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POST-AUTOMOBILE TRANSPORT

The automobile has surely been one of the most successful technological developments of all time -- and one of the most consequential. In those nations where advanced industrialization has combined with high per capita incomes and with rapid pace of city building, the automobile is becoming the dominant mode of urban transportation and then a dominant force of social change. These conditions obtain most apparently in the United States, Canada, and Australia. But the patterns so firmly established there are now becoming manifest in the nations of Western Europe and in Japan. The combination of circumstances that nurtured the automobile in North America is now being replicated in each of these countries too.

One is compelled to ask whether the history of the automobile and the parallel history of its consequences in North America is likely soon to be repeated in Europe and then in the Third World. If so, and if there really is a compelling natural history at work, we might well learn from American experience, gaining a preview of possible future histories here. In turn, if the forecasted history is not the desired one, corrective action taken early might forestall the occurrence of the unwanted outcomes. Let me therefore, as a case study, recount some of the consequences following from mass use of automobiles in North America, and more specifically in the United States.

It is by no means clear what motivates individuals to buy and use automobiles -- during the early years of a nation's auto era, that is. (As I shall argue later, once many persons get them, the others no longer have the option but to follow along.) The motivation researchers have suggested that the deep seated and profound psychic causes are the real generators of market demand; and, for all I know, that may be true. I have no insights to add to theirs in these respects. I do find the universality of those motivations surprising, however. Given the wide cultural differences among the nationals of the various continents, from Tokyo and Bangkok to Caracas, to Nairobi, I find it amazing that virtually all homo sapiens should so eagerly seek personalized and motorized wheels beneath them. There can have been no genetic selectivity for that trait, I don't suppose, although the universally observed hunger for personal freedom and for ease of movement may have been generated back during the origination of the species; for these are traits that contribute to success and survival. I leave to others the question of original cause -- whether original virtue or original sin, as you wish. It is sufficient to my present concern to record only the behavioral manifestations. Once human beings taste automobility, they seem determined to acquire at least one car per family -- then one car per person -- and then to use them as a virtual extension of their selves. The U.S. is already half way there; with a car for every two persons, there are already enough cars for the entire population to ride in front seats at the same time. (The entire population of the U.S.S.R. could simultaneously ride in the back seats.) And there is already enough highway space to accommodate cars for all these people simultaneously.

The intrinsic virtues of the automobile over competitor transportation systems are apparent. The auto provides door-to-door service, with no waiting, with no transferring, with flexible routing -- and all with comfort, privacy, and an accepted degree of safety. Persons whose travel habits are spatially or temporally erratic find them superior to fixed-route, mass transit systems. Others who place high value on privacy seem to also.

So long as the numbers who elect the auto alternative comprise small minorities, traffic congestion levels remain low and mass transit services remain as viable alternatives. During the early stages of automobile use, it retains its initial character as essentially a transportation mode. Under conditions of mass use, however, its character changes dramatically. Rather than a mere transport mode that makes for transportation problems, as is so commonly supposed, it becomes a shaper of societies, of cities, and of the people who comprise them. Once integrated into modern society, once engaged into the interactive processes by which institutions and technologies mutually shape each other, the societal outcomes of auto use become the dominant ones. In turn, as I shall suggest in a moment, among the most consequential of its effects are the distributional ones -- making questions of equity and equality among the important political issues for transportation policy makers in both the developed nations and the less developed ones alike.

The meaning of the automobile in America's past 70 years is fairly apparent in some of these respects. After the First World War the number of motor cars increased dramatically, and

with them came a new degree of locational freedom for those families whose incomes permitted both auto ownership and home ownership. An unprecedented suburban expansion followed during the 1920's, but it was too small a sample of the impending new city structure and the incipient life style to have been detected by more than a few observers. The city's real explosion came after the Second World War, of course; and the surprising thing is that it too came as something of a surprise, even to the astute. It is still moving at full throttle, redistributing factories, offices, shops, and houses far into the countryside surrounding the old cities, and, more dramatic still, into the distant new cities and new metropolitan areas thousands of miles from the northeastern urban centers.

