71

Design Quarterly

MASS TRANSIT: PROBLEM AND PROMISE

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DESIGN QUARTERLY 71

MASS TRANSIT: PROBLEM AND PROMISE

By Patricia Conway George

Walker Art Center   Minneapolis, Minnesota

INTRODUCTION

This issue of DESIGN QUARTERLY concerns itself basically with available or theoretically possible ground transportation systems and presents various solutions to an immediate problem in interurban and intraurban transportation. Walker Art Center also organized an exhibition on the same subject, supported by a grant from the Graham Foundation for Advanced Studies in the Fine Arts. This exhibition will open at the Walker Art Center and then travel to participating museums in major cities throughout the United States.

Transportation problems are evident in all areas of our society. To the intercity traveler, the suburban commuter or the individual in one of our major airports, transportation has become a critical issue. But Mass Transit has different meanings for different groups of our society. To the affluent motorist Mass Transit problems are apparent only during rush hour, bumper-to-bumper traffic or when he is desperately searching for a parking place in a downtown area already crowded by buses, trucks and taxicabs. At the same time the executive traveling from city to city will frequently find that his airport-to-downtown trip equals his city-to-city flying time. To the ghetto dweller, Mass Transit or the absence of it becomes de facto discrimination, the result of a society that has fled to the suburbs and, in the process, taken the industries with it.

Transportation, the movement of people as well as goods, is such a highly complex problem that it urgently demands new ways of finding solutions. The influence of Mass Transit on our environment, the continuous urbanization of our society and the fact that it often takes more than decades to develop the comprehensive systems needed makes it even more important. Systems analysis, a new science that applies mathematical programming and computer simulation to the systematic study of all facets of a complex problem, is already being applied to the Northeast Corridor. It attempts to describe the area from Boston to Washington in its present and future form and to predict the consequences of actions and possible alternatives in order to furnish legislators and agencies with pertinent information and forecasts.

Of special concern to all travelers is the interconnection between the various modes of transportation, particularly the feeder and distribution systems with the major transit networks. With airports moving further from the cities and the suburbs growing into new cities, it is essential to develop an interlocking system of transit. But with all the space age technology available, it is surprising to see the development of mass transit in the rail categories only.

The acceptance of advanced systems is appreciably risky; consequently they are seldom considered by individuals making high level decisions. Although this is understandable, another fact in transit design is not: this is the metamorphosis from good conceptual design to conventional products. Usually explained in terms of high re-tooling cost, the results often take the form of high-speed trains looking as if they had been designed and produced in the 1930 s.

It is important that we take a new look at Mass Transit Planning. Instead of pouring billions of dollars into programs such as the SST, whose sole purpose is getting to Paris or Istanbul faster, we have to view Mass Transit as a right for every individual and subsidize it accordingly. Systems engineers, industrial designers, architects and urban planners should work together with the various agencies in order to produce aesthetic and highly efficient systems for Mass Transit, which combine the flexibility of the private automobile with increased speed and safety. P.S.

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y Patricia Conway George

f there is anything more talked about and less cted upon than the weather, it must be the risis in mass transportation. Despite the lamor of newspaper editorials and after-linner speakers, our traffic jams are getting vorse everyday.

Not that anyone expected the paltry $375 nillion made available through the Transporta-ion Act of 1964 to work miracles. It's just hat after four years of listening to the same ptimistic proposals, the same reports on et another study, and the same enthusiastic lescriptions of those marvelous subways n London, Paris and Moscow, many people are eginning to wonder if the long-heralded nillenium will ever arrive.

True, there has been some progress. Aontreal's Metro is a smashing success, prov-ng that it *can* be done. Boston's 70-year-old ransit system (the oldest in this country) s getting a bright, new look, demonstrating that here *is* hope, even for what has been described s "the most squalid public environment in he U.S.," the New York subway. And apologists or BART would have us believe that, in spite f financial difficulties, public disenchantment, olitical wrangling, and aesthetic compromise, an Francisco will soon be served by the nost comfortable, convenient, and attractive apid transit system in the world.

On the other hand, Cleveland has shattered pace-age illusions by coming forth with a ar for its new airport-to-downtown link that ooks as grim and uncommodious as any-hing General Grant ever had to contend with. kkeptics in the nation's capital hint privately hat Washington's much-touted subway nay never be built. Such an ignominious fate vould not be unprecedented in the history f American transit planning. In 1919, Cincinnati laid several miles of track for a ystem that was never completed and has since een abandoned. And just as some of our nore congested cities are turning to conven-ional rapid rail transit, advanced thinkers varn that the heyday of rapid rail has passed—hat the future belongs to such sophisticated oncepts as light-weight, bi-modal systems n which individual cars will lock into computer-ontrolled, electrically-powered guideways hat will speed people door-to-door.

For the ordinary citizen wary of local politics and unfamiliar with computer technology, the most disturbing aspect of the current up-roar over mass transportation is the "reality gap"—the seeming disparity between what he is being promised at election time and what he is likely, several years later, to be riding to work on every morning. The artist's rendering may be straight out of Buck Rogers, but the final design is too often neo-Civil War.

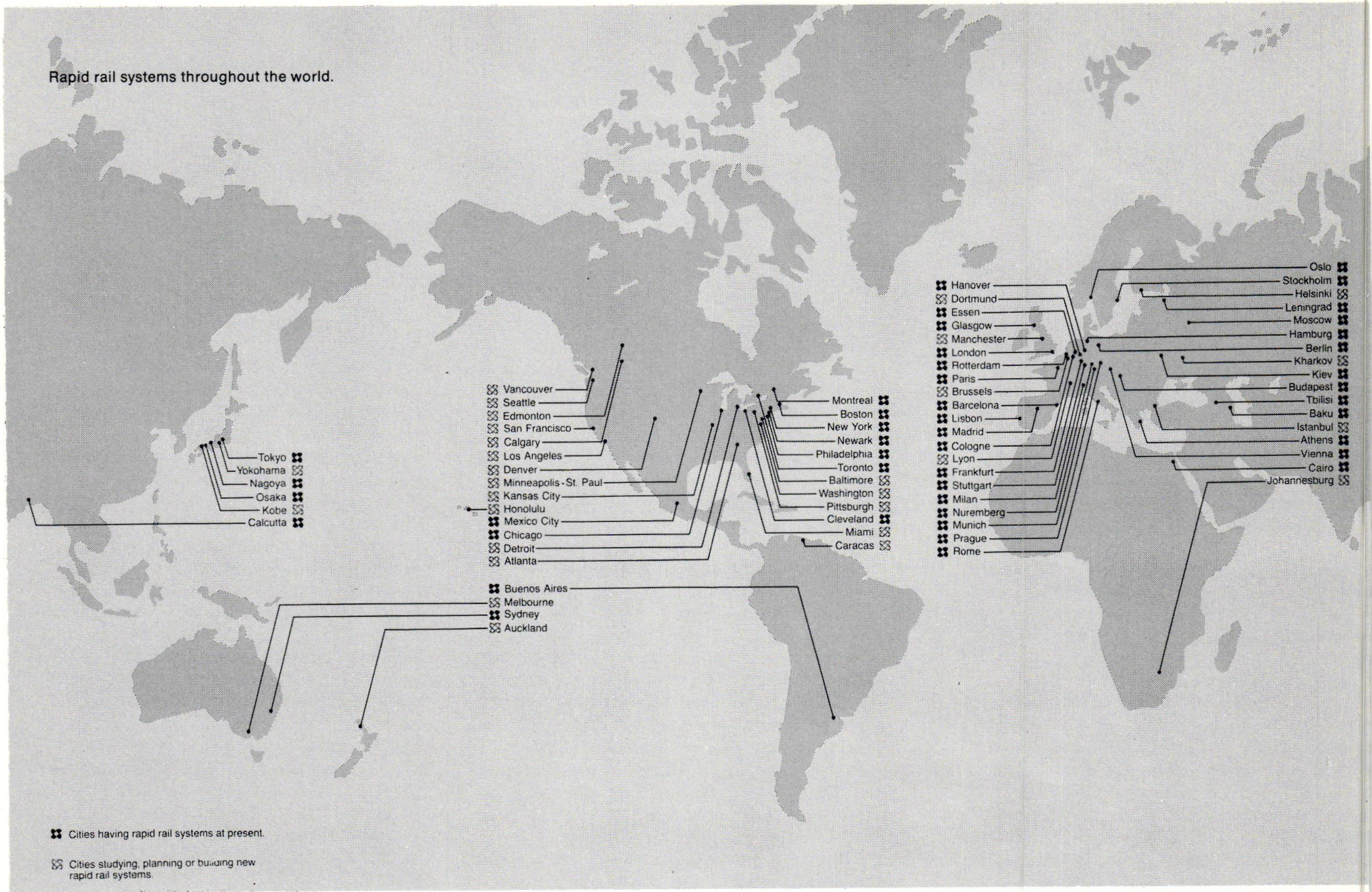
Although this country got off to a good start in railroading in the mid-1800's, the New York subway had hardly opened in 1904 when along came Ford's Model T. America fell in love with the private automobile, and New York was the last city in the United States to build a rapid transit system from scratch. In less affluent countries, highly developed rail systems provide almost the only means of interurban and intraurban transportation. Although rail service in Europe is now deterio-rating with the rise of the automobile there, the U.S. still lags behind many other countries in rail technology and passenger service. For example, there is no interurban rail service in this country to rival the speed and comfort of Italy's "Rapido" or Japan's "Tokaido" line. In fact, timetables from 1861 indicate that service on some of our interurban lines was faster then than it is today. Total depen-dency on the private automobile also explains why only 6 out of the world's 44 urban rail systems are located in American cities.

Since World War II, U.S. railroads have seen their share of the passenger market decline steadily. Unlike the buses and airlines which enjoy indirect subsidies, the railroads are taxed on their trackage and subject to full-crew regulations. In recent years, operating losses on passenger runs have discouraged capital improvements, a factor that has not only stimulated the trend to air and highway travel, but has also arrested the development of rapid rail technology. For the most part, the railroads have met the competition from air-lines, buses, and the private automobile negatively by cutting back schedules, reducing maintenance, and minimizing replacement. Since 1955, interurban service in this country has been curtailed by two-thirds, and there are now only 950 intercity runs still in opera-tion. Passenger service between Pittsburgh and Cleveland—major cities only 125 miles apart and located along what the Department of Transportation has identified as one of the busiest corridors in the United States—was terminated as recently as 1965. Only a few months ago, the famed Twentieth Century Limited from New York to Chicago was replaced by a slower train. And America's fastest train, the Afternoon Zephyr between Chicago and St. Paul, averages 67.4 mph and takes 20 minutes longer to make the run than did its predecessor a generation ago.

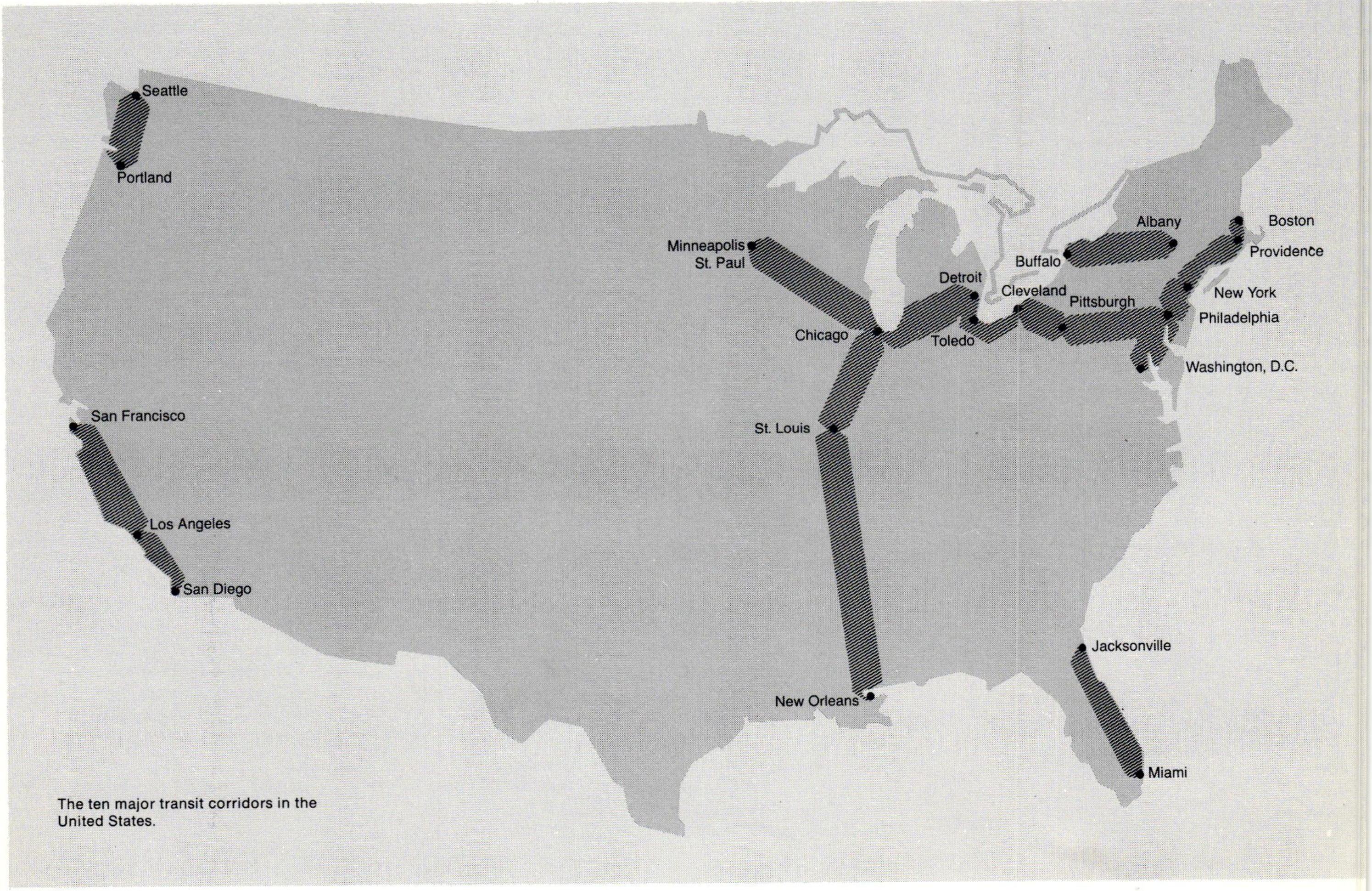
The fate of intraurban public transportation has not been any happier than that of the interurban rail system. During the late forties and early fifties, many trolley systems and transit companies in medium-size cities went out of business. Big-city transit systems have also languished. Plagued by operating deficits and dwindling patronage, they have been unable to update equipment or meet changing transportation needs. More than one-fourth of all transit cars presently serving intraurban lines in this country were built prior to World War II.

The decline of interurban rail systems and the stagnation of intraurban transit have seriously depressed the passenger car build-ing business. Except for deliveries of com-muter coaches, mail and express cars, and an occasional day coach, the builders have not made a substantial sale in years. Some 60 per cent of all passenger cars now in operation were delivered before 1930. Like the railroads, the car manufacturers have been reluctant to invest in capital improvements, and the basic design of passenger cars has remained virtually unchanged for at least half a century. Now that renewed interest in rapid rail transit offers the prospect of a boom in the industry, builders are digging into their bottom drawers for the blueprints of that last job. Slicked up a bit, these are the designs that the manufacturers and the rail-roads are foisting off as "modern" rapid transit.

The trouble with this kind of marketing is that, while design in rail transport has atro-phied, Detroit has been hard at work transforming the modest Tin Lizzie into a genuine plastic wood grain vinyl four-on-the-floor super eight overhead cam 380 horse-power magnesium hubcaps stereophonic automatic 36-months-to-pay status symbol. Similarly, the airlines have been wooing passengers with plush lounges, colorful planes, Rosenthal china, and free drinks—thereby creating an increased demand for luxury in public as well as private transportation. Americans may resent the fact that it takes longer to drive from home to the airport than to jet from one city to another; perhaps they *are* getting fed up with air pollution and traffic jams; they may even boggle at the thought of their country becoming one solid coast-to-coast parking lot. But it is not likely that, having been conditioned to a certain standard of comfort and convenience, they are about to abandon their private automobiles on the say-so of some expert who assures them that being squashed into a hot, dirty sub-way every morning is more efficient than riding to work in solitary, air conditioned



Rapid rail systems throughout the world.



The ten major transit corridors in the United States.

splendor. Nor are they about to fall for streamlined visions of pneumatic tubes when the newest thing in rapid transit looks suspiciously like a World War I troop train. Even such a modest venture as the high-speed Washington-to-New York demonstration, loses some of its appeal when passengers on the present run are treated to smelly cars, smeary windows, over-flowing toilets, and trash-strewn aisles.

Underlying both the failure of initiative in conventional rail transit and the dismal outlook for more sophisticated systems are some cold, hard economic facts. Since 1964, the federal government has been spending $117 million a year on intraurban mass transit. Prior to 1964, there were no funds at all. In 1965, a lump sum of $90 million was made available for the development of high-speed interurban ground transportation. These figures are something of a joke when compared to the $4.5 billion that the federal government spends on highway construction every year, or the $2.2 billion that the auto industry invests in annual model changes. They also total an appallingly small fraction of the actual cost of providing adequate mass transportation.

It is generally conceded that mass transit has to be a subsidized enterprise. The railroads cannot afford to overhaul their present facilities without government aid. Few cities are about to follow the energetic lead of San Francisco, which has voted nearly $1 billion in bond issues to finance the construction of a rapid transit system. Fare revenues seldom meet operating expenses, let alone provide for new and improved equipment or extended services. The timetable for the development of new systems will be determined largely by how much money the government is willing to invest in demonstration projects. Yet there are powerful interests aligned against the concept of subsidized mass transit, not the least of which are the automobile and highway lobbies.

In addition to some form of subsidy, mass transit planning calls for regional authorities. One of the reasons for the success of rapid transit in Europe is that the various local governments there do not enjoy the unassailable autonomy that they do in this country. Transportation planning in most American cities depends less on land use studies and traffic surveys than on the caprice of a handful of merchants and politicians in surrounding suburbs whose support the cities must have in order to finance a comprehensive system. Certainly everybody wants rapid transit—as long as it stops a block from the house (never *on* the block, you understand, because that might devaluate the property).

The fundamental inadequacy of our current mass transit program is further revealed by its failure to confront two of the most vital issues in transportation planning: the movement of goods, particularly within urban areas, and the interface between the various modes of transportation. Of the 17 new systems study contracts awarded by the Department of Housing and Urban Development, only one deals with the distribution of goods in urban areas.

