. Our treatment of them in this bulletin is meant to be suggestive rather than definitive, and it is hoped that the technique can be further refined and its application further extended.

HOW TO CONSTRUCT ISO-TIME ZONES

An iso-time, as we have defined it, is a line connecting all geographic locations which are removed from an employment center by the same distance in time by the same means of transportation. Each iso-time will circumscribe an area or an iso-time zone, all parts of which are distant from the employment center by no more than the time value of the iso-time line. For example, it will be possible to draw an iso-time line connecting all points which are fifteen minutes distant from the employment center by street car. (This would include modifications for time spent to reach the street car line from nearby points.) This line will delimit a zone. Workers living within this zone and traveling by street car will not spend more than fifteen minutes in journeying to work. Iso-times can be drawn for any time interval and for each mode of transportation, such as walking, bus, street car, subway, train, automobile, bicycle, etc. The shape of these zones will be dependent upon the layout of the transportation system and may vary considerably in shape for each mode of transportation. They will be constructed in the same way that iso-therms are drawn for weather maps or iso-vals are drawn for urban land value maps.

When these iso-time belts are superimposed upon a map showing the distribution of the community's labor force broken down according to economic, social and demographic characteristics and showing the distribution of places of employment broken down according to labor force requirements, an estimate can readily be made of the size and type of labor force located within a given journey-to-work distance.
(time) of any employment center, given the available transportation system. Imbalances between the characteristics of labor available and labor required can be spotted with relative ease.

For purposes of illustrating this method, the following step-by-step procedure is suggested.

**PROCEDURE**

Several forms of base maps will be required, for the recording of pertinent data and the analysis in terms of iso-times. Two basic types are suggested:

**FOR CONSTRUCTION OF ISO-TIMES**

1. A large-scale base map of the city and surrounding areas from which labor is recruited and where plants employing workers residing in the city are located. On this base map, the following data should be transcribed (preferably by means of acetate overlays):

   a. The location of major areas of employment concentration classified as to general wage levels, degree of skill, sex of workers, number of workers, etc.

   b. The location and lay-out of all major lines of transportation in the region, differentiated according to mode of transportation and relative speed of travel. (For example, different colors or symbols should be used for automobile streets - traffic streets, four-lane highways, super-highways, freeways, etc. - bus lines, railway lines - express, local - street car lines, etc.) Capacity of these various transportation facilities should also be recorded.

   c. Generalized pattern of residential land use of the region distinguished according to the characteristics of the population - income level, family composition, racial and ethnic characteristics, age and sex distribution, level of education, degree of skill, occupational breakdown, etc.

This base map will be a useful guide to an overall picture of the present relationship between places of work and places of residence. More detailed analysis of specific areas within the city will have to be referred back to this overall view map. For the construction of detailed iso-time zones and for more detailed analysis of individual employment centers, additional maps covering smaller areas will also be required.

2. For each center of commercial or industrial employment, construct a separate and large-scale base map showing the center of employment and the surrounding area. (The extent of this
area which should be included will depend, of course, on the maximum length of journey-to-work time for which an analysis is to be made and upon the form of transportation.) On these maps, the following data should be recorded:

a. The location of major routes of transportation leading to the employment center differentiated according to mode, speed and capacity.

b. Along each line of transportation, lay off the distance which can be traversed within a given interval of time (under normal conditions). The choice of the time interval will depend upon the nature of the community. In our illustrations we have arbitrarily chosen a fifteen-minute interval.

c. Taking each mode of transportation separately, connect all points of a designated time interval. Then, adjust the pattern to these lines to take into account the time required for persons residing in the interstitial areas between the spokes of transportation lines to reach these lines. This will result in roughly a star-shaped or webbed-fingered pattern, more pronounced in the bus and street car iso-times and less sharply in the case of automobile iso-times.

d. Where walking to work constitutes a significant pattern in the community, roughly circular concentric iso-times should also be constructed. Topography will play a more important role in determining the shape of walking iso-times than in the iso-times of other modes of transportation.