A great many forces have been propelling the suburbanization of old cities and the construction of new ones, of course. It was not the automobile alone that energized the move to new patterns. The revolution in agricultural productivity, governmental tax and lending incentives to home ownership and to construction of new industrial buildings, the changes in industrial processes that called for increased land areas, the universality of telephonic communications that erased the frictions of space for much message sending, the rise of the information-based industries that freed them -- the most rapid growing sector of the economy -- from natural resources sites and permitted virtually unrestricted locational freedom, and many other events combined to make rich and productive life quite possible at locations far removed from the traditional industrial urban centers.

The extensive suburbanization in turn contributed to long chains of organizational and behavioral consequences that have fundamentally modified values and belief systems, living patterns, family relations, local government and political behavior, sexual practice, friendship patterns, industry structures, retail distribution systems, intracorporate structure, recreational activities, religious practices and more.

It is probably impossible to discover the precise roles the automobile has played in this scenario. There are seldom, if ever, simple, one-to-one causal relations between any technological development and its social context. Rather than a straightforward reaction to a new technology, the relations are interactional, such that the technology and the society mutually shape each other through time. In intricate and complex ways, changes in the society affect changes made in the use of the new technology; in turn, the technological applications modify the social processes that affect subsequent uses; and so on.

That may be one of the more important observations we might make about the relations between the auto and society. Mass use of motor cars is in some large degree a consequence of the changes in the society that have occurred in some part because of the automobile. If that sounds like circular reasoning, it is only because the several changes we are looking at were indeed caused by each other. The effect is rather like that of the loudspeaker in an electronic public address system which can feed its own sound into its own microphone, thus forming a positive feedback

loop through which it progressively amplifies its own output. We have all heard the high pitched screech of an overloaded public address system, and most of us are conditioned to leap to turn down the volume control. But my point is more subtle and more important than the observation of mutual reinforcement, and I don't mean to suggest there is a handy knob that can turn off a society-technology interplay, especially not where the automobile is involved. My observation is, rather, that once integrated into modern society, the auto becomes an inseparable attribute of the society. It then becomes meaningless to speak of it as somehow an appendage or even as having an identity of its own. It certainly becomes difficult to speak of the impact of the auto on society, for they have by now become aspects of each other. The invention of money is another of those technological integrals -- can you conceive of a modern society from which money has been removed? Probably not, for these are commercial trading societies which are intrinsically monetized. For good or evil, they are also automobilized. I mean to say, I find it impossible to speak of transport planning or transport regulation as though transport systems could be changed while social history remained unaffected.

Those families that have moved to single unit, free standing houses in suburban locations were able to do so only because their relatively high incomes permitted them to pay the high costs of the associated package of consumer goods. Low density is the counterpart of the single family dwelling, and low density is equivalent to increased distances between buildings, hence between interacting

persons. Interpersonal, face-to-face contact in those settings typically requires an auto trip. Grocery shopping can no longer be readily accomplished on foot; thus the automobile becomes an integral instrument of food marketing. The auto's large parcel carrying capacity fosters the purchase of enlarged food-storage capacity, so that the daily trip to the grocer is replaced by the weekly trip, thus changing housewives' daily lives in pretty important ways. The food refrigerator and the food freezer thus become normal accoutrements of the normal household, and the demise of the family grocery store and the rise of the giant chain store and the giant auto-based shopping center follow in turn. In parallel, increased distances and increased incomes encourage purchase of the large array of household equipment that the modern household now demands. Each of these additional pieces of machinery requires additional floor space which calls for larger houses, which induces lower ground density, which further increases distances, which calls for more auto use by more members of the family in another positive feedback cycle.

Families spread over large areas acquire somewhat different familial arrangements from those who remain close to each other. It would be hard to discover whether the decline of the extended family in America was in any considerable degree the direct result of spatial disengagement of kinfolk. But it is clear nonetheless that the extended family of grandparents, uncles, cousins, etc. did give way to the nuclear form (of parents and their children) at the time of rising automobile use and of the several related, concomitant urban and social changes that came along with the motor car.