While everybody is busy acquiring data, forest and farmland are disappearing under eight lanes of concrete at an alarming rate; more and more fine old buildings and lower income neighborhoods are being demolished to make way for parking lots and urban freeways; atmospheric pollution, much of it attributable to automobile exhausts, continues unabated; and more than 8 million new cars a year are being added to the 97 million already on the road. It is against this background of inadequate funding, uninspired marketing, political inertia, and public apathy that the present level of design and planning in mass transit must be evaluated.

With interurban travel now running more than 900 billion passenger miles annually and expected to double within the next 20 years, there is an urgent need to improve the transportation between cities. Automobiles account for 90 per cent of intercity travel, but their efficiency is severely limited. At 70 mph, one lane of highway can safely accommodate 1,200 cars per hour with minimum recommended clearances. Even if every car carries five passengers (which is more than double the average occupancy), this is a capacity of only 6,000 people per hour.

The airlines, which average 350 mph on short-haul runs, now account for slightly more than 8 per cent of intercity travel. But major air routes are becoming dangerously crowded, land for desperately needed new airports is difficult to find, and the ever-lengthening trip from airport to downtown sometimes more than doubles actual flying time. New ground systems, like automated highways, pneumatic tubes, or tracked air cushion vehicles, could not carry freight and would therefore be costly to operate. On the other hand, with proper signalling equipment and improved roadbeds, a single track of railroad could easily handle 45,000 people an hour at speeds up to 125 mph. More important, this level of efficiency could be achieved on existing rights of way using existing technology, and without the vast expense of building entirely new systems. For this reason, current efforts to improve intercity travel are being concentrated on high-speed rail service between major cities located within 500 miles of each other. (For distances greater than 500 miles, even high-speed rail is not competitive with jet service.)

Using the 1960 census, the Department of Transportation has identified ten major rail corridors in the United States. These include the well-known Northeast Corridor between Washington and Boston, the Keystone Corridor between Philadelphia and Cleveland, and the Midwest Corridor between Cleveland and Chicago. Within the next few months, two new high-speed trains will be demonstrated on the Northeast Corridor to determine the market for this kind of service. Public response to these demonstrations, which are being partially financed by Department of Transportation, may well determine the fate of high-speed rail transportation in this country.

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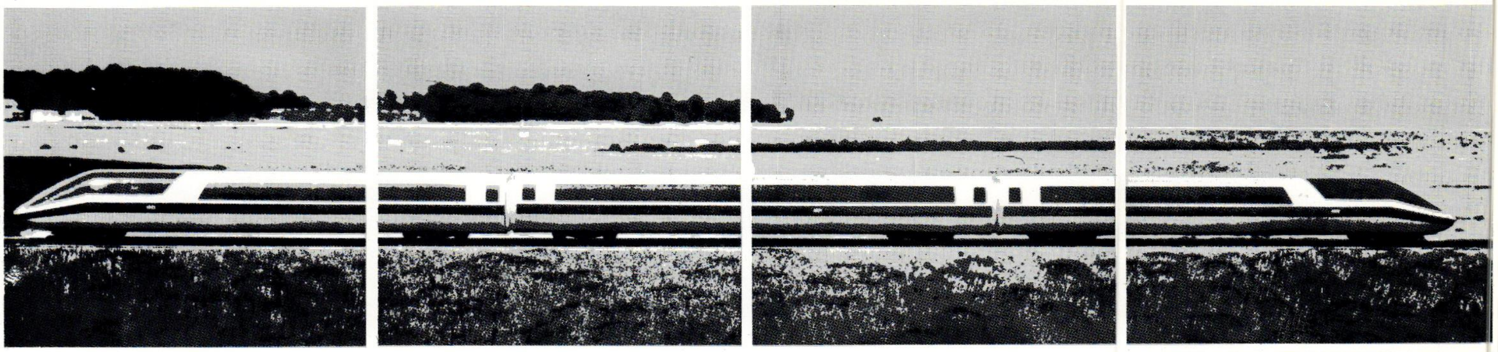

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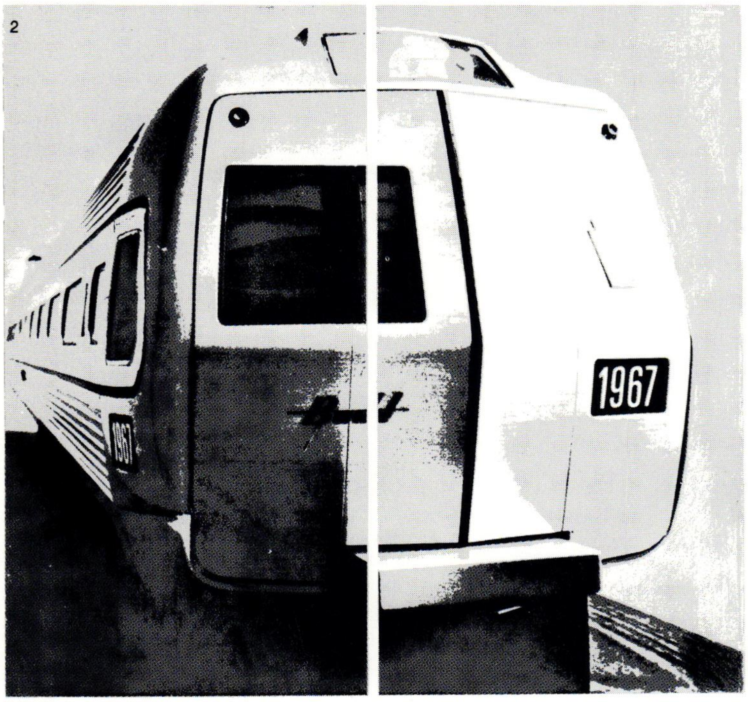

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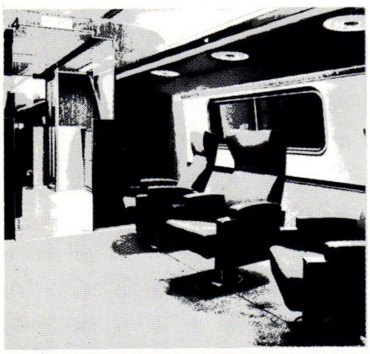

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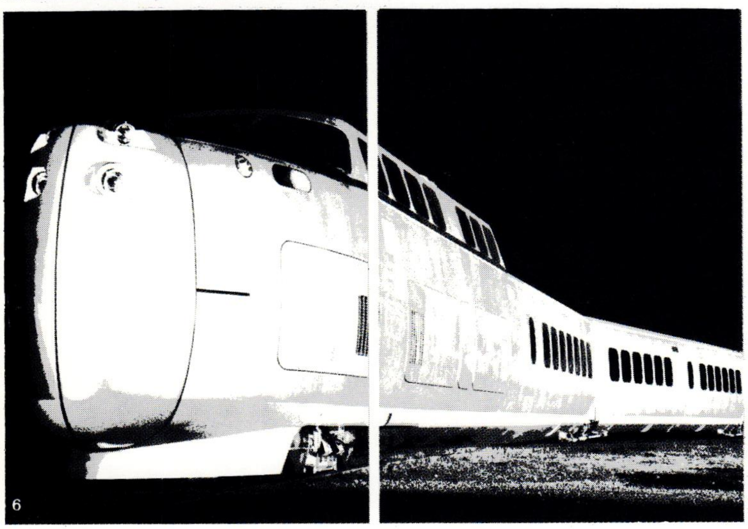

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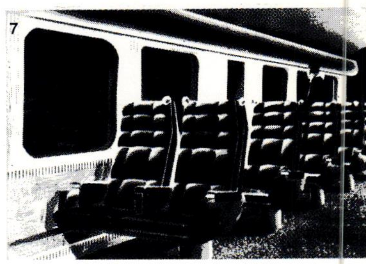

The Northeast Corridor:
1. Budd Company's original proposal for Washington to New York train
2. 1965 Budd design
3. 1966 Budd production version for Pennsylvania Railroad
4 and 5. Budd car interiors
6. United Aircraft Turbotrain
7. Turbotrain interior.

Washington to New York

In 1967, nearly twice as many people traveled by air between New York and Washington than by train, despite the fact that train fares are considerably cheaper. More than 20 per cent of all planes landing in New York City's overcrowded airports are commercial flights from Boston and Washington. Beginning sometime in 1968, the Pennsylvania Railroad hopes to recapture part of this market by putting 50 new cars on its New York-to-Washington run. The new trains, which have hit 164 mph on test runs, will operate at speeds up to 110 mph—hardly supersonic, but nevertheless a substantial improvement over existing service. Although the demonstration cars and equipment are being described as "ultra-modern" and "experimental," they are really nothing more than a belated response to an obvious need. Even their speed is not that impressive when it is recalled that the "streamliners" of the 1930s commonly hit 100 mph.

With these new cars, running time will be reduced from the present 4 hours to just under 3. At reasonable speeds and under ideal conditions, the drive from New York to Washington takes 4 hours. Flying time is only 45 minutes, but with increasing air and highway congestion, the trip from downtown to downtown takes at least 3 hours. Based on trip time, the new trains will thus be competitive with the airlines and highways. But in order to attract passengers, they must also be as comfortable, smooth riding, quiet, and attractive as the potential rider's brand new Cadillac or Eastern's shuttle service.

The new cars, built by the Budd Company, Philadelphia, are electrically powered, self-propelled, and totally independent of each other. This means that they can be hooked together into as long or short a train as is needed without sacrificing total horsepower. The cars are 85 feet long and slightly wider than conventional cars; parlor cars will seat 34 passengers, coaches 80. The interiors strive hard for the airplane look: reclining upholstered seats are high and wide, with pull-down serving trays located on the backs of coach chairs; reading lights are recessed in the overhead luggage racks, with individual lamps positioned above each seat. All cars are air conditioned and have wall-to-wall carpeting; every second coach is equipped with an electronic snack bar. Continuously welded steel rail and special car insulation will help to keep noise and vibration to a minimum. The windows are small and placed above shoulder level to avoid any unpleasant effects that the fast-moving scenery might have on passengers. Doors are located flush with platforms to expedite loading and unloading, and pretaped station announcements will be broadcast on board the trains.

One of the most interesting aspects of the Budd design is its metamorphosis from original concept to final production model. In response to President Johnson's recommendation for a high-speed train to serve the Northeast Corridor, Budd unveiled in June of 1965 a scale model of a highly streamlined double-ended train featuring large expanses of curved, tinted glass. It was developed for Budd by the industrial design firm of Cuccio and Chieda, Westport, Conn., who, in January 1966 designed another model for the Northeast Corridor. It is on this second, more conventional model, that the cars now being purchased by the Pennsylvania Railroad are based. The official explanation for the discrepancy between original concept and final design is that the earlier version, while technically feasible, was merely a "publicity" train. As such, it was quite successful: photos of the model were reproduced in practically every major newspaper in the country. Then it was decided that the streamlined design would not meet the requirements of the Pennsylvania Railroad, which needed a multicar train.

It could be argued that the original proposal was a bit flashy, that a train should look like a train, not like a guided missile. Perhaps some features of the earlier model would have proved impractical. But a train that can go 164 mph and is billed as "streamlined" and "ultra-modern" ought to *look* the part. Actually, as conventional trains go, the second model isn't bad. The front end, at least, has a bold, uncluttered look that is certainly equal to the task of hauling commuters up and down the coast. Unfortunately, the design process took another step backward when, after the second proposal was bid, Budd's engineers assumed full responsibility for the project. A quick comparison of the second model and the train as it looks in production shows how a few pieces of tacked-on hardware, exposed riveting and screwheads, bad graphics, and awkward detailing can do violence to a basically crisp, clean design.

This story of the Budd train sums up the relationship of design and marketing in mass transit: slick "publicity" vehicles are presented to dazzle the simple folk; but stock nuts-and-bolts production models are produced. The moral: you can lead a manufacturer to good design, but you can't make him produce it. Or, looking at things from the point of view of the government, the railroad and the manufacturer: even if you can't fool all the people all the time, it's worth a try.

New York to Boston

At about the same time that the new Budd cars go into service between New York and Washington, the Department of Transportation will also begin a two-year demonstration run between New York and Boston, using two three-car gas turbine powered trains. These "TurboTrains," as they are called, have been designed by United Aircraft Corporation and are being built by Pullman Standard. Five seven-car "TurboTrains," manufactured by the Montreal Locomotive Works, have also been ordered by The Canadian National Railway for operation between Montreal and Toronto.

Although the trains have hit 170 mph on recent test runs , initial operating speeds will not be greater than 110 mph. Thanks to a special banking system, the trains will be able to round curves at speeds 30 to 40 per cent greater than conventional trains. "TurboTrain" cars hang from their wheel assemblies like pendulums, and as the train takes a curve at high speed, centrifugal force causes the cars to swing outward from the bottom and in at the top, providing a banking effect like that of an airplane. With these new trains, travel time between New York and Boston will be reduced by one hour.

Perhaps because it represents the first significant transfer of aerospace technology to high-speed ground transportation, the "TurboTrain" is a much more sophisticated vehicle than the Budd train. The aerodynamic principles on which it was conceived have dictated a high, rounded nose and smooth aluminum skin in the tradition of the "streamliner." The first and last cars of the double-ended trains carry aircraft-type jet engines, one to push and one to pull. These cars are also equipped with a third rail power pick up for use within cities. Passengers will ride atop the power units in high, windowed domes. Doors are located in the center of the cars rather than at the ends; both powered and non-powered cars will seat about 50 passengers. The "TurboTrain" interiors, for which Raymond Loewy and William Snaith acted as consultants during the early phases of design, are even more reminiscent of a jetliner than are the Budd cars.

While not exactly handsome, the "TurboTrain" at least looks fast, and it is far more exciting than the Budd train. This may be because the designer was an aerospace company looking to expand the market for its jet engines (United Aircraft has expressed an interest in adapting the "TurboTrain" to intraurban and suburban runs if interurban operations prove successful) rather than a conventional car builder bogged down in old inventory.

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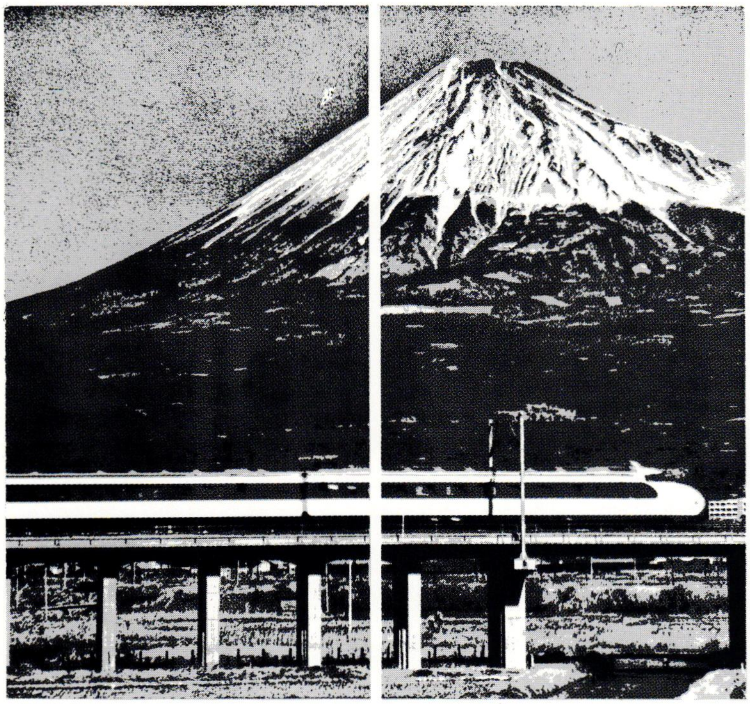

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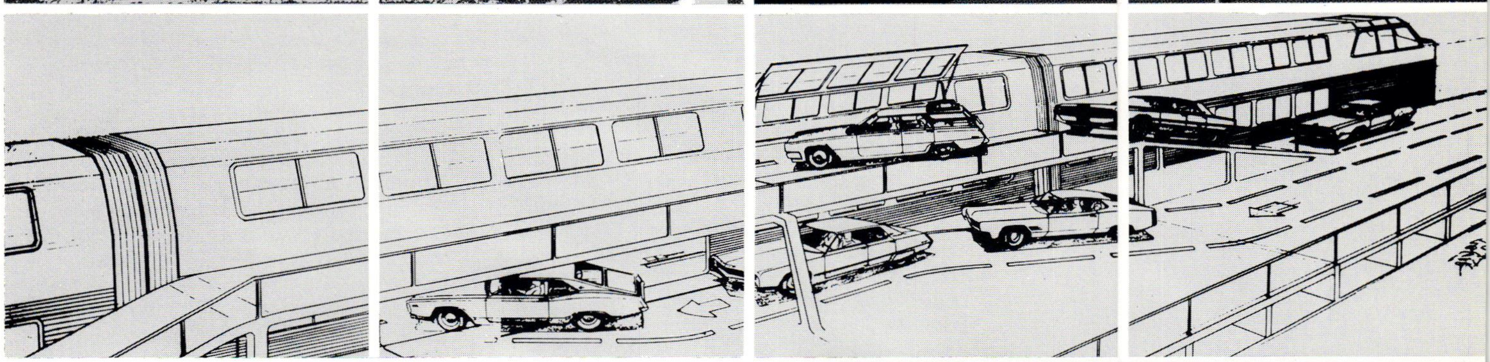

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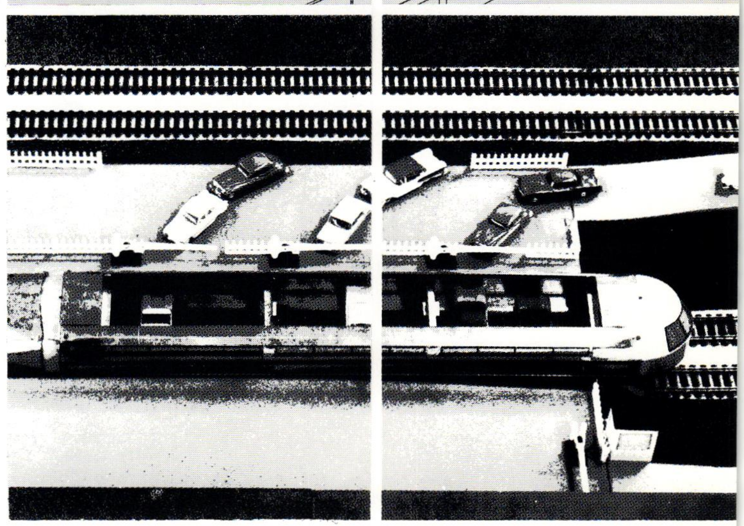
1. Japan's Tokaido line in operation
2. Tokaido line, interior of second class coach
3. Tokaido line, interior of first class coach
4. Auto-train, proposed by Department of Transportation
5. RRollway, model, proposed by General American Transportation Co.