For ease in presentation and for clarity in analysis, it may be desirable to record these zones on acetate overlays so that they can be combined and re-combined as required. For example, for one purpose, it may be necessary to compare and relate the 15, 30, 45 and 60-minute iso-times for bus transportation on one map. The solution to another problem may require the combination of fifteen-minute iso-times for all means of transportation. Overlays will permit flexibility in the handling of these problems.

These, then, are the basic maps and diagram techniques for analyzing journey-to-work patterns. Illustrations of several of these constructs are shown below. In what ways can these maps be used?
FIGURE 1 - 15 and 30-minute ISO-TIMES for Buses and Walking.

- Bus-line
- Walking Iso-time
- Bus Iso-time


4-lane highway @ 24 mi/hr.
8-lane highway @ 36 mi/hr.
Congested traffic street @ 10 mi/hr.
Average city street @ 20 mi/hr.
Automobile Iso-time

Scale \( \frac{1}{2} \) equals one mile.

FIGURE 3. - SHOWING THE RESIDENTIAL AREA WHICH WOULD BE BROUGHT WITHIN THE 30-MINUTE ISO-TIME ZONE IF TWO NEW BUS ROUTES WERE ADDED TO AREA.

Area of high female occupancy
Area of high male occupancy

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THE USES OF BASE MAPS AND ISO-TIME DIAGRAMS

One of the uses of these maps will be as a graphic summary of descriptive data. The places of residence of workers in particular employment centers can be plotted on the base maps (by data obtained through employee interviewing or plant records) and distinguished according to the means of transportation used by the employee. (Red dots might be used to identify the residences of workers driving automobiles to work; green dots for workers using buses to travel to work, etc.) This will give us the distribution (geographically) of all employees of an employment center. This spot map can be used in conjunction with the iso-time maps for the employment center to reveal the journey-to-work patterns. Not only can this summarize the journey-to-work patterns, but it can also reveal any major discrepancies between the "cost to workers" of various types of their journey to work. These discrepancies will then require more careful analysis.

A second use of these maps will be in estimating the labor market potential for any new industry. This may be done in the following manner: The new industrial location should be plotted on the base map and the transportation routes leading to it properly designated. By constructing iso-time zones and by analyzing the characteristics of the labor force residing within these zones, we can estimate the potential labor force available for each journey-to-work "price" level. We can refine this even further. If, for example, we know that the industry will employ low-income persons whose skill (and car ownership) is low and will pay fairly low wages, we can concentrate our analysis of the labor force potential on the time-zones of walking, bus and street-car transportation, and eliminate the train and automobile zones. Also, on the basis of what we already know about the journey-to-work patterns of unskilled and low-waged workers (white), we can concentrate our analysis on the fifteen and thirty-minute iso-times, since it is unlikely that they will be willing to travel longer, as a general rule.

Obviously, the more accurate our knowledge of how much people are willing to sacrifice in time, the better will be our analysis and our predictions. The interview techniques to be described below are oriented toward such knowledge.

Let us take for illustrative purposes a hypothetical example. Let us assume that we already have adequate knowledge about the journey-to-work patterns of workers of various characteristics. Let us assume, say, that young white semi-skilled factory workers will not generally accept a journey-to-work "cost" of more than three-quarters of an hour; young white unskilled workers (because of perhaps a greater competition for employment) are willing to travel up to an hour to work; and non-white semi-skilled factory workers (due to restrictions in the employment market) customarily pay a "price" of up to one and one-half hours' travel time. An industrial firm which will require large numbers of semi-skilled workers plans to build its plant in a particular location.
By analyzing the occupations, racial and skill characteristics of workers residing in the iso-time zones surrounding the proposed plant location, and comparing these with the plant's labor requirements, an estimate can be made of the potential labor pool within the "significant" time zones. Thus, the number of young white semi-skilled workers residing within forty-five minutes of the plant, and of young non-white semi-skilled workers within ninety minutes of the plant would be studied. If a sufficiently large labor pool does not exist within these zones from which the plant can draw, the firm may have to draw workers from beyond these areas by the offer of higher wages. Moreover, the city may be required to provide additional transportation facilities, or to extend its transit lines to accommodate the workers drawn from greater distances. Although firms do not often consider these factors when deciding on a plant location, it might be in the best interests of both the firm and the city to reconsider the plant location in the light of the journey-to-work patterns.