It would be equally difficult to demonstrate the specific relations of the motor car to the modern life -- to recreational patterns, political and voting behavior, and the range of other characteristic shifts that came with automobility. It is probably true that in none of these changes was the automobile a sufficient cause. But in many it was nevertheless a necessary contributing cause of these outcomes, because both low density suburban development and high geographic mobility would not have been possible with mass transit types of urban transportation systems. The high standard of living that marks the working class and middle class suburbs is characterized by and dependent upon the freedom of movement and the large number of optional destinations that private transportation permits. In a society of free people, that standard of living and that mobility are not likely to be given up. Where citizens have voices, they do use them to improve their life opportunities -- as they perceive those opportunities.

We have become well aware of the high costs that this style of living and this style of travel entail. Not only is the private cost of automobile travel high, but the social costs are now cumulating to such extraordinary levels as to command the attention of governments everywhere and to provoke political movements in opposition to the automobile. Large volumes of automobiles used in large concentrations produce large external costs that fall upon large numbers of nonusers. We have become well aware of these, and some work is underway seeking corrective measures.

Less visible, less discussed, and far more important, I believe, are the effects that fall upon those who are carless.

These are the same people who have been bearing the social costs generated by massive restructuring of metropolitan settlement patterns and by reconstruction of the metropolitan transportation systems. So long as relatively few persons used motor cars, the collective consequences were manageable. Now that mass use has made it the shaper of urbanization processes, a different set of problems has been thrown up.

The problem is not that the new great cities of America are in some fundamental sense deficient because they lack the high density centers that have been so productive in the great cities of Europe. High concentrations of resident populations and business establishments were merely expressions of pre-automobile transportation technologies rather than of some fundamental imperative of civilization. The new cities that lack such centers are not less productive, creative, or "cultured" than the traditional ones. For their own time, I suspect they are equally "civilized." The new dispersed metropolitan settlements, of which Los Angeles is probably the clearest example, permit comparably rich opportunities for their residents; they are fantastically successful commercially and industrially (especially in the new knowledge-based industries); and they prosper in the arts and high culture in ways that recall the glories of old Florence and Paris. The test of their success is, obviously, their attractiveness to migrant families and business firms which move there from traditional cities.

The problems are not that they are bland, inconvenient, unpretty or nontraditional -- as is so commonly said. It's not

even that they suffer from traffic congestion. In fact, they have far less congestion than traditional cities. (Moreover, congestion is typically a sign that the transportation system is working well, permitting people to move wherever they wish to go. The reason traffic piles up is that people can travel in their private cars.)

I suggest, rather, that a central problem of the new style automobile city and of the automobile suburb is that the quality of accessibility furnished by the automobile is not available to everyone. One response to that problem, it follows, is to reverse that condition and effectively to make each person the equivalent of a motorist, with equivalent mobility and locational freedom to that enjoyed by the persons who have discretionary use of motor cars.

* * *

You are all familiar with the common history of public transit services when they have faced competition from private automobiles, and I need not recount the classical cycle by which fares and service are progressively reduced in another of those positive feedback amplifications. One direct and apparent consequence has been to reduce the mobility of those who do not have ready access to a car of their own. The rise of the automobile transportation system has unquestionably worked to the positive disadvantage of carless persons. They are much worse off because persons with cars are better off. (Some of you will recognize that as a negative Pareto optimum.) With the decline of public transit service, their mobility has been directly restricted. With the

expansion of suburbs and the relocation of a great many employment opportunities to outlying places that can be reached effectively only by private cars, they are further disadvantaged by declining earning capability. The reduction in life opportunities that the automobile has wrought for those who are too poor to own a car and whose residence is limited to the centers of the old cities is, I shall contend, the central problem of the automobile in the American setting.

Those who are poor, undereducated, under-skilled, and also members of a minority underclass are finding that their social mobility is being restricted, at least in part, because their geographic mobility is restricted. Despite the high rates of automobile use in America, well over half of the families with incomes below the officially designated poverty line do not own cars. I am suggesting that a significant contribution to the conditions of poverty in the midst of great wealth is that automobility has been so unequally distributed.

But of course it is not only the poor who have been so deprived. The automobile's great benefits have fallen selectively upon a comparatively small sector of the population -- those who are middle aged, middle income and middle class, or now also working age, with a work income and working class. The young, the old, and the infirm, like the poor, have suffered the reductions in mobility resulting from the decline of mass transit service and from the spatial dispersion of the new metropolitan settlement pattern. Children who are isolated in a suburban residential district have far fewer opportunities for nonformal education than

do those living in highly concentrated cities with good public transit service. Old persons who have lost their driving skills are similarly handicapped. And, of course, those who suffer physical handicaps from illness or accident are comparably deprived from the loss of public transit service and from the spatial dispersion.