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Japan's "Tokaido" Line

Probably the most convincing demonstration of the potential of high-speed ground transportation is Japan's "Tokaido" line. Completed in 1964 just five-and-a-half years after it was begun, the new line covers the 320 miles between Tokyo and Osaka—cities about as far apart as Boston and Philadelphia—in 3 hours and 10 minutes. Trains are dispatched at regular 15-minute intervals, and in a single day the line has carried as many as 200,000 passengers. To allow for cruising speeds of 125 mph (top speed is 160 mph), the track had to be made as straight as possible. Consequently, 13 per cent of the line runs through tunnels and 4 per cent on bridges.

The "Tokaido" is doubtless the fastest, most modern intercity train in operation. It is also one of the best designed. Two blue accent stripes running the length of the white train heighten its streamlined appearance. Extensive human factors research has gone into the seating, which is reported to be quite comfortable. On the debit side, lighting is somewhat harsh and there are no individual reading lamps. Also, overhead storage racks are constructed of open tube work that allows small packages to slip through. But the practical Japanese have thought to install coat hooks along the windows and to attach hand grips (that protrude distressingly) to the aisle seats. Snack bars in the second class coaches have stand-up serving counters running along one side of the aisle and sit-down counters under the windows on the other side. This allows passengers to look out at the passing scenery while they eat. (For some reason, rapidly-moving scenery doesn't bother the Japanese.) If someone wants to place a call while en route, there are telephone booths on board the train. (AT&T is now installing telephones on the Budd trains—the first such system to be developed in the United States.)

The same concern with design that distinguishes the train is also evident in the twelve attractive new stations along the "Tokaido" line. For example, all ticket windows, gates, escalators, signage, clocks, and other hardware conform to uniform design standards. It is not surprising that, given this combination of good service and pleasing environment, the Japanese have responded enthusiastically to the "Tokaido." Just prior to the inauguration of the high-speed trains, travel between Tokyo and Osaka was 34 per cent by rail and 66 per cent by air. One year after the "Tokaido" began operating, this proportion shifted to 54 per cent rail, 46 per cent air. Since then, rail service has been improved and the ratio is now even more favorable to the railroad.

The Car Ferry Concept

In addition to the two Northeast Corridor runs, the Department of Transportation is hoping to market test a car-carrying "Auto-Train" on the east coast. Originally scheduled to begin in 1968, the demonstration has been temporarily shelved because of budget cuts.

The "Auto-Train" was conceived as a bi-level vehicle that people could drive onto in their own cars. Once on the train, they would remain seated in their cars for most of the journey, but there would be easy access to snack bars, rest rooms, lounges, and entertainment areas. One 15-car train (12 bi-level cars and 3 single-level cars) could carry 99 automobiles and about 400 people, with automobiles parked longitudinally. Terminals would be located along major suburban highway networks. The route selected for the "Auto-Train" demonstration was Washington, D.C. to Jacksonville, Florida. The diesel-electric train would have had a maximum speed of 100 mph, but travel time over the 750-mile distance was estimated at 12 hours, with stops. That's an average of 62½ mph—not really high-speed, but certainly a lot faster and safer than driving. The great advantage of such a service would be that the passenger could take his car with him.

For several years, the General American Transportation Company has been promoting a similar car ferry concept, which it calls the "RRollway." As it is presently proposed, the "RRollway" would be an electrically-powered, steel-wheel-on-steel-rail system with top speeds of 150 mph. However, it could also be developed as an air cushion system which would increase its cruising speed to 200 mph. "RRollway" cars would be 128 feet long and 24 feet wide—much wider than conventional railroad cars—so that each one could accommodate 12 automobiles parked transversely. The sides of the cars would open completely and automobiles would load on one side, unload on the other. This, of course, would require a wider-than-normal track, which would make the "RRollway" incompatible with existing rail facilities.

The success of any high-speed interurban system, no matter how technologically advanced, depends on what kind of support it gets from urban and suburban distribution systems. In the United States these support systems are, without exception, inadequate, unpleasant, and obsolete. Yet, with 70 per cent of our population crowded on little more than one per cent of our land, some 90 per cent of all movement of goods and people takes place in densely settled urban areas. Only six cities in this country now have what can barely be called rapid transit. (Rapid transit is ideally defined as any transportation system that runs over exclusive rights-of-way at speeds of 50 mph or better, and is automatically controlled; it is doubtful that any existing system meets all of these requirements.) Moreover, there are at least 25 cities in the United States with populations of 500,000 or more — the point at which rapid transit becomes a necessity — that have not even begun to plan for this kind of transportation (See map on page 11). Another 13 cities are in various stages of developing rapid transit proposals, but to date, all are based on relatively obsolete technology and the familiar steel-wheel-on-steel-rail concept. In short, the only thing new about these "new" systems—Montreal, San Francisco, Washington, D.C.—is the construction work. Fundamentally, they are no different from the London subway built in 1863.

Admittedly, almost any form of rapid transit is better than none at all. And in high-density areas where people must be moved from the suburbs or outlying facilities to an urban core, or where various centers of activity are far-flung, conventional rapid rail has its place. But it does not provide adequate circulation within central business districts, nor does it meet the collection and distribution needs of low- and medium-density suburbs. In fact, rapid transit alone—regardless of what form it takes—is probably not the solution to our intraurban transportation problems. What is needed is a combination of low-, medium-, and high-speed carriers, some with exclusive rights of way, some traveling on public thoroughfares, some automatically controlled, and some individually operated. Such a systems approach, however, will not be possible until more advanced technology is available—that is, until we apply much of our presently unused technology or transfer it from other areas to the field of mass transportation.

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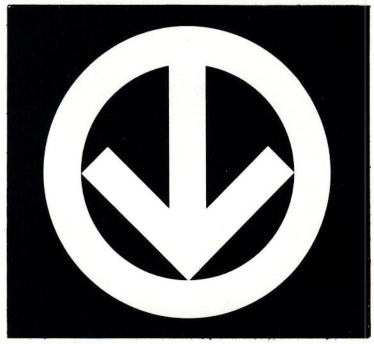

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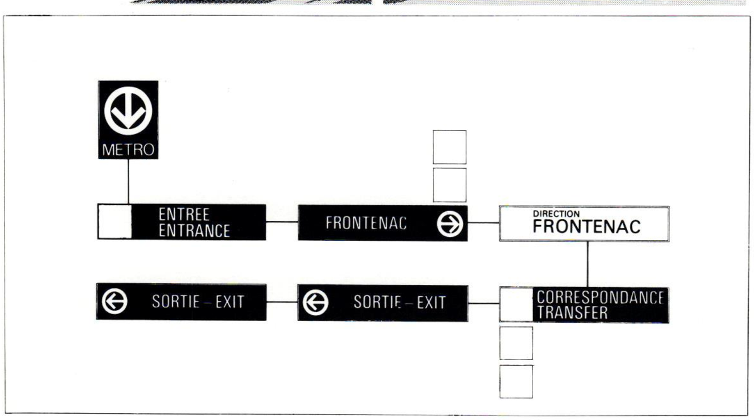

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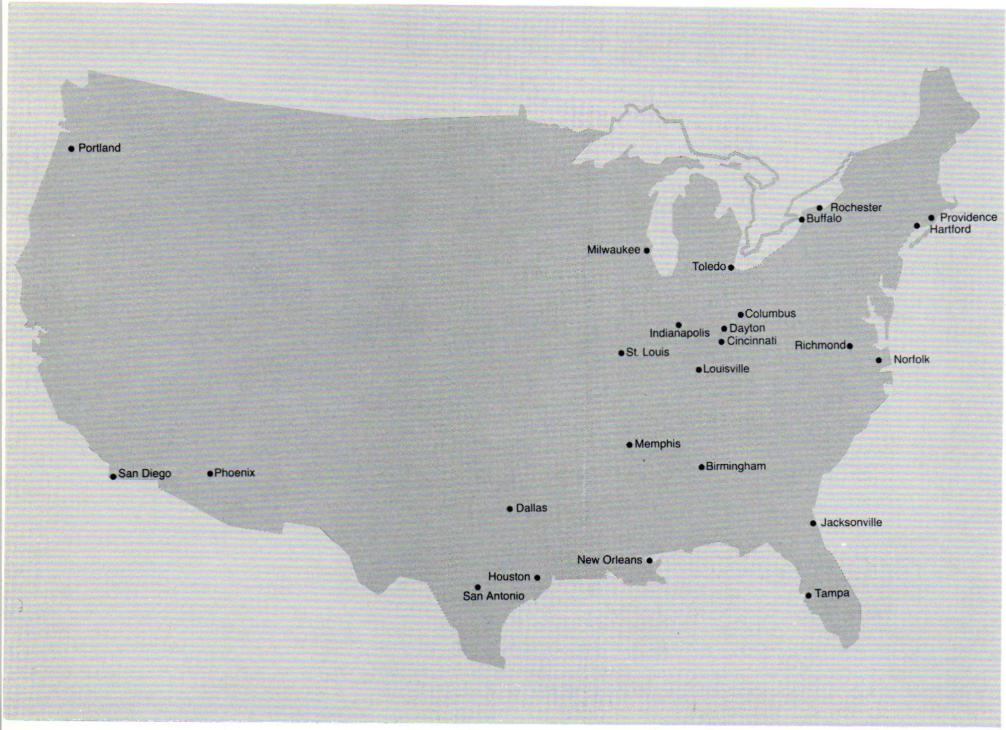
Montreal Métro:
1. Identifying symbol designed by Jacques Gillon and Associates
2. New cars, designed by Jacques Gillon
3. Métro graphics.



Where rapid transit is needed:
These 25 cities with populations of 500,000 or more need some form of mass transit.

So far, efforts to develop more advanced intraurban transit technology have been piecemeal at best. The limited funds which the federal government is making available are going into the improvement and extension of existing facilities, or into construction of "new" systems using old technology. Even the Housing and Urban Development new systems studies are not aimed at developing new technology as such; they are merely intended to gather data on those "new" ideas that have already been proposed. Since the government is stimulating research only indirectly, and neither the traditional transit industry nor the local transit agencies are willing or able to develop new technology, most of the really advanced thinking is coming out of the universities, private industry (particularly the aerospace industry), and the minds of lone inventors.

Meanwhile, using the technology at hand, one city—Boston—is updating its existing facilities, and several others—notably San Francisco and Washington, D.C.—are trying to build the best systems possible. And across the border, Montreal has proudly unveiled the newest rapid rail system in North America.

Montreal's Métro

For most Americans, the words "rapid transit" recall a harrowing descent into the bowels of a subway, elbowing onto a crowded car along with a lot of people who eat garlic for breakfast, and risking impalement on some little old lady's umbrella.

The first real indication that subways could be anything but gruesome came during Expo '67 when millions of people had an opportunity to ride Montreal's new Métro. They found the stations clean, well lit, and attractive, the trains relatively quiet and comfortable, the signs easy to follow, and the service frequent—all the things that rapid transit should be but seldom is.

Perhaps the most remarkable thing about the Métro is its very existence. Montreal had been planning a rapid transit system for over 50 years, but not until an energetic mayor staked his political future on it did the project begin to materialize. When Mayor Jean Drapeau took office in 1960, he found piles of mass transit reports locked in vaults. He vowed then to stop making reports and start building a subway. At that time, Montreal did not have the extensive network of urban highways that most American cities do, so the need for improved transportation was acute. Within just five years of the decision to go ahead with the project, trains began operating on the first two lines of the 16.1-mile system. It has been charged that in the rush to complete the subway in time for the opening of Expo, certain problems were not adequately thought out. But over all, the Métro is quite impressive, and what is more important, it's there.

Each station was designed by a different architect and has its own distinctive character, so that a trip through the Métro is a varied and exciting visual experience. In some stations the walls are curved, in others they are straight or zig-zagged. In each there is a variety of textures with brightly colored tile predominating. It is this tile, more than any other single design element, that gives the Métro its flamboyant Gallic flavor. While this flamboyance tends to cloy and even, at times, to offend, it does serve to break up large, cavernous spaces into smaller areas of visual interest. Seating is recessed from the platforms, providing an oasis of relative calm where passengers can wait for the next train. Some stations are distinguished by colorful molded fiber glass seats; others have upholstered seats or attractive wooden benches. In at least one station, round cantilevered stools seem to spring from the walls like mushrooms. As a train pulls into a station, platform gates automatically close, thereby

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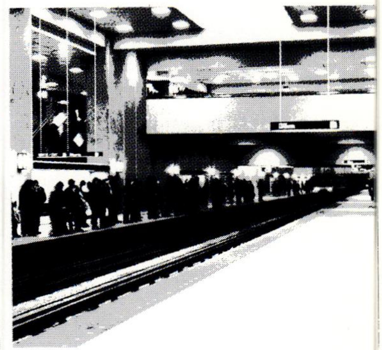

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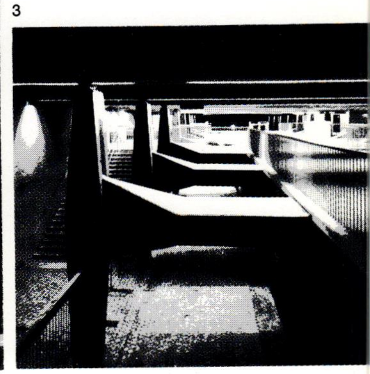

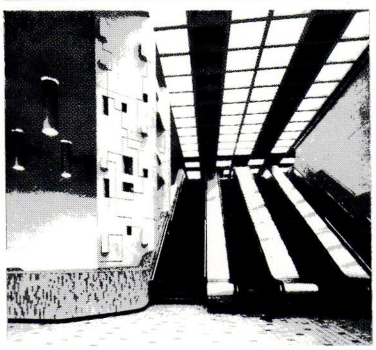

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Montreal Métro:
1. Car interior designed by Jacques Gillon and Associates
2, 3 and 4. Station interiors designed by different architects.

reducing confusion and assuring safer operation. Incandescent lamps are housed in a variety of fixtures, from large white globes to striking black cylinders. It is to their credit that the architects have exploited the design possibilities of all surfaces, partly because they wanted to build in decoration rather than allow future city administrators to come along and tack it on. Even the floors have received considerable attention: various textures, colors, and patterns are used throughout the system, in materials ranging from concrete to tile. There are only two serious faults to be found with the stations. One is that the tunnels have already begun to leak, and the other is the absence of properly designed trash receptacles, particularly near the transfer machines where discarded tickets accumulate on the floor.

The cars, however, are another story. Whatever their amenities, they are just a refined version of the standard subway car—more specifically, the Paris Métro car. Many transit experts originally advised using a Canadian car, but substantial funding from the French government and the influence of French engineering consultants dictated the use of the rubber-tired Parisian vehicle. Canadians now rationalize the vehicle on the basis of its superior traction which allows steeper grades—an important factor where the line dips down under the St. Lawrence River. Even the most critical observer must admit that the rubber tires do give a smoother, quieter ride than any steel-on-steel system designed to date. On the other hand, the use of rubber tires precludes extension of the system above ground; in Montreal's icy winter weather, rubber tires would skid dangerously. There is also the matter of cost: maintenance alone makes rubber tires more expensive than steel wheels because they wear, lose their tread, and can blow out.

Although the French car was adopted in principle, the city decided that the body should be completely redesigned. For this largely thankless task, the firm of Jacques Guillon and Associates of Montreal was retained. Handicapped from the outset by French engineering specifications, the designers nevertheless managed to acquit themselves in workmanlike fashion. Unfortunately, not all of their recommendations were followed, but it is safe to say that where the Métro car succeeds, it is owing to their efforts.

One of the primary design objectives was to lighten the vehicle visually and create a feeling of spaciousness within it. The car is relatively small—56½ feet long as compared to San Francisco's 70-foot car. It is also narrow, a function of tunnel size and the width of the French-designed bogies. To compensate for these factors, the designers slanted the sides out from the top, curved the lower side panels, and enlarged the door and window areas.

From the outside, the car's boxiness is relieved by a large expanse of glass in front that runs all the way up to the roof line. The designers have achieved a high degree of visual clarity by making all windows the same size and aligning them. A body skirt extending below the line of the platform also helps to tidy up the car's appearance.

The interior of the car leaves much to be desired. Stanchions are placed near the doors rather than back in the seating areas, so that standees tend to block exits. The elimination of overhead bars and hand grips avoids a lot of visual clutter, but when the car is crowded, many standees have precious little to hang onto. The only other supports are vertical bars placed next to the doors and seat-mounted hand grips. Overhead there are some rather old-fashioned ceiling fans (the car is not air conditioned) that pull air in from under the car and exhaust it through the roof. During cold weather, the car is warmed by heating units located underneath the seats. The seats themselves are molded fiber glass with contoured recesses in which preformed Naughahide pads are fitted. Originally, the designers specified a slightly less vertical back with a fully recessed pad. But Canadian Vickers, builder of the car, altered the design so that the present seating is less comfortable than it might have been, and the back pads protrude just enough to invite vandalism.

In the original Paris car, the seats are laid out facing each other, one pair under each window, but the designers felt that two transverse seats placed back to back, with single seats perpendicular to them along the sides of the car, would provide more standing room and facilitate traffic movement. Happily, in this instance the designers prevailed.

To date, the biggest problem with the cars is overheating. Ignoring the designers' recommendations, the engineers did not air condition the cars. They counted on the cars remaining fairly cool in the tunnels, and on the adequacy of the forced-air ventilating system. Unfortunately, they underestimated tunnel temperatures, and the amount of heat generated by the electric motors. In addition, the tunnel ventilators have failed to work properly. Consequently, there is so much heat trapped in the tunnels that during the summer the trains are unbearably hot, and even during the winter the forced-air heating system is unnecessary. In an effort to alleviate this problem, some of the door windows have been replaced by open screens which do little for the car's appearance and admit a lot of noise.

In addition to redesigning the car body, Jacques Guillon also submitted proposals for the turnstiles, ticket booths, showcases, station seating, graphics, and maps. Their station seating designs were rejected and the rest of their standards more or less ignored. As a result, the otherwise excellent graphics suffered an unfortunate reduction in size. The route maps, however, are highly intelligible, and the identifying symbol is excellent graphic design. Instead of adopting one of the more common symbols—"T" for transit, "M" for metro or metropolitan, "U" for underground, or "R" for rapid—the designers chose to use an arrow, perhaps the world's oldest and most universally understood traffic symbol. The arrow not only serves to identify the system, but when pointed up, to the right, or to the left, indicates direction. The basic colors of the back-lit station signs are white on a field of blue; when used to direct traffic, the symbol also appears in white on red. Evidently overwhelmed by the symbol's simplicity, the city fathers insisted that the word "Métro" be spelled out beneath it on the station entrance signs. Because Montreal is a bilingual city, the graphics system relies partially on pictograms for signs like, "Buses," "No Smoking," etc. Perhaps the highest tribute that can be paid the Métro graphics is to report that it is virtually impossible to get lost in the system.