Still another use of the base maps and diagrams will be in determining the labor force which will be drawn into the potential labor market of a commercial or industrial area by the extension or improvement of an existing line of transportation or the construction of a new route. A priori, some effects will be predicted. The effect of any increase in speed of travel along an existing line of transportation will be an elongation of the time zones along the line of transportation. The effect of any new transportation route will be a change in the shape of the time zone. In both cases, a greater area will be included within each time zone. The area added should be analyzed with reference to the characteristics of the labor force living there.

This can serve as a basis for policy decision in the following manner: Suppose we are faced with a shortage of labor in a particular area of the city. Suppose further that this labor must be of a rather highly-skilled variety of light factory work. The lightness of the work and the manual dexterity required means that women are best suited for such employment. Suppose further that we plan to extend a transportation line in a particular direction. Drawing an iso-time along this projected transportation system circumscribes an area which previously did not fall within the labor market area of this plant. Taking the area so circumscribed, we can study the characteristics of the population within it. If the area contains large numbers of unmarried and transient males, the extension of the transportation line in this direction will obviously not solve the labor shortage for women workers in the particular plant. Extending the transportation line in another direction may very well solve the problem. In any case, we will have had some basis for making the decision.

Figure 3 illustrates this analysis.

These are but a few of the possible uses of these maps. Others will undoubtedly be found as the research progresses.
The accuracy of the above analyses, as stated before, will depend upon the extent of our knowledge of the relationship between labor force and employment characteristics and the behavior patterns of the journey to work. With a knowledge of this relationship, our predictions can serve as foundations for policy decisions. Without such knowledge they are only tentative speculations. The data from which a knowledge of these relationships can be obtained will come primarily from interviews with employees.

THE DESIGN AND USE OF THE INTERVIEW SCHEDULES

To make any predictions as to future transportation requirements or the availability of labor for employment centers, etc., the use of the iso-time analysis method must be combined with a knowledge of the factors which are associated with particular journey-to-work patterns and the "acceptance" of particular journey-to-work "costs." We hypothesize two types of factors which are associated with these patterns and costs. The first is the characteristics of the employment firm and the second is the characteristics of the worker. These are obviously interrelated and overlapping. If we can find high correlations and degrees of association between specific characteristics and specific journey-to-work patterns and time-costs, then given any change in the characteristics of the labor force or the characteristics of the employment base, a prediction can be made of the probable journey-to-work patterns which will result.

The characteristics of the employment firm (such as location, size of plant, type of industry, wage level, etc.) as they relate to the journey-to-work patterns of employees has been studied quite extensively, although not conclusively. The studies of the Indiana Employment Security Division and of J. Douglas Carroll, Jr., among others, attempt to correlate these variables with the dimensions of the journey to work.

The relation between the personal characteristics of workers and their journey-to-work patterns has also received considerable attention, but of an even less conclusive nature. Rough correlations have been found between the journey-to-work pattern and the age, income, sex, race or ethnic group, marital status, family composition, occupation, etc. of the worker. We would expect such correlations since these characteristics are related both to the housing and employment opportunities open to an individual and to his values concerning the journey-to-work "price."

There is a great need for increased knowledge and refinement of these correlations, if they are to be useful for prediction. We must study the present behavior patterns (time taken to get to work, method of travel, etc.) of workers of all kinds, and, on the basis of our hypotheses, test the statistical significance of correlations between these patterns and the personal characteristics of workers and the characteristics of employment firms. Data for these statistical computations can be collected from employees in the community according to the following suggested schedule:

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FACTUAL QUESTIONNAIRE SCHEDULE

1. Name of Place of Employment
2. Address of Place of Employment
3. Home Address of Respondent
4. Job Classification and Description

(This should be given in detail. The purpose of this question is to permit a distinction to be made between "undifferentiated" and "differentiated" job skills and capacities. The assumption is that where a skill is undifferentiated, i.e., is general, and therefore can be used in a great number of types of jobs and in a number of places of employment, the worker is more job-mobile than where the demand for his skill is restricted to only a few places of employment in the community. For example, a worker with the skill of a janitor can find employment in practically all industrial, commercial, and even residential establishments. He is, therefore, able to change jobs readily than is a highly-skilled steel fabricator located in a community where there are only three steel fabrication plants with established locations.)