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The common response to this set of problems has been to call for a return to the old city form, for a reconstruction of mass transit services, and for restrictions of movement, especially movement by cars. In the metropolitan area where I live we have just spent \$1.4 billion to build a new rapid transit system and additional sums to build new bus and ferry systems. It is still too early to know whether these will significantly improve accessibility for the four groups I mention -- the poor, the young, the old, and the infirm -- not to speak of the suburban housewives who are isolated when their husbands take the family cars to work. I say it is too early only because the new rapid transit system is not yet fully operational. A group of us at Berkeley have initiated a long term study to measure its effects for the several groups I've mentioned here and, of course, the middle majority groups who now use automobiles. My reserved and private guess is that the present auto users will not abandon their cars in large numbers, and that those who do will be replaced by others who will choose to use the vacated highway space. (You know there is a combination of John Say's Law and Parkinson's Law at

work in this field. It seems that newly supplied highway space creates its own demand, and that cars fill whatever highway space is available to hold them.) I think it is unlikely that traffic volumes on roads will be significantly cut by the rapid transit service.

On the other hand, if the transit system should succeed in attracting present suburban motorists, thus freeing up highway space and permitting higher speeds on the highways, commuters will then be able to live still farther out in the suburbs. The rapid transit system may induce still further dispersion of the metropolitan settlement by freeing up motor car travel.

On both these counts, then, it seems unlikely that automobile use will be reduced, hence that the automobile-generated effects will be eliminated. Auto travel could actually be increased by the BART system by increasing options for travel and thus fostering more movement. However, it may turn out that neither future automobile use nor future urban development in the San Francisco metropolitan region will be significantly affected on the metropolitan outskirts by the rapid transit and other transit systems being installed. (We must wait a few years to find which if any of these propositions proves true or not, however.)

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The major objective for the rail rapid transit system in the San Francisco Bay Area was to promote centering of employment and cultural activities in places like central business districts.

Centers of cities were understood to be centers of civilization. The causal inference was that civilization depends on a high density configuration. But that large inference may not be tenable.

Degrees of connectivity depend on the transportation and communications systems extant at any specific time in history. When men relied on walking, face-to-face talking, and postal services, cities were also small and compact. The walking mode set a two-mile radius for those who were within 30 minutes of each other. The horse drawn omnibus raised it to three or four miles. The electric streetcar spread it to five or six miles. The auto and freeway system makes off-peak trips of 50 miles feasible within an hour. And, of course, when the auto and freeway system are supplemented by the telephone and other communications substitutes for travel, for a great many people and organizations CBD types of location are neither necessary nor desired.

It is no longer apparent that high density or agglomeration contributes to civilization. It now seems likely that the societal systems -- economies, societies and politics -- are becoming independent of geographics; that civilization, the culture of the civitas, is no longer reliant upon cities.

But that may still be an open question. It is paralleled by another open question. In the San Francisco Bay Area it is by no means clear whether the expected effects of BART will happen -- whether it will induce centering. This is the first time a rapid transit system has been built alongside a full freeway system in an area with high auto ownership and fully established auto-using

habits. It must be treated as an experiment. We want to see whether rail systems still have the locational effects at the end of the 20th century that they had at the end of the last century.

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Another response to the unanticipated and undesired effects of automobile use has been some sorts of restrictive measures aimed at compelling users into mass transit. Road pricing schemes, postponement of road improvement projects, free or reduced transit fares, bans on new parking structures and high parking fees, car-free central districts, and other negative constraints are commonly proposed. The political traditions of some nations are compatible with constraints of these types. But it may be that the political traditions of America, as compared with nations having strong traditions of governmental regulation, will -- when combined with the popular preference for the motor car -- make these styles of governance less acceptable there than elsewhere. In any case, I suggest that the approaches that are most likely to find popular acceptance while simultaneously best satisfying the ethical criteria of a free society, would be those that expand individual freedom of choice -- which enlarge movement options -- rather than those that constrict options.