Technically, Montreal's system represents no breakthroughs. Although train movement is continually monitored in a central control station, each operator runs his own vehicle with the help of an antiquated wayside signal system. Probably the most advanced element of the system is its automatic fare collection equipment and the automatic transfer dispenser installed in every bus and Métro station. Montreal has one fare and one ticket, which is good on either the bus or subway. These tickets, which can be purchased from a bus driver or station attendant, have a band of magnetic tape on which a pulse is encoded. The tickets are also printed so that they can be recognized visually. When a passenger enters a Métro station, he feeds his ticket into a reading machine mounted on top of a standard turnstile unit. If the ticket is valid the turnstile is activated.

Whatever its defects, the Métro is unquestionably the finest system in North America. Hopefully, some of the visitors who enjoyed its services during Expo '67 will begin to demand new or improved transportation for their own cities.

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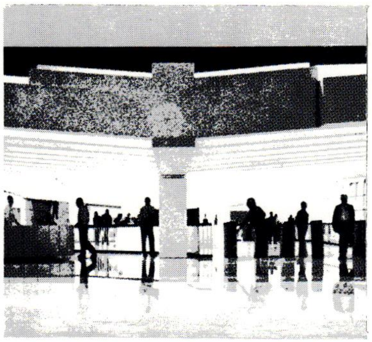

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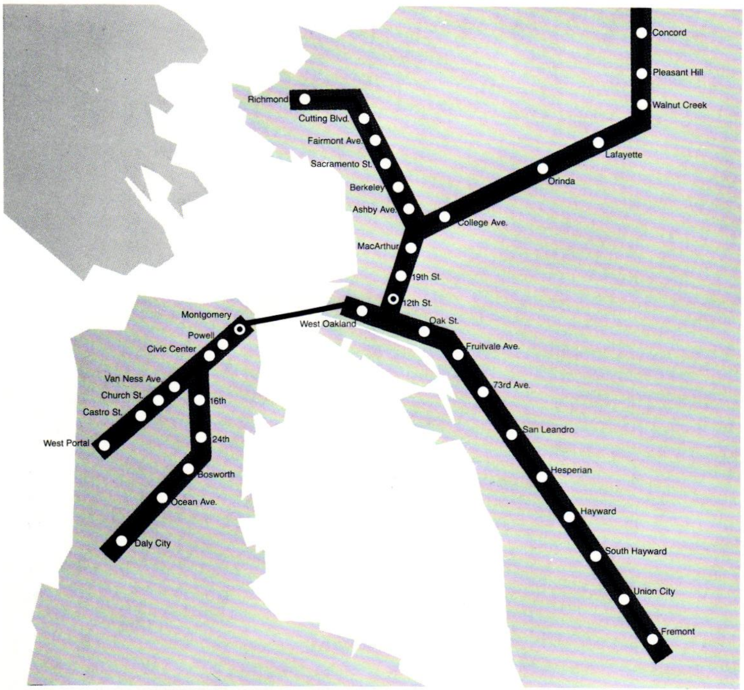

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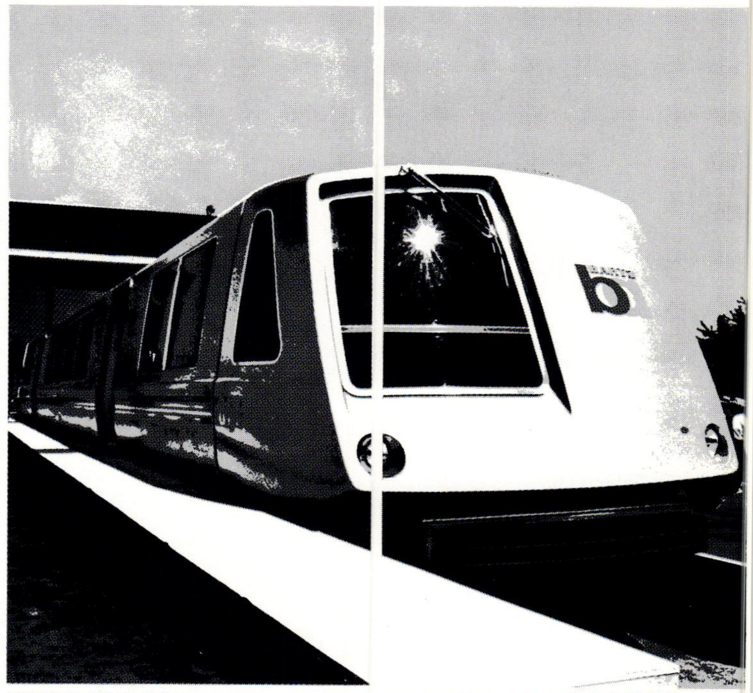

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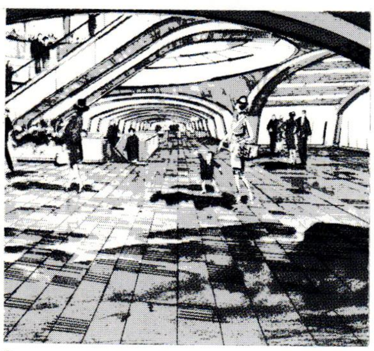

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San Francisco BART:
1. Plan of BART system.
2. Control car, prototype, designed by Sandberg-Farrar.
3. Car Interior, designed by Sandberg-Farrar.
4, 5, and 6. Station interiors, as designed by different architects.

San Francisco

San Francisco is the only city in the United States with an entirely new rapid transit system actually under construction. But progress has been slow and wobbly. Studies for a Bay Area system began in 1951, and in 1957 the Bay Area Rapid Transit District, now known as BART was created. In 1962, a bare majority of voters approved a $792-million bond issue to finance construction of a 75-mile, automatically-controlled rapid transit system to serve San Francisco and its suburbs. After 11 years of feasibility studies and a massive public relations campaign, BART was finally off and running.

Two counties originally included in the system have dropped out, a number of taxpayer suits have been instituted, and land acquisition is still only 75 per cent complete. There have been charges that the system is being designed to serve the affluent middle class, that it ignores the transportation needs of the poor, and that routing of lines cuts off predominantly Negro neighborhoods from the rest of the community. Moreover, the high-powered public relations campaign has begun to backfire. In order to succeed financially, BART will have to lure 200,000 commuters a day out of their cars and onto its trains. Therefore, a great deal of publicity was given to early design proposals that tended to pamper the commuter. As the system has developed and these initial proposals have been modified, people have protested that BART is reneging on its promises to the taxpayers.

That at least some of these protests have been justified was borne out by the resignation of BART's chief design consultants—architect Donn Emmons and landscape architect Lawrence Halprin. The difficulties which prompted these two resignations arose because of a basic flaw in BART's organization. Instead of being directly responsible to the transit agency, the design consultants reported to the engineers. At the time of their resignation, the consultants claimed that not only had the engineers rejected their work, but that they had never even submitted it to BART's board of directors.

Emmons felt strongly that the proper location and architectural handling of stations could stimulate commercial and cultural development, and that the design of these stations should relate them to their surrounding areas. He urged that spacious plazas and handsome entrances be provided, and that aerial structures be designed to enhance the landscape, not detract from it. Clear directional signage and efficient lighting were his chief concerns. Similarly, Halprin proposed that protective fencing on surface lines be placed as close to the tracks as possible, rather than along the outer limits of the right of way. This, he argued, would allow for the development of linear parks with playgrounds, cycling paths, and riding paths. Because much of the BART system runs on elevated structures, Halprin proposed that these be located at the sides of streets in newly-created park areas, or run through commercial buildings, rather than down the middle of streets. When the engineers refused to go along with this approach, the citizens of Berkeley voted $20.5 million to put the line in their area underground. A similar revolt is now underway in Oakland.

Since the system was begun, construction costs have been rising at the rate of 6 to 7 per cent a year, and the original estimate of $1 billion now looks low. BART had hoped to begin operating in 1968, but the first trains will not roll until late 1969. And the only real innovation in car design — a detachable control pod — has been dropped because, according to BART officials, it is "not feasible." Curiously enough, several trains with detachable control pods were operating in this country 100 years ago.

Pod or no pod, the BART car is unique in that it is the first rapid transit vehicle ever to be designed, as opposed to *re*designed. Refusing to settle for a warmed-over version of some manufacturer's standard commuter model, BART hired the firm of Sundberg-Ferrar, to develop a completely new prototype. But, considering the unprecedented latitude which the designers enjoyed, it is perhaps disappointing that they did not achieve a more radical departure from the traditional transit car. At least it is designed not just to carry passengers, but to insure that they will enjoy the ride.

The most distinctive feature of the BART car is its slanted profile and sculptured fiber glass front end (originally the pod, now part of the control cars). Already the influence of this sloped look can be seen in other recently-designed transit cars, notably New York City's new subway model. The designers rightly felt that while a train with a top speed of 80 mph should not look like a bullet, neither should it look like a cattle car. Their solution is a very solid, practical looking vehicle with just a touch of streamlining. Because track for the BART system will be a wider-than-normal 5 feet, 6 inches (standard gauge is 4 feet, 8½ inches), the designers have been able to give the car a wider, lower cross-section. By angling the sides, they have not only broken away from the box car look, but have also created more hip and elbow room inside. Large tinted glass windows lighten the vehicle's appearance, and will give passengers a panoramic view of the famed Bay Area landscape. On the assumption that they are difficult to read and therefore useless, the designers have eliminated all signs from the exterior of the train. Destinations will be posted on overhead platform signs, at right angles to the track, which will light up 60 seconds before a train pulls into a station.

Inside, passengers will be treated to air conditioning, wall-to-wall carpeting, and upholstered seats with arm rests. Lighting units are flush-mounted in the ceiling, over the seats and parallel to them. Specially designed fixtures split the beams into low-level ambient light and higher-intensity reading light focused just forward of the chest of a seated passenger. After exploring the possibilities of zig-zag seating, lounge-type arrangements, swivel chairs, and flip-back seats, the designers settled for non-reversible seats placed transversely, two abreast on either side of the aisles. Because neither the cars nor the seats can be turned around at the end of the line (the BART system is a shuttle with no loops), half the seats face in one direction and half in the other.

To encourage people to move into less crowded cars, passage ways between cars are enclosed in weatherproof, accordion-pleated structures. Bi-parting doors connecting the cars will be passenger-operated by a treadle or push button. BART is promising that there will be seats for everybody, except perhaps at rush hour in crowded downtown areas. Consequently, the designers have made minimal provisions for standees. A few stanchions are located near the doors (again, a fault in that they will concentrate standees in entrance/exit areas), and handgrips are recessed in the seat backs. But these hand grips — the only supports within the seating area — are designed more to assist people in getting in and out of their chairs than to steady standees. Should BART's traffic projections prove to be low, standees will have a hard time finding something to hold onto.

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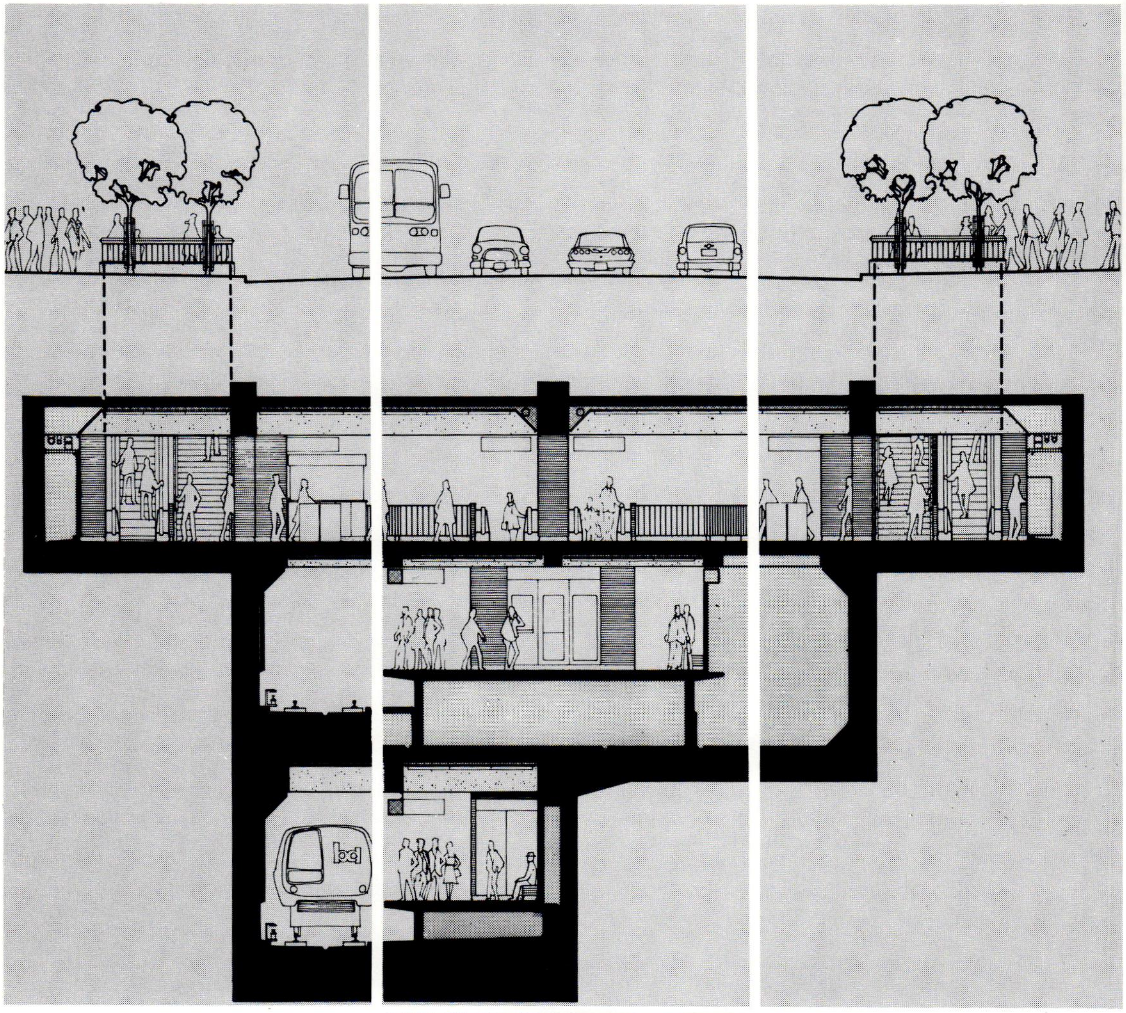

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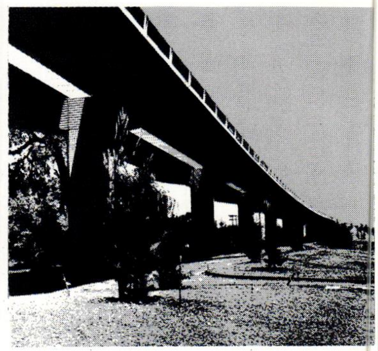

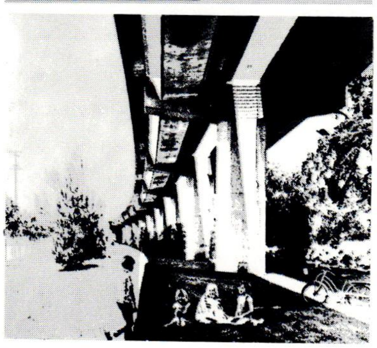

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San Francisco BART:
1. Section view showing concourse and train levels of station.
2. and 3. Aerial structures designed by Lawrence Halprin.

BART officials were so pleased with Sundberg-Ferrar's car prototype that they awarded them design contracts for the turnstiles, ticket booths, vending machines, station agent's booth, and automatic fare collecting equipment. So far, the firm has presented proposals for a fare deficit collector (BART will have a graduated fare, and this machine will collect additional fares from those people who decide to ride beyond their paid destination) and a ticket dispensing machine. Both are simple, straight-forward packages housing very complex equipment.

Although Donn Emmons originally set up general design criteria for BART's graphics and recommended that Saul Bass be retained to carry them out, Sundberg-Ferrar is now handling that phase of the design program, too. At this point, the program is still in its formative stages, but it has been decided that Universe type will be used throughout the system. Station signs will have white lettering on a darker field (possibly blue) and will not be back-lit. In dark areas, front-lit units may be integrally mounted on the signs. A complete system map will be installed in every car and station, with a bright red or orange "you are here" sticker affixed at appropriate points on the station maps. A local map of the immediate neighborhood, showing parking facilities, freeway interchanges, and connections to other modes of transportation, will also be placed in each station.

The one element of the graphics program already in operation is the system symbol. Wanting to retain its identity with the widely publicized "BART" or "BARTD" name, transit officials insisted that the symbol be based on some form of these acronyms, rather than on one of the more universal letters ("T" or "R" certainly would have been applicable), or an abstraction like Montreal's arrow. Accordingly, Sundberg-Ferrar reduced the acronym to a lower case "ba," rounded the letters into squat ciphers, and overlapped them. As the symbol appears on the prototype, it is complicated by the addition of the word "BARTD" in the upper right-hand corner (evidently all transit authorities suffer from an irrational fear of going unrecognized), and the overlapping of the "b" and the "a" to the point where the circular areas in the center of these letters are all but eliminated.

Visually, the symbol is static, suggesting, if anything, an optometrist's office rather than rapid transit. Phonetically, it triggers many associations, none of them relevant to the business of moving people, unless BART intends to treat its passengers like sheep.

While most of the hardware in the system will bear the stamp of one design firm, BART's 38 stations are being individually designed by a total of 14 different architects. Their efforts are being guided by a "Manual of Architectural Standards" compiled by Emmons prior to his resignation. Many of the architects complain that the manual is too specific and that it inhibits their work. But if the purpose of the manual was to impose a certain visual coherence on the system, perhaps it is not specific enough. Judging from a few of the renderings, BART will be considerably less unified than the Montreal system, which was also designed by different architects. Unlike the Metro stations, which vary in color, texture and style but always within the same frame of reference, BART's stations evoke wholly unrelated feelings. One of their most disturbing features is their low ceilings which emphasize the longness and narrowness of the tunnel structure, thus creating a gun-barrel perspective. (Contrast Montreal with its staggered ceilings, open spaces, and lofty stairwells.) Even in BART's more open stations, there is a sense of monotony and isolation distressingly reminiscent of the New York subway. San Francisco residents are also grumbling that the stations will not link with shopping concourses or provide access to the buildings above, and that they are so far down in the ground that direct transfer to other transportation facilities will be impossible. Emmons at one time hired a human factors engineer to study these and other problems, but his suggestions – 500 of them – were flatly rejected by BART officials.

Now that Emmons and Halprin are gone, John Burchard, acting dean of Berkeley's College of Environmental Design, has been appointed special advisor to BART's board of directors. This appointment, however, appears to have been more a public relations gesture than a serious attempt to replace Emmons and Halprin. Burchard's function is simply to approve policy, not to make it. There is not now, and never has been, any one person with authority to coordinate the various design functions. Review power is shared by a bewildering array of officials, from the general manager on down through the public relations director, to the executives of the consulting engineering firm. Whether BART can succeed functionally and aesthetically without professional design guidance remains to be seen. At worst, it will still be this country's finest system. But many car-clogged cities are keeping a sharp eye on San Francisco; failure to achieve a truly well designed system could either set undesirable precedents or discourage rapid transit planning altogether.

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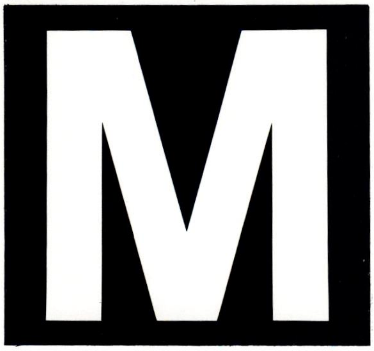

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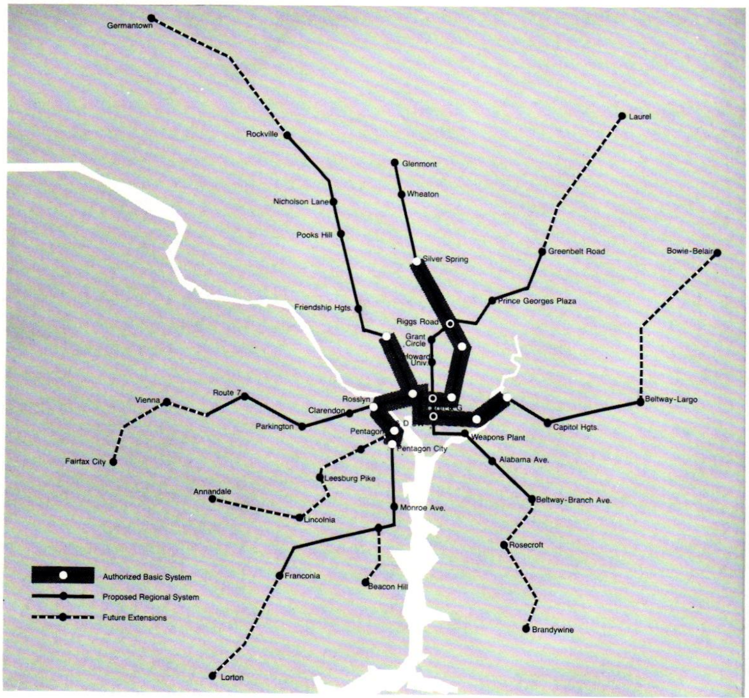

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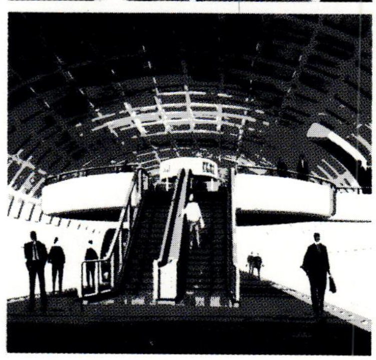

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Washington Metro:
1. Identifying symbol, designed by Unimark International.
2. Plan of Washington system.
3 and 4. Station interiors, designed by Harry Weese.
5. Street entrance to station.

Washington, D.C.

Just about the only thing that Washington's proposed rapid transit system has going for it is the chance to benefit from those lessons learned in Montreal and San Francisco. Otherwise, it is beset with problems that make the building of China's Great Wall look easy. For one thing, the city has no elected government (though its residents are, indeed, taxed on their property). For another, the congressional committee that runs the city is composed of politicians whose constituents, i.e. vested interests, are hundreds of miles away, and whose attitudes toward the District's largely Negro population are ambivalent, at best. Moreover, the majority of Washington's middle class has fled to the suburbs – which in this case means to another state – and the people who stand to benefit most from an urban system no longer make up the tax base on which it will be at least partially financed. Any extension of the system into suburban areas will involve cooperation among not only a number of counties, but individual states – Maryland, Virginia, and the District of Columbia.

The need for improved transportation in the nation's capital is painfully obvious. Not only is the metropolitan area the fastest growing in the United States, but is the second largest in the country (after Los Angeles) not being served by some form of rapid transit. The lack of adequate transportation is felt by the 15 million tourists who flock to the capital every year, as well as by the poor who cannot seek employment outside their own neighborhoods. Recognizing the danger of relying entirely on a never-ending program of highway construction, Congress began studies for a rapid transit system in 1952. In 1960 it created the National Capital Transportation Agency to implement these studies. Then, in 1965, Congress authorized a 25-mile, $431 million subway for downtown Washington. Scheduled to begin operation in 1972-73, these 25 miles of subway , to be known as the Metro , will be the nucleus of a larger regional network . Financing of the initial 25-mile system will be one-third local and two-thirds federal. Once the system is extended out into Maryland and Virginia, however, it is doubtful that Congress will continue to support it. The ultimate success or failure of the program, therefore, depends on the willingness of surrounding counties to vote the necessary bond issues. Recently, the National Capital Transportation Agency was supplanted by the Washington Metropolitan Area Transit Authority (WMATA), a newly-formed agency representing nearby counties in Maryland and Virginia, as well as the District of Columbia. It is the job of this agency to work out a regional plan that will feed suburban commuters into downtown Washington.

One man who does believe in the future of Washington's rapid transit system is Chicago architect Harry Weese. His firm has been retained by the transit authority to prepare conceptual designs for stations in the initial 25-mile system, and to make recommendations on graphics, hardware, and rolling stock. In preparation for this task, Weese and his staff toured some 20 foreign subways, noting those features that seemed possibly applicable to Washington. Although it is still too early to evaluate Weese's work, the design process itself is indicative of what can be expected. Avoiding the pitfalls of BART's organization, WMATA has set up its consultants so that neither the architects nor the engineers have review power over the others' work. Instead, both report directly to the transit authority, which makes all final decisions – subject to the approval of Washington's Fine Arts Commission. Judging from that Commission's past performance, its contributions to the subway are not likely to be positive.

The Fine Arts Commission has already approved the conceptual design for one station, and since Weese believes that the system should be visually unified, the renderings of this first station give some indication of what the entire subway will look like. All stations will be vaulted, regardless of whether they are tunnel or cut-and-cover construction. Actually, they will have two ceilings, the first a structural vault and the second a free-standing shell of precast concrete. This shell will run off any water seeping through the natural rock, and will also make possible a continuity of form, even where structural requirements vary. The inner ceilings will be coffered to add visual interest and break up sound. Sight lines in the stations will be unobstructed by columns or other supports; platforms will be floated out from the walls to allow for indirect lighting and to prevent people from touching the walls.

One of Weese's chief concerns is to avoid the labyrinth – that maze of enclosed stairways, connecting passageways, blind turns and dark tunnels that can try the courage of even the bravest commuter. He feels that people are happier about going down into a subway if what is happening underground can be visually and spatially related to what is going on above ground. Therefore, wherever possible the stations will be designed so that escalators will move passengers directly up from the platform and out onto the street. Entrance enclosures will be eliminated so that people leaving the subway can see the outdoors as they emerge, and those about to enter can look down and be reassured that it's not such a bad place after all. Weese proposes that air curtains be used to seal off entrances and, where needed, surface shelters be reduced to simple canopies. Where direct platform-to-street access is not possible, mezzanines will be located overhead of the tracks with open escalators leading directly to the platform. These mezzanines will be completely open structures, strongly curvilinear in form. Service kiosks will be placed so that passengers are in full view of station attendants at all times; closed circuit TV may be used for supplemental monitoring.

Because he regards the subway as a public environment and not a commercial enterprise, Weese is recommending that all station entrances be located in parks, malls, or median strips – not in department store basements. (But considering public reaction to the BART stations, is it possible that people actually prefer neon signs and discount booths to trees and flowers?) Weese's philosophy is that transit riders should not be treated like a captive audience, and that a subway should provide dignified, even elegant spaces. To this end, he is urging that advertising be strictly controlled, and that concessions be limited to newspaper stands. Bars, gates, turnstiles, and other barriers that insult the passenger's integrity may be eliminated. Instead, Weese is recommending that pass gates be operated by electronic eyes that would recognize some form of magnetic card. These gates would remain open and invisible, except in the case of an incorrect fare when they would close automatically.

The form that the car for the Washington system will take is as yet undetermined. Weese favors the traditional railroad aesthetic, so if he has any say in the matter, the train will probably look more like the old IRT than San Francisco's spiffy prototype. But at the same time the WMATA is listening to Weese's suggestions, it is also looking at some very untraditional manufacturers: Owens-Corning, Lockheed, and Boeing. So far, the only specifications are that the system be steel-on-steel, and that the car be an unusual 75 feet long.

It is difficult to tell how much of Weese's thinking will carry through to the completed system, but given a reasonably sympathetic transit authority, the prospects for Washington's Metro are bright indeed, providing it doesn't bog down in the sort of bureaucratic quagmire for which our capital is famous.

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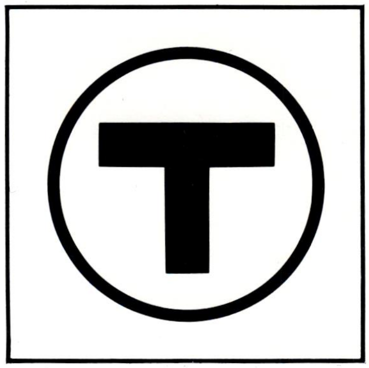

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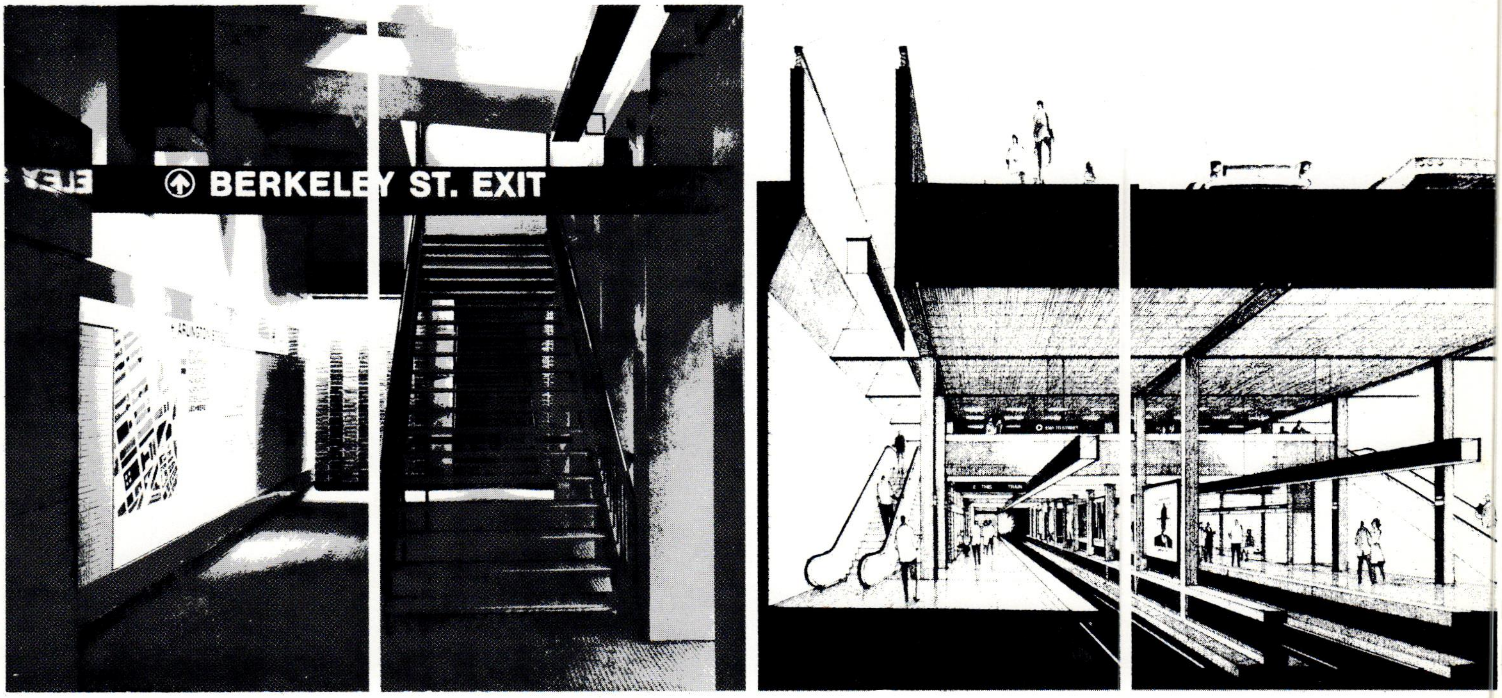

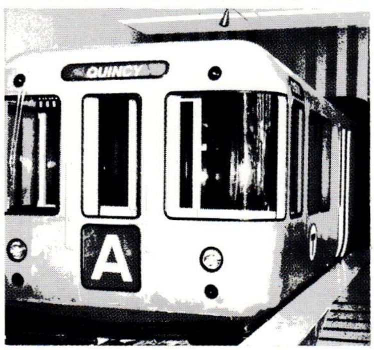

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Boston subway:
1. New identifying symbol.
2. Station interiors.
3. Redesigned cars.
4. Detail of station wall photomural, identifying neighborhood feature or landmark. Designs by Cambridge Seven Associates.

Updating Existing Systems

While San Francisco and Washington are occasioning all the fanfare, Boston is quietly overhauling its dingy 1898 subway. Though strictly a remodeling job, the Boston project is turning up some design ideas that are as fresh and exciting as anything to be found in the newer systems. Perhaps this is because the problems are so well defined and the before-and-after contrast so dramatic. At any rate, Cambridge Seven Associates—the firm chosen by the Massachusetts Bay Transportation Authority (MBTA) to redesign its stations, cars, and graphics—has worked a veritable miracle in Bean Town. And if Boston can do it, why not Philadelphia, Chicago, and New York?

Starting with the premise that chaos and disorientation are the chief offenders in existing systems, Cambridge Seven has worked to bring order to the Boston stations. In the process, the designers have also eliminated the squalor and ugliness so often associated with rapid transit in this country. Gone is the cacaphony of screeching brakes, naked light bulbs, irrational signage, uncontrolled advertising, exposed pipes, and uncoordinated finishes. In its place are soft, indirect lighting, attractive fixtures, modern turnstiles, cantilevered wooden benches, and special rubber flooring that absorbs sound and is restful underfoot.

Unable to alter that basic structure of the stations, the designers have concentrated on redefining and clarifying existing spaces. This they have achieved through meticulous attention to detail. Advertising posters have been removed from the walls, and placed in illuminated frames located between the double tracks. Positioned here, advertising becomes a strong, deliberate architectural element, rather than a disruption, and at the same time it provides an ever-changing exhibition for waiting passengers. Arriving passengers, on the other hand, face the walls, so here the designers have mounted large photomurals of well-known landmarks in the area of each station. As decorative elements, these are reminiscent of the abstract murals in the Stockholm subway, but they also help to tell the rider where he is. Passenger orientation is reinforced by detailed neighborhood maps and color-coded end walls: cheerful orange and red stripes indicate the downtown direction; cool blue and green stripes point the way to the suburbs. The grey and white trains have bright yellow doors that beckon boarding passengers. This same yellow is used to call attention to the edge of the platform which is illuminated by a continuous lighting fixture. In addition to functioning as a safety device, this fixture throws light up onto th[illegible]ng, thus bringing out the character of [illegible] space.

Like Weese, Cambridge Seven feels that communication between subway and street should be as direct as possible. In the four-volume design standards manual that the firm prepared for the MBTA, it recommends that stations be opened up to the outdoors by removing roofs from the entrances. For those stations having escalators running all the way up to the street, Cambridge Seven has designed a transparent kiosk having a simple arched shape that is compatible with the architectural style of any neighborhood in the city. Perhaps the most remarkable thing about Boston's design program is that it is being applied to the entire transportation system—buses as well as subways.

One of the designers' first tasks was to replace the old "MBTA" with a new system symbol. They chose a "T" in a circle, similar to Stockholm's Tunel-Banan symbol. This "T" is not only appropriate for Boston, but it is also intelligible to foreigners because it is the first letter of many words associated with transit in other languages. One can ride the "T," just as one can ride the "Metro" or possibly the "M," but certainly never the "ba." Boston's "T" is displayed on large, round, back-lit signs at station entrances, and is painted on the sides of all buses and transit cars. The type face for all signs, vehicles, maps, and other printed matter is Helvetica Medium. Like the transit cars, the buses are painted grey and white with yellow doors.

Following the example of the London Underground, which is considered by many to have the finest graphics of any rapid transit system in the world, the designers have introduced color coding to Boston. Each rapid transit line is designated with a different color, according to which the route is named: Red Line, Blue Line, etc. Two appropriately colored bands bearing the name of the stop run the entire length of the station walls. One band is positioned about half way up the wall, the other near the floor so that standees can see it without bending over. Buses which terminate at a rapid transit station carry the color of that line as a background on their rear-lit destination signs. If a bus crosses a second rapid transit line on the way to its last stop, the color of that line also appears on the destination sign, along with the name of the intermediate station. All bus stop signs carry labels that correspond in color and route number to the buses stopping there. In this way, routes and connections become visible, and transfer between buses and rapid transit is much easier. To help make Boston's subway comprehensible as a whole, the designers have prepared a highly simplified color-coded system map along with individual strip maps for each line in the system.

Cambridge Seven has also been retained by the MBTA to design—or, more accurately, to redesign—a transit car for Boston's new South Shore extension. Since the new cars must be compatible with existing rolling stock, the scope of the project has been necessarily limited to human factors considerations and general appearance. According to the designers, they have tried to achieve a timeless look—one that will not go out of style for at least 35 years (the life expectancy of any transit car). Evidently, they are not too optimistic about the progress of rapid transit design: the vehicle is quite conservative, with flat ends that allow it to be easily coupled and a fairly simplified exterior. Unfortunately, someone has insisted that car numbers be conspicuously displayed over the side windows, and that trains be identified by route letter (below, in front) and system symbol (side panel), as well as by destination (overhead, in front). Since it is doubtful that anyone waiting in an MBTA station could be expecting the Santa Fe Chief, the system symbol seems to serve no useful purpose and merely adds to the visual clutter.

The one respect in which the Boston car differs significantly from the Montreal and San Francisco vehicles is in its relationship of control cab to seating compartment. Because most of the South Shore line will run above ground, the partition separating the operator from the passengers has been made transparent so that riders can look out the front of the car at the scenery ahead.

The seats are floor-mounted (maintenance of the carpeted floors might have been facilitated had they been cantilevered) with padded armrests attached to the outside of each double-seat unit. Polyurethane cushions covered with pleated vinyl are set into the fiber glass seat shells. The majority of the seats are positioned transversely, one next to each window. This one-to-one ratio of seats to windows results in the insistent repetition of narrow windows that characterizes the external appearance of the car. As in the San Francisco prototype, half the passengers will be riding backwards at all times.

If all subways were as well designed as Boston's, the outlook for rapid transit in this country would be considerably brighter. Unfortunately, most of the work in updating and extending existing facilities is drab and uninspired. To be sure, the opportunities for innovation are necessarily fewer in an existing system than in a new system, but the scope of these projects is further limited by a desire to "clean up" old equipment rather than invest in a thorough redesign. The emphasis is on air conditioning and cushioned seats—embellishments that the public can easily recognize and will be quick to accept. More subtle factors such as seating arrangements, hardware, lighting, finishes, graphics, and traffic movement are generally ignored.

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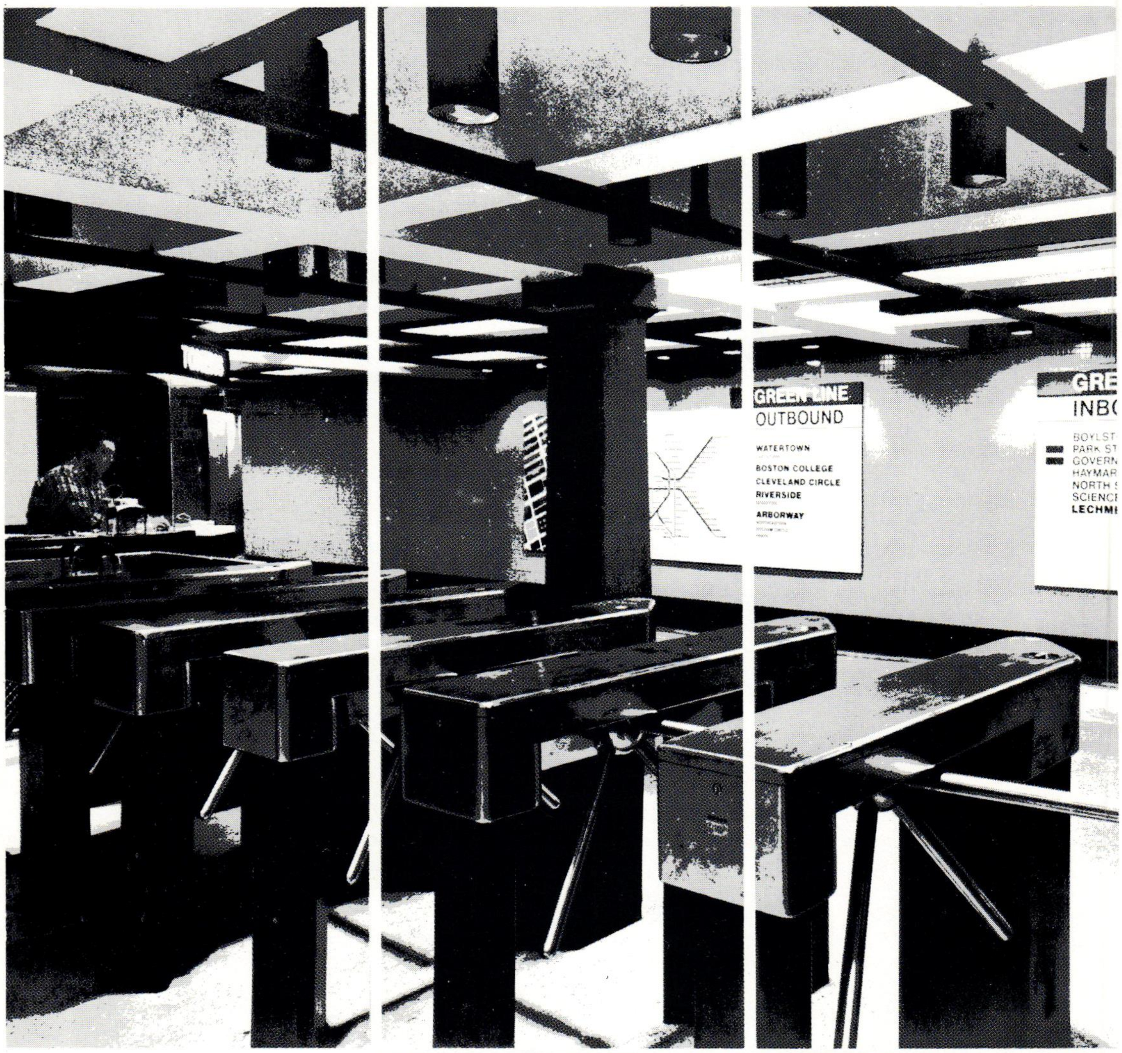

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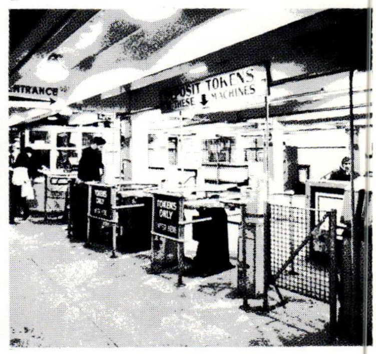

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Boston subway:
1. Remodeled station.
2. Same station before remodeling.
3. Detail of station wall photomural, identifying neighborhood landmark.

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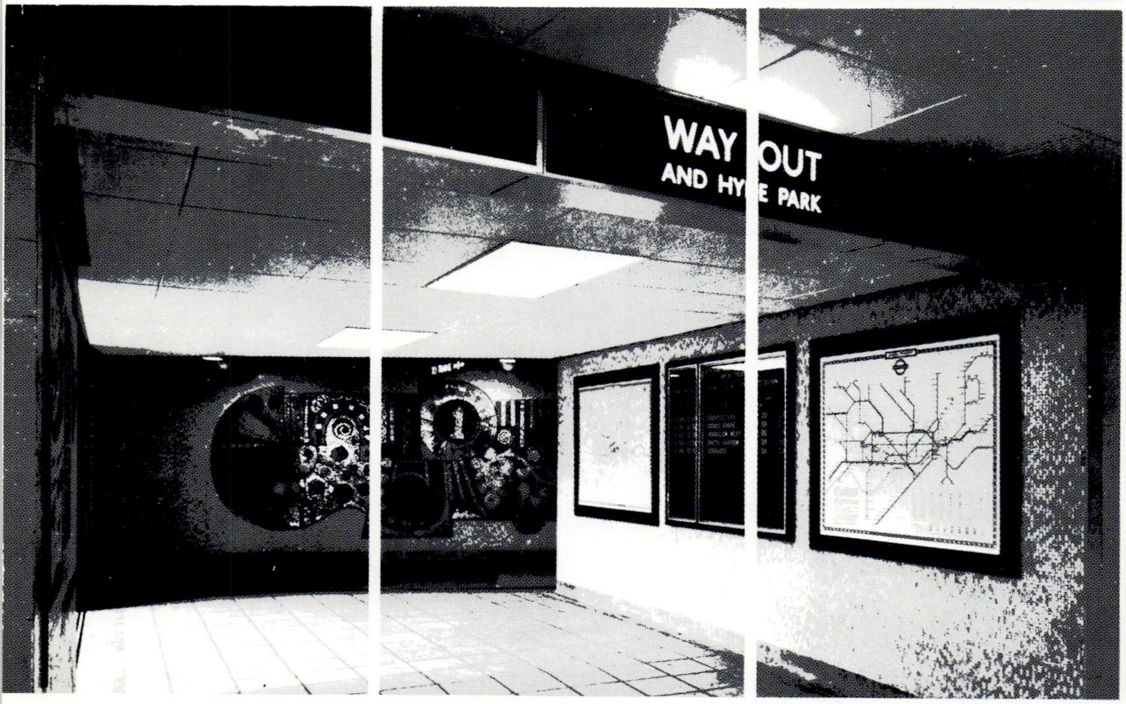

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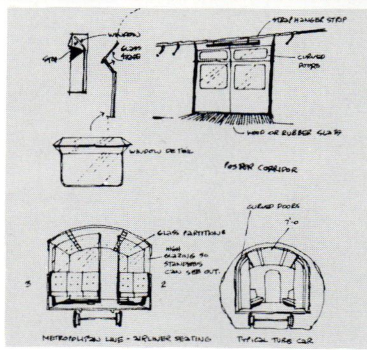

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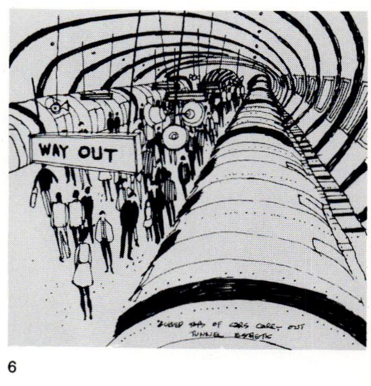

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London subway:
1. Identifying symbol.
2. Station interior showing effective display of clear graphics.
3 and 4. Street Furniture and station exterior.
5. Car interior, details.
6. Station interior.

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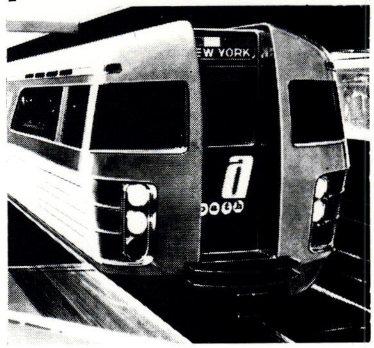

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New York subway:
1. New cars for Trans-Hudson tubes.
2. Original design for Trans-Hudson cars by Sundberg-Ferrar.
3. Trans-Hudson car, interior.
4. New cars, designed by Raymond Loewy/ William Snaith.

Take, for example, New York's new subway car. Designed by Raymond Loewy/William Snaith, it is distinguishable from the old one only in that it has borrowed a slanted front from the San Francisco prototype—a touch of streamlining that seems rather out of place since the rest of the car body remains as clumsy as ever. The numerous signs are still unreadable, the windows are still awkwardly divided, and the graphic symbol continues to be the worst in the world. (Aside from being badly executed, New York's "ta," like San Francisco's "ba," does not suggest rapid transit, does not function as a name, and has gone unnoticed by the public for years.) The slightly angled side panels are merely an affectation, and one that comes off poorly because the doors remain straight. The angling works to break up the line of the car body rather than to streamline it. Inside, the cars are relatively unchanged from the existing model. The passengers still lurch about on slippery longitudinal seating.

Meanwhile, the Long Island Rail Road is purchasing 200 electrified cars from the Budd Company for its commuter service. Under a regional plan that links New York City with its Long Island suburbs, these new cars will carry passengers directly to Wall Street. The cars themselves will be sleek and comfortable, having what designers Sundberg-Ferrar like to think of as a "living room atmosphere." The only fallacy here is that few living rooms are long and narrow with three seats on one side of an aisle and two on the other. While this arrangement provides maximum seating capacity, it also results in narrow, cramped aisle space and a rather unpleasant degree of crowding, Most seats have headrests, except for those on the aisle in the three-abreast unit, which are considerably lower and have handgrips running across their backs. This is to encourage riders to move over into window and middle seats instead of taking aisle seats when the others are vacant. Air conditioning, carpeting, and pleasing decor notwithstanding, veteran commuters are disappointed because the seats cannot be reversed for the convenience of card players. Considering the popularity of this pastime and the fact that many businessmen do paperwork on the train, it is surprising that the designers did not provide snap-down tables or some other flat surface. Also, the lighting seems poorly planned, being positioned in the center of the ceiling over the aisle rather than directly above the seats.

One of the oldest lines serving the New York area, the Port Authority Trans-Hudson tubes, has recently replaced its vintage 1909-1928 trains with light-weight aluminum cars. Also designed by Sundberg-Ferrar, these cars have the molded fiberglas end and bowed sides that are becoming the hallmark of this firm's work. Unfortunately, the smooth exterior contours are complicated by a profusion of lights, handgrips, and crude detailing (evidently engineers still ride along clinging to the outside of the train, a la Casey Jones). The interiors, however, are as pleasant as anything to be found in rapid transit today. Continuous strip lighting is integrated with advertising panels which, together with the uncluttered wall and ceiling surfaces, creates a feeling of welcome spaciousness. The cars are air conditioned (the only cool ride in all of New York), and the molded fiberglas seats are upholstered with vinyl cushions.

Cleveland is now working on an extension of its rapid transit system which, when complete, will provide the first high-speed airport-to-downtown service in this country. The prototype for this much needed service ought to be as up-to-date and appealing as the airlines which it will support. Regrettably, this is not the case. Imagine the air traveler's chagrin when he steps off the "Red Carpet Special" into an old-fashioned railroad car with rigid seats, exposed metal seaming, inefficient lighting, and lots of metal pipes dangling from the ceiling.

No discussion of design for intra-city systems would be complete without some mention of U.S. Steel's "SCOT" car. This vehicle, a super-slick mock-up designed by Peter Müller-Munk Associates, is part of the company's campaign to sell steel to cities planning to build new systems or expand old ones. With its panoramic windshield, sculptured snout, and enormous windows that wrap up over the roof line, it is another example of the Buck Rogers come-on to be followed up, in most cases, by an ordinary railroad car. This is not the fault of U.S. Steel. The mock-up is intended only to suggest the use of steel in rapid transit design; it does not pretend to be a production model. But many features of the prototype are so poorly thought out (for example, the driver's seat is not separated from the passenger compartment) that it contributes little to an understanding of the basic problems involved in designing truly modern, functional rapid transit.

The present hiatus in rapid transit is attributable to several factors that have influenced the design of all the vehicles described in this survey of intra-city systems. There is, as mentioned before, the timidness of car builders, reinforced by the willingness of transit officials to sacrifice any improvement that does not result in reduced maintenance or construction costs. As in all design projects, a lot of good ideas have gotten lost on the way from the drawing board to the assembly line. While the public is willing to pay for air conditioning, carpeting, soft seats and a little pazzaz, the less obvious—but often more important—design considerations are often overlooked. Then, too, because public taste is being molded by the seductive styling of automobiles and airplanes, there is a great temptation to make a rapid transit vehicle look like a car or a plane—which it is not. The danger in this kind of thinking is two-fold. First, automotive styling has already deteriorated to a non-rational exercise in planned obsolescence; to emulate automotive styling is to risk doing the same for rapid transit, and the economics of car building are not yet such that a rapid transit vehicle can be allowed to go out of style every two years. Second, in striving to achieve a "car" or "plane" look, the designer misses an opportunity to reappraise the rapid transit vehicle for what it is—a package with a function much different from that of a car or a plane. To date, no one has had the courage to scrap all existing concepts and begin with the transit vehicle as a special problem in traffic movement and human factors.

Perhaps cars serving local stops in high-density areas should have only pull-down seats along the sides, thus allowing more standing room for those people who are riding only one or two stops, and easing the flow of traffic during periods of frequent stops. And what about vertical switching? Since people are the reason for congestion and confusion, and their movement cannot be perfectly controlled, the solution might be to decrease the movement of people by increasing the flexibility of the vehicle. Perhaps transit vehicles should have sides that open up completely to facilitate the flow of passengers on and off the train.

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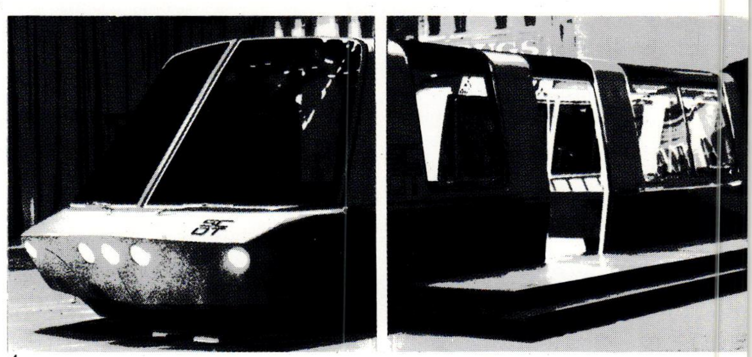

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Cleveland Transit System:
1. New cars for airport-to-downtown surface line.
2. Identifying symbol.
3. Car interior.

Prototype Intra-city vehicle:
4. SCOT Car, proposed by U.S. Steel, designed by Peter Muller-Munk Associates.

Another problem currently being ignored is the movement of the old and the handicapped. Since these people are often totally dependent on public transportation, it is shocking that none of our new systems provides ramps in the stations or space for wheelchairs on board the trains.

There is also the matter of interface with other modes of transportation. Most subways depend on bus lines to feed in their passengers, and vice versa, yet none of the systems currently being designed includes proposals for improving these connections. Why couldn't bus stops located near transit stations have well-lit, canopied shelters furnished with benches and maybe even coffee-vending machines? Such shelters might also be heated by air curtains and monitored by closed circuit TV to make commuting safer and more pleasant for those people who work and travel at night.

In the area of graphic design, there is a need to do away with the written language wherever possible, and rely more on pictographs. The exclusive use of one language makes a rapid transit system difficult for foreigners to comprehend, thereby discouraging tourism. And it should be remembered that a sizeable proportion of our urban population is either illiterate or non-English speaking.

Underlying the many failures in transit planning is also the fact that the people who make the final design decisions—the directors of the various transit authorities—are not professional planners or transportation experts. They are politicians, and while they may be advised by expert consultants, their decisions invariably reflect short-term political interests or mere personal preference.

In addition to the need for improved interurban and intraurban transportation, there is a growing demand for limited distance support systems, often automatically controlled horizontal elevators. These systems could solve the increasingly difficult problem of moving goods and people around sprawling complexes such as shopping centers, airports, universities, sports stadiums, industrial sites, amusement parks and exhibition grounds. The concept of the horizontal elevator is also important because it could be applied to the central business district where low-speed, not high-speed transit is needed.

The horizontal elevators best known to this country are the "Expo Express" (an automatically-controlled, conventional rapid rail system), the Expo "Minirail," (a lightweight monorail of sorts), and the Disneyland "PeopleMover." Of the three, the most sophisticated is the "PeopleMover," a prototype of which was first demonstrated in the Ford Pavilion at the 1964-66 New York World's Fair. The "PeopleMover" consists of small, motorless cars that glide along electronic guideways in which drive units are imbedded. The cars move silently and continuously at speeds up to 7 mph. Passengers are fed onto the system from revolving platforms that move at the same rate of speed as the cars. WED Enterprises, developer of the system, is now planning to install a "PeopleMover" in its EPCOT development (Experimental City of Tomorrow) near Orlando, Florida.

Another system being adapted for use as a horizontal elevator is the Westinghouse "Skybus." Although originally designed as a rapid transit system for medium-density metropolitan areas, the "Skybus" is now being modified to link the main building of Tampa's new International Airport with outlying loading stations. It is a duorail system consisting of small, rubber-tired vehicles that move in a series along a concrete guideway at speeds up to 50 mph. The trains are smooth riding, quiet, and completely automated; no on-board operator is necessary. A prototype is now operating in a demonstration park near Pittsburgh. The small boxy cars, designed by Eliot Noyes, New Canaan, Conn., have smooth skins, slightly rounded at top and bottom, and large tinted windows that curve into the roof line. Inside, the cars are spacious and comfortable, with upholstered longitudinal seating divided by armrests. Integrated into the armrest units are bent stanchions that fasten to the ceiling. Over-all, the cars are probably the most crisply detailed transit vehicles in existence

Out in the hills of White Pine, Michigan, ore is being hauled from a copper mine by a system of individually-powered modules interlocked to a track within a rectangular tube. This system, known as the "Dashaveyor," can travel horizontally like a train, vertically like an elevator, or up a steep grade like a conveyor belt—at speeds ranging from 3 to 50 mph. Its principal components are a clutchless electric drive, a vertical switching mechanism, an automatic control system, and the tubular guideway. The "Dashaveyor's" extreme flexibility makes it particularly suitable for rough terrain and performing complex material handling operations, but by mounting different types of modules on the drive unit, the system could also be adapted to carrying people, baggage, cargo, freight, and mail. Inventor Stanley Dashew claims that the "Dashaveyor" could even provide high speed transportation within or between large metropolitan areas. His immediate interest, however, is in developing the system as a horizontal elevator. Among the public agencies reportedly looking into the "Dashaveyor" are the Los Angeles International Airport (people, baggage, freight and mail handling), the City of Pomona (link between the Los Angeles County Fair Grounds parking lot and a downtown pedestrian mall), the National Park Service (tourist transportation), and the U.S. Post Office (mail and parcel post handling between regional centers and outlying districts).

Another of the more advanced horizontal elevators is a French system, the Battelle "Transveyor," a prototype of which will be unveiled in 1969. The "Transveyor" is a series of small, windowed, compartments conveyed on moving belts. As a passenger enters one of the slow-moving compartments, a door closes behind him and the compartment picks up speed. At the point of debarkation, the compartment slows down again and a door opens in front of the passenger, allowing him to step out. Throughout the trip, passengers remain standing. Each compartment accommodates two or three adults comfortably and there is ample space for bulky packages, wheel chairs and baby carriages.

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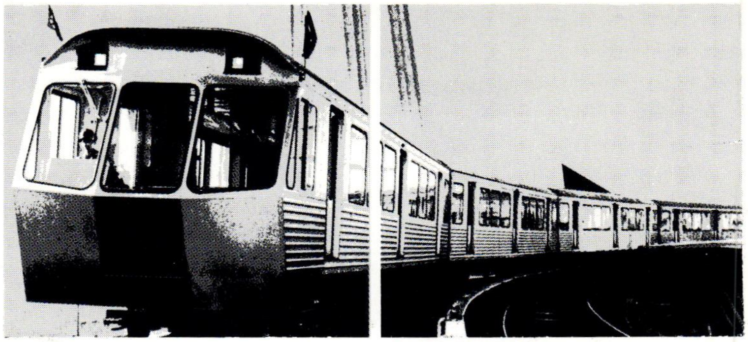

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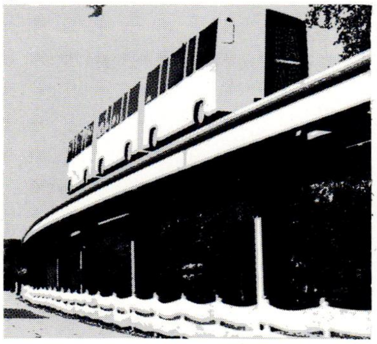

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Horizontal Elevators:
1. Expo Express, EXPO '67.
2. Skybus, designed by Eliot Noyes, built by Westinghouse.
3. Skybus, interior.
4. PeopleMover.
5. Minirail, EXPO '67.

Horizontal Elevators:
1 and 2. Dashaveyor units and plan for airport installation as proposed by designer, Stanley Dashew.
3. Dashaveyor, as proposed for intercity system.
4 and 5. Boarding station of Transveyor system proposed by Battell Institute, France.

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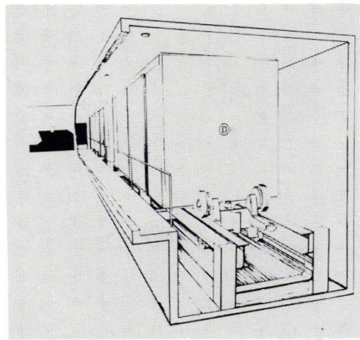

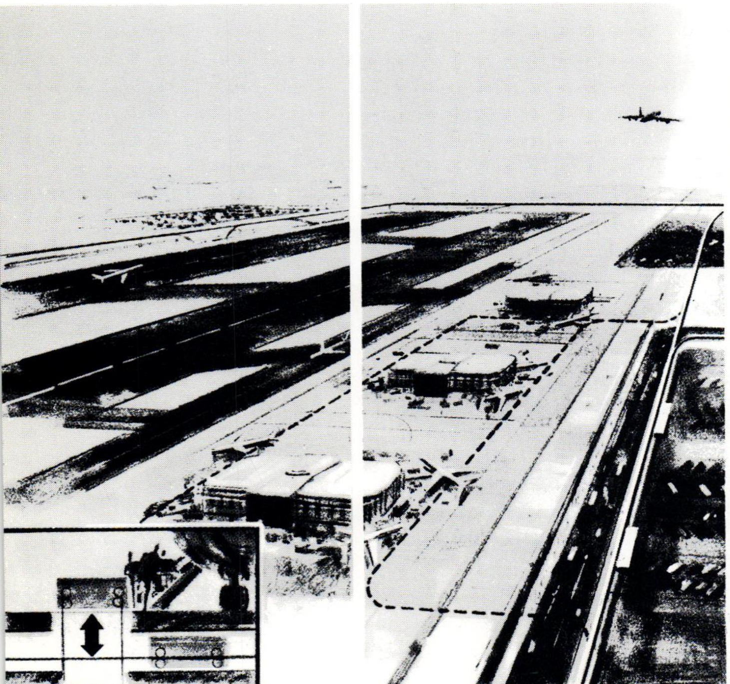

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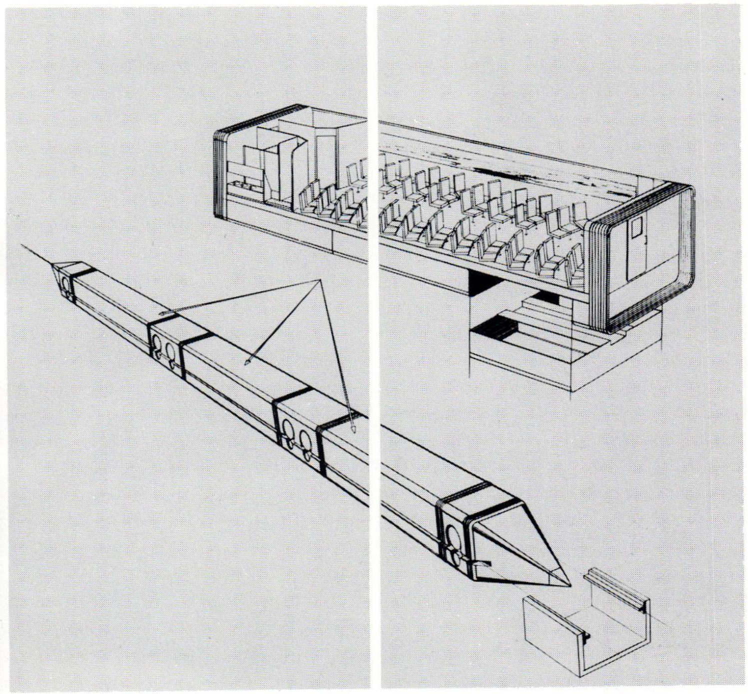

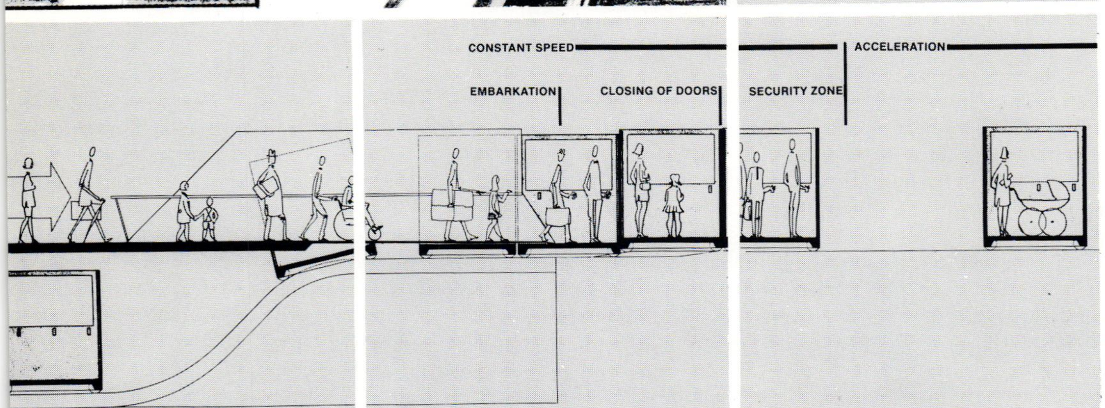

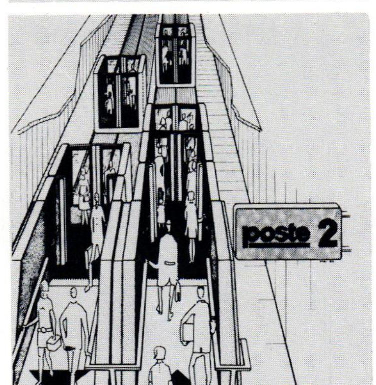

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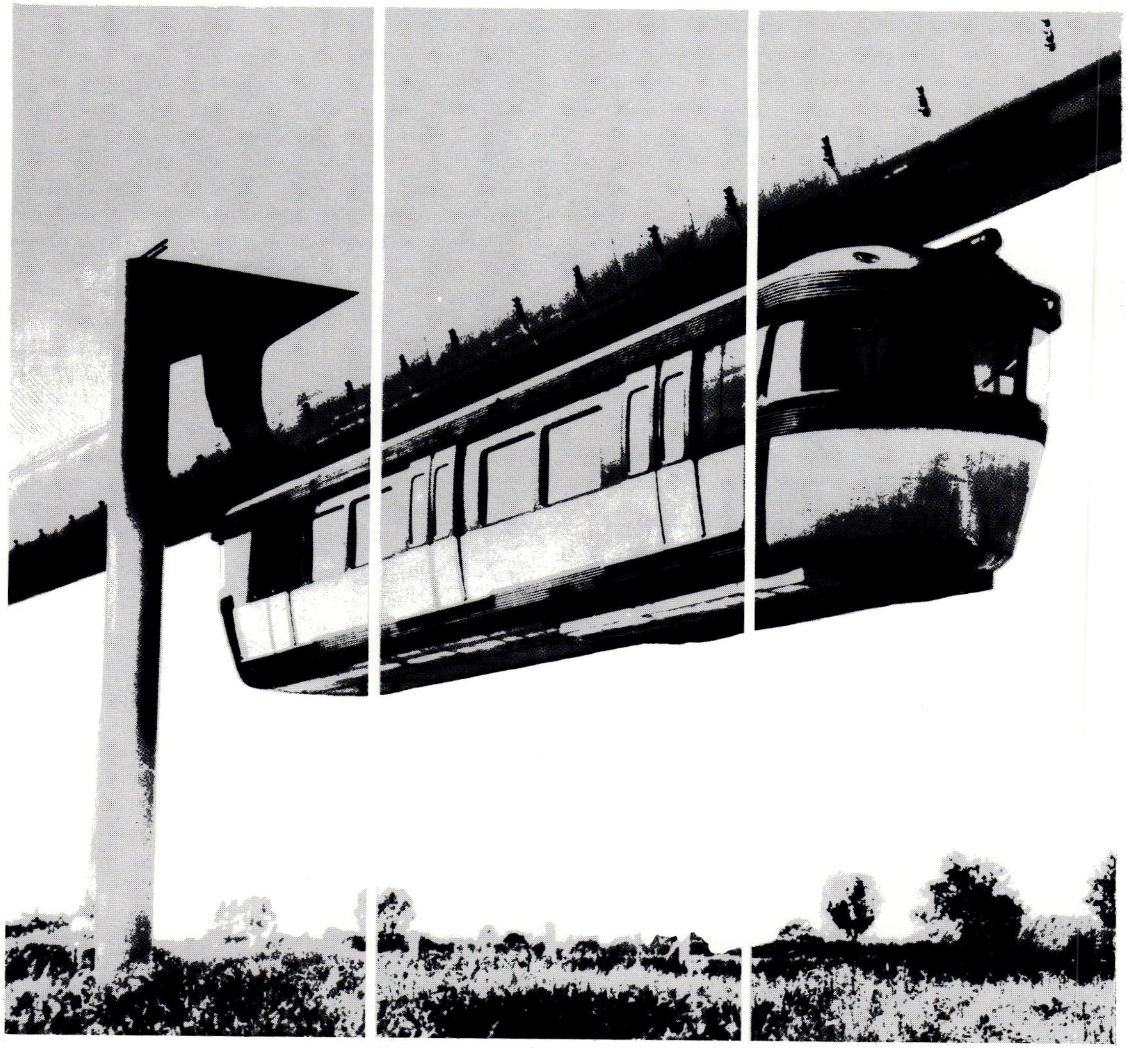

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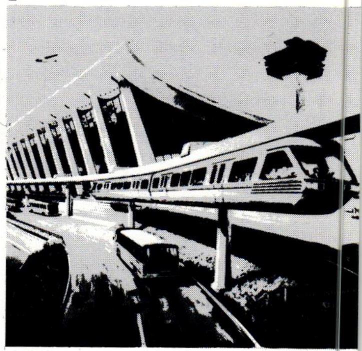

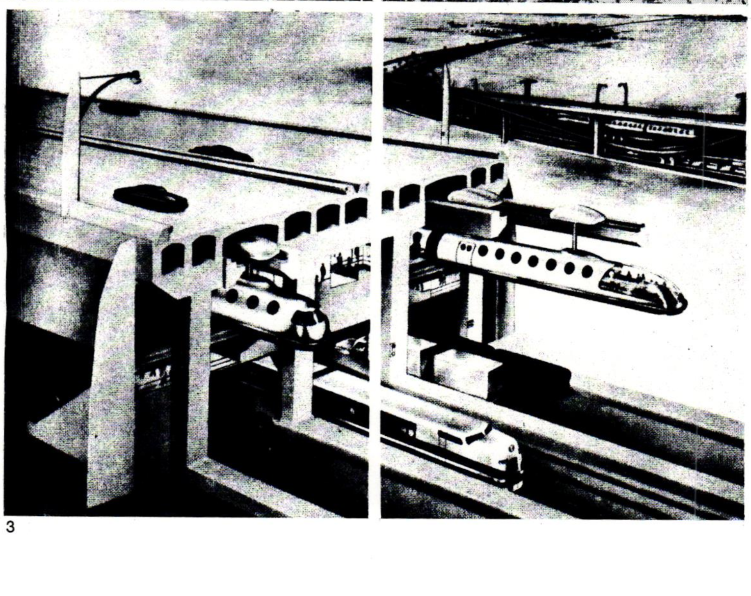

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Monorails:
1. Safege monorail in operation near Paris.
2. Airport-to-downtown application of Safege system, proposed by General Electric Co.
3. Hi-Level system, proposed by M. C. Bayer, incorporating elevated expressway for private cars, suspended mass transit vehicles and surface rail system.

Conventional rapid rail, no matter how highly refined or well designed, has severe functional limitations. To be sure, it has not yet outlived its usefulness, and for those cities seeking immediate relief from congestion, there is currently no more advanced technology available. But many planners are looking forward to the development of more sophisticated systems that will provide higher speeds on intercity runs, greater flexibility in suburban areas, and improved circulation in high-density urban cores. In suburban and urban applications, rapid rail is limited by its rigidity (once the track is laid, it cannot be shifted around to meet changing transportation needs) and poor accessibility (passengers must seek it out, it cannot be brought to them). On intercity runs, there is some indication that at speeds approaching 150 mph, the steel-wheel-on-steel-rail principle reaches the limit of its utility. Beyond this, wheels begin to slide and wear excessively. And some observers believe that by the time an adequate high-speed intercity rail network could be built in this country, vertical take-off and landing aircraft will be available.

There are probably a hundred different advanced systems now being proposed by various engineers and entrepreneurs. Some are as familiar as the venerable monorail; others as exotic as the 17,000-mph "Hyperion" rocket. Many are hardly new (a pneumatic tube system was built in Ireland during the 1840s), and some are so similar to one another that it is difficult to draw patentable distinctions between them. Critics of these advanced concepts claim that they lack linear integrity (one breakdown in a pneumatic tube would immobilize the entire system), that their capacity is overrated (some small car guideways might not be able to carry as many people as present freeways), and that they are too expensive to build and operate. But with construction costs running as high as $25 million a mile for urban freeways and $15 million a mile for double-track subways, this last objection becomes highly debatable. Furthermore, not to explore the possibilities of even the more far-fetched proposals would signal a retreat to the dwindling ranks of buggy whip manufacturers.

Monorails

"Monorail" is a common misnomer for all overhead suspended rail systems, many of which are, in fact, duorail. There are two distinct types of true monorail: suspended and supported. The earliest monorails were probably developed around 1870, and in 1896 construction was begun on the first and only system ever successfully adapted to mass transit: the 8.3-mile suspended monorail in Wuppertal, Germany. This system is still in use today, but in the 70 years since it began operation, only one other large-scale mass transit monorail has ever been undertaken. This is the 8.2-mile straddle-type supported monorail linking Tokyo International Airport with downtown Tokyo. Completed in 1964 at a cost of $60 million, the system is technically not a monorail; no supported type is, with the exception of the Brennan gyro stabilized system. Principally because of poor planning (a high-speed expressway was constructed along the same route), the Tokyo monorail has been a financial failure, operating well below capacity. On the other hand, a similar supported monorail built to connect downtown Seattle with the site of the World's Fair is still running, and at a small profit. Now that the originally "temporary" structure threatens to become permanent, however, property owners are suing for damages and there is a good possibility that this country's only successful monorail will have to be torn down.

For the most part, the monorail has been relegated to amusement parks and expositions. Because the switches and crossovers present serious technical problems, particularly in suspended systems, it has never received enthusiastic support from rapid transit planners. The cars are necessarily small and narrow, and capacity is therefore limited. Upon closer examination, many of the advantages claimed for the monorail—lower construction costs, higher operating speeds, lightweight supporting structures, narrow rights-of-way, self-banking characteristics—turn out to be somewhat exaggerated by the system's proponents. For example, a monorail support structure is only slightly less obtrusive than any well designed elevated structure, and monorail speeds are no greater than those of conventional rapid rail. Recently General Electric joined the monorail campaign with its purchase of the SAFEGE franchise. (This same franchise had been dropped by American Machine Foundation after the failure of its New York World's Fair prototype.) G.E. sees a market for its suspended system in airport-to-downtown runs, and there is a possibility that it may be installed along a highway connecting El Paso, Texas, and Juarez, Mexico. A French version of the system now being demonstrated near Paris regularly reaches 90 mph.

One of the more novel variations on the monorail theme is the "TransDrive," a car ferry. In this system, bogies suspended from a monorail would pick up automobiles by special attachments located on the car roofs. Developers of the "TransDrive" claim that it would be capable of transporting fully loaded, conventional automobiles at speeds of 300 mph. The most interesting thing about the "TransDrive" concept is that it recognizes public acceptance of the automobile and actually combines two modes of transportation in one system: the private automobile with its inherent flexibility and accessibility would provide low-speed collection and distribution service over short distances; the monorail, running at high speeds on exclusive rights-of-way, would provide rapid transit over long distances. The principles of dual mode transportation will be discussed at greater length later on.

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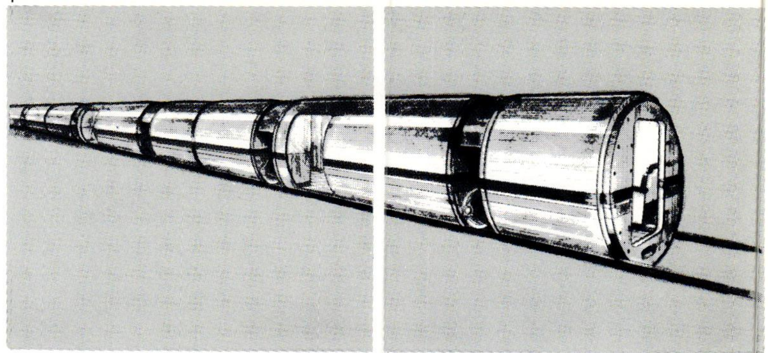

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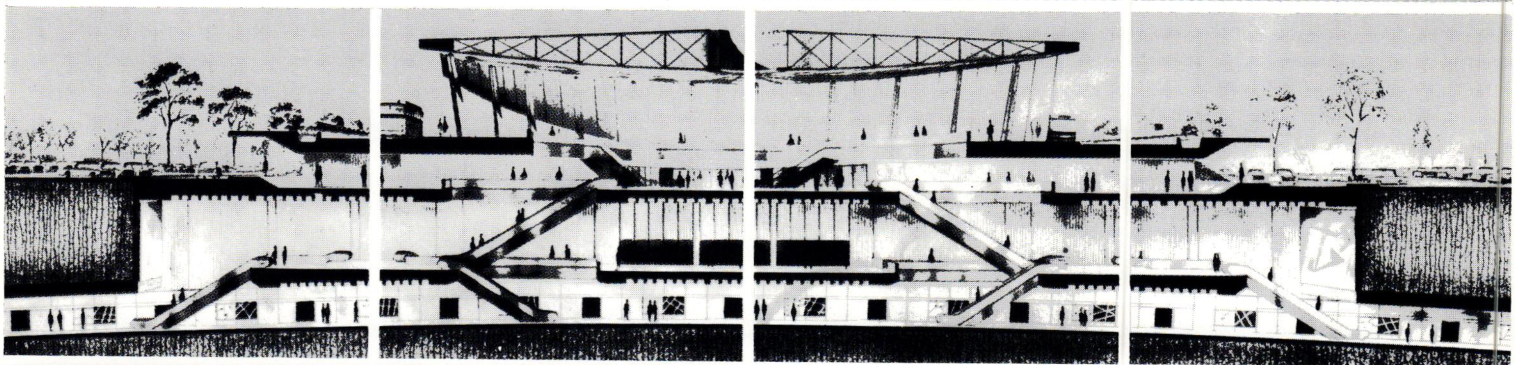

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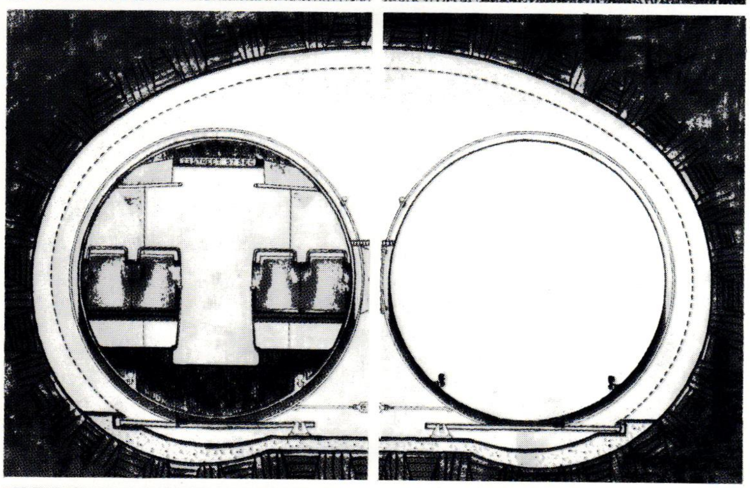

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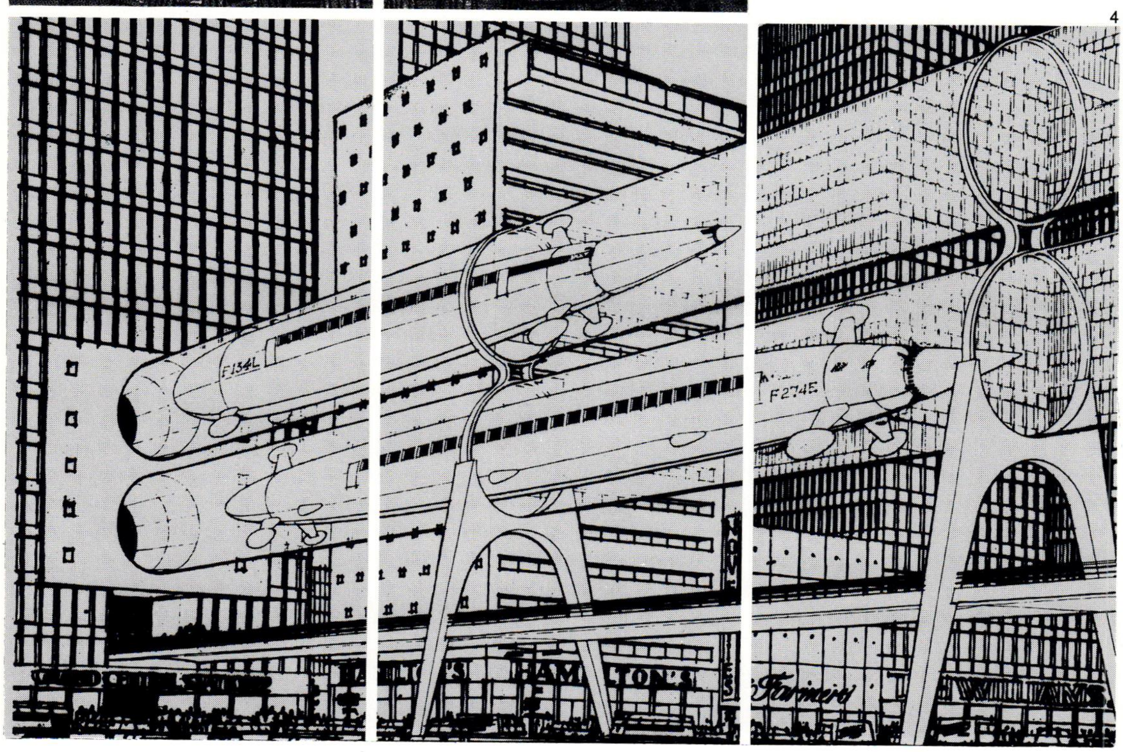

Pneumatic tubes:
1 and 2. Cars and station of gravity-vacuum system proposed by Lawrence K. Edwards.
3. Section of Edwards tube system.
4. System proposed by Joseph V. Foa.

Pneumatic tubes

Perhaps the most appealing of the advanced high-speed ground transportation proposals is the Edwards pneumatic tube. Unlike many other new proposals, this system, designed by former aerospace engineer Lawrence K. Edwards, has been quite thoroughly researched. Like the monorail, the pneumatic tube is not really new; a demonstration system was installed under Broadway in New York City in 1870. But the Edwards design is attractive because it offers very high speeds (maximum is 500 mph) in both intraurban and interurban applications. Installed in the Northeast Corridor, for example, the Edwards tube could reduce travel time from Washington to Boston to 90 minutes. Cost for construction of such a system is estimated by Edwards at $5 million per mile (critics say $10 million) compared to the $6 million per mile it would take to duplicate the Tokaido line along this route. In an urban area, the tube could provide service roughly twice as fast as that provided by conventional subways. Recently Edwards proposed that his system be installed under New York City's busy East Side. He claims that a 34-mile tube extending from Westchester to Staten Island could be built in the next eight years for less than $500 million. The trip from one end of the line to the other, with 28 intermediate stops, would take 48 minutes.

The Edwards pneumatic tube would take advantage of two natural forces: gravity and the vacuum. The course of the tunnel would arc downward between each station so that trains would be both accelerated and decelerated by gravity. According to Edwards, this pendulum motion would not be felt by passengers. Within the tunnel, two adjacent tubes would move trains in opposite directions. The trains themselves would be long, pressure-tight cylindrical capsules with diameters two inches smaller than the steel tubes. Electrically-powered pneumatic pumps or compressors located next to the tubes would reduce air pressure within the tubes to 1/60 of atmospheric pressure. This would cut air-drag losses as a train passed through the tube, and would supplement gravitational forces in starting and stopping. The trains would be guided by flanged steel wheels on steel rail. Critics of the system contend that at speeds of 500 mph, steel wheels may not be feasible, but Edwards points out that wear would be minimized by the fact that the wheels would not have to transmit heavy propulsive and braking forces.

Another type of tube transport system has been developed by Joseph V. Foa of Rensselaer Polytechnic Institute. Unlike the railroad tunnel or conventional pneumatic tube in which the air is in motion, Foa's system would allow the air to remain nearly at rest while the train passes through the tube. That is, the train would propel itself by transferring the air fore-to-aft through passages within the train, as well as through the space separating the train from the tube. Some of the air captured in the train would be compressed, heated, and ejected again which would help to transfer the remainder of the air through the space separating the train and the tube. The principle of ground effect could be employed to support the train on all sides, cushioning its free motion in the tube and banking it on curves. Foa has proposed two types of air-gulping trains. One would carry 100 passengers at speeds up to 375 mph; the other would carry 200 passengers at speeds up to 525 mph. Theoretically, his system is capable of speeds of 2,000 mph.

Ground effect vehicles

The best known ground effect, or Air Cushion Vehicle (ACV) is the British "Hovercraft." Produced in America by Bell Aerosystems under a franchise from Hovercraft Development, Ltd., the ACV is currently being used to ferry commuters across the San Francisco Bay and to land troops and supplies on the beaches and swamps of Viet Nam. The advantages of the craft are its high speed over any kind of water (roughness does not affect the ride) and its amphibious nature. The craft can be settled down on a beach or landing ramp so that passengers can step directly onto dry land. Its chief drawback is excessive noise. A Hovercraft built to carry 254 passengers and 30 cars has been tested successfully across the English Channel and is scheduled to go into service in fall of 1968.

The same ground effect principle is being applied by Hovercraft to the "Hovercar," a tracked ground transportation system. Because the vehicle would not ride on wheels but would instead be supported by cushions of air, friction would be reduced and a smooth ride at speeds up to 500 mph would be theoretically possible. The tracked "Hovercraft" is still in the development stage, but a half-size model of a similar vehicle, the French "Aerotrain," has reportedly reached speeds of 250 mph along a 4.2-mile test track outside Paris. The French government is now financing construction of a full-size "Aerotrain" and an additional 12.4 miles of test track. Promoters of the system hope eventually to extend the line all the way from Orleans to Paris. The full-size train, which would ride on a thin cushion of air along a concrete track that looks in cross-section like an inverted T, would be able to carry 80 passengers over the 70-mile route in 25 minutes. As with the Bell ACV, however, there is a serious noise problem. Even if the train is thoroughly sound-proofed, residents along the right-of-way are certain to object to the roar.

At the same time that it is supporting development of the "Aerotrain," the French government is also constructing another two miles of track to test an air cushion vehicle propelled by a linear induction motor. A similar concept has been proposed by MIT in its study of high-speed ground transportation for the Northeast Corridor. MIT's "Glideway" is based on a system of modular carriers that could operate separately or in trains. For people traveling alone or in small groups, there would be small, personalized carriers. For those people wanting to take their cars with them, there would be car-carrying modules, a larger version of which could accept trucks or buses. The various modules would ride on a cushion of air along fin-slotted guideways. Simple wheeled suspensions would be provided for modules stopping in a station or traveling too slow to achieve ground effect.

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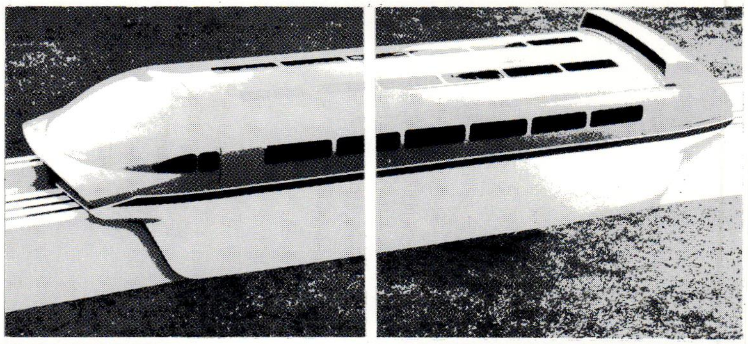

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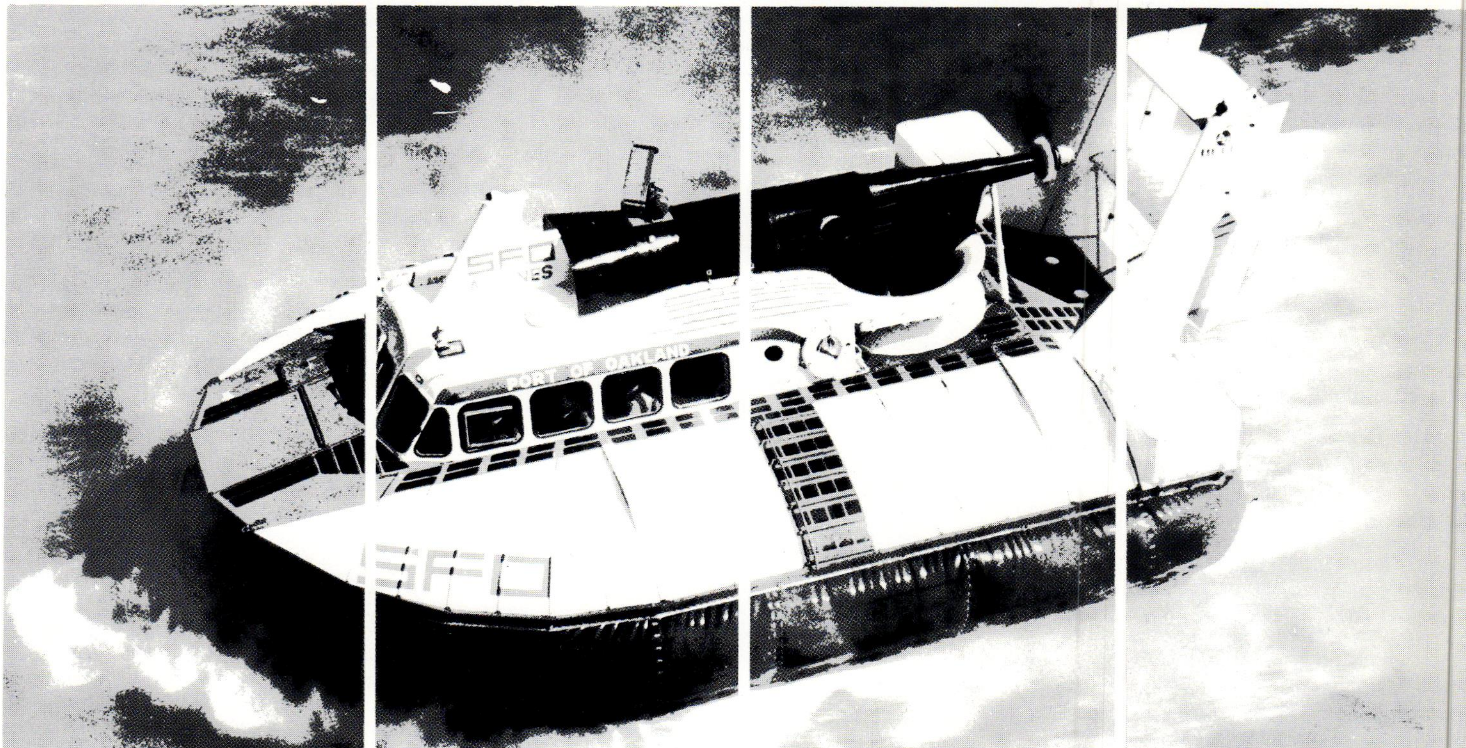