5. Present wage
6. Age
7. Sex
8. Race
9. Marital Status
10. No. of Children Under 18
11. Place of Birth
12. If foreign, how long in the United States?

13. Are there any other members of your family residing with you who are employed? If so, where do they work? (State their relationship to you)

14. How do you usually travel to work? Walk Street Car
Bus Train Automobile Other
When you are unable to use this means of transportation (for example, in an emergency), how do you, or can you, get to work?

15. Using your usual means of transportation, and on an average day, when do you leave your house for work?
When you arrive at work?
What is the actual time spent in traveling?
What time do you leave work?
What time do you arrive home?
What is the actual time spent in traveling?

Factual Data to be Filled in by the Employer

1. Total number of employees
   a. Women
   b. Men
2. Average wage scale
3. Labor turnover rate (average for year)
4. Product manufactured or industry classification
This will give us both a picture of what workers of various kinds are presently paying for their journey to work and an insight into some of the important variables affecting journey-to-work decisions. A study of present patterns will not be sufficient, however. We must also understand the attitudes which underlie worker-decisions to change their place of residence, to change their jobs, or to accept a given journey-to-work "sacrifice." This insight can be gained from a study of the past history of workers, concentrating on situations in which decisions of this sort were made. In addition, interviews with workers designed to probe into their attitudes toward their present journey to work can also provide us with such insights.

Whereas the factual interview schedule can be distributed to workers and filled out by them, this will not be possible with the attitude questionnaire. Workers will have to be interviewed in person, and the interviewers must be relatively skilled at encouraging the respondent to give more than superficial answers to the questions contained in the following suggested interview schedule.

**RESIDENCE-WORK HISTORY AND ATTITUDE SCHEDULE**

1. How long have you been at your present job?
2. (If less than five years) Can you give me the locations of the jobs you have held in the last five years and the approximate dates of termination?

3. Why did you change jobs? (probe for as many reasons as possible, and estimate their relative importance to respondent)

4. Have you moved in the last five years?
5. (If yes) Can you give me the addresses of the residences lived in in the past five years and the approximate date you moved from each place?

6. Why did you move?
7. How long does it take you now to reach your job from home?
8. In the past five years, were there times when getting to work took a longer or a shorter amount of time? Could you tell me more about that?

(Find out whether due to changes in distance, mode of travel, transportation system changes, etc.)

9. When you changed jobs or moved in the past, did you consider the time you would have to spend in traveling to work? Did it influence where you moved or what job you took, or were there other considerations which seemed more important to you? Explain (if it influenced, in what way?)

10. Do you think you spend too much time in getting to work now?
11. What do you think is a "reasonable" amount of time to spend in getting to work?

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12. Now I know this is a difficult question to answer, but, if you were offered a job which paid more than your present one, but which would take you one-half hour more to reach than the one you have now, do you think you would take it? Why? What things would you consider before deciding whether to take it or not? (probe)

13. Have you ever been faced with making that kind of decision before? What did you do?

14. How do you usually get to work now?

15. Before, when you worked at a different location or lived elsewhere, did you use the same kind of transportation? (If no) How did you get to work then?

16. What do you like or dislike about your present form of transportation to work?

17. (If public transit is used) Did the schedule or route of the (insert form of mass transportation used) influence either your choice of job or residence? (If yes), In what way?

Factual information to be filled in by interviewer or from Factual Interview Schedule if such has already been filled out.

Age  Occupation  Income
Sex  Marital Status  Car Ownership
Race  No. Children  No. persons in
      Under 18  family working