Especially in the urban policy fields, where so little is understood about the forces shaping growth and about the criteria that might equitably guide future development, it would seem prudent to permit more nearly equal distribution of the benefits and permit

open experimentation with new styles of living. In the absence of demonstrated theory that can explain cause-effect relations and that might permit forecasting of probable outcomes resulting from one public policy over another, it would seem wise to maintain an adaptive posture, rather than a rigid or traditional one.

That strategy may be particularly appropriate to the newer middle-to-large metropolitan areas, where suburbanization, spatial diffusion, and lowering densities have so rearranged origins and destinations as to make mass transit service difficult or impossible. It may already be too late to install large-capacity transit vehicles in the 20th century metropolitan areas of the United States.

Where origins and destinations are particularistic -- i.e., where individuals or small numbers start and end trips at physically separated places -- the geometric characteristics need to approach those of telephones rather than those of airports. Telephones work so well because they employ the principle of random access, i.e., any particular location can be connected directly to any other particular location. That's also the special character of automobiles -- with one big difference. Telephone lines themselves take little space, so phones are compatible with high density concentrations. Autos are not. The response to that deficiency has been to move away from the high density concentration. For some classes of business, that seems to have been satisfactory. Many have selected the option of small vehicle random access over close spatial proximity.

I said at the outset that questions of equity are among the most pressing ones for transportation policy makers. I then observed that the great benefits of the automobile have fallen unevenly upon the populations of America, some realizing spectacular benefits while others have been positively hurt by it. It would seem to follow then that the problem is to find ways of making the benefits of the automobile available to those who have so far been denied them. The ideal way would be so to arrange things that everyone could have discretionary use of an automobile equivalent -- wives, children, old persons, poor persons, handicapped persons. If the problem of handling large numbers of vehicles could be dealt with, and if the problems of deficient driving skills could be countered, the personal freedom and the life opportunities that middle majority persons enjoy could be had by those who have until now been positively hurt by the rise of the automobile system.

Rather than putting our energies into inventing even more forceful constraints on freedom to move, rather than finding ways of banning or curbing the car, it appears to me that proper strategy should be to invent a car that can be driven by anybody. A system like that would probably be a variant of the dual-mode and personal transit systems under investigation in several countries now.

The trouble is that the auto transportation system comprises three subsystems, and we have not focussed equally upon all three. Much attention has been devoted to the vehicle subsystem

by the auto industry. Public grants have supported the study and development of the road subsystem. But we have yet to deal with deficiencies in the driver subsystem. Elevators can be operated by anyone, but not automobiles. The current concern with equity and social justice is redirecting our attention to the technological problem of building a metropolitan transportation system that does not require driver skills for those sectors of the population that cannot acquire those skills.

If installed at fine enough geographic density, a dual mode/PRT system could provide a degree of accessibility and free movement comparable to that of the present motor car. If automatic guidance were installed, no driving skills would be required so long as it operated upon its guideways, thus permitting unskilled persons to "drive." If the network were sufficiently extensive, persons living in the city center would have access to places in the suburban reaches that are currently out of bounds for them now. Such a system would be a hybrid between privately owned auto, rented car, taxi, jitney, bus, and train, combining operating traits of each. In some senses, it would be a superior car.

There can be no doubt that a system of this sort would itself generate its own array of external, unanticipated consequences, just as the auto did. New city arrangements would certainly follow from the installation of a transportation system as space-erasing as an extensive dual mode person transit system would be. But that is a prospect that I would

urge us to risk -- rather: to seek. For although the new problems might themselves be difficult ones, we would at least have confronted the present ones in the right way. I mean to say, we would have confronted the transportation system as a subsystem within the larger societal system, and with an eye to improving the qualities of life, to expanding personal freedom, and with the effect of enhancing equity among the city's publics. In itself, that would seem to be the more effective way of attacking the automobile on its own grounds; for it is essentially an instrument of freedom. That's presumably why so many people choose them in the first place.

I am arguing that the way to deal with the problems the automobile has thrown at us is to outdo its virtues. If we could in effect make the equivalent of a motor car available to everyone, we shall then have carried the automobile revolution to its resolution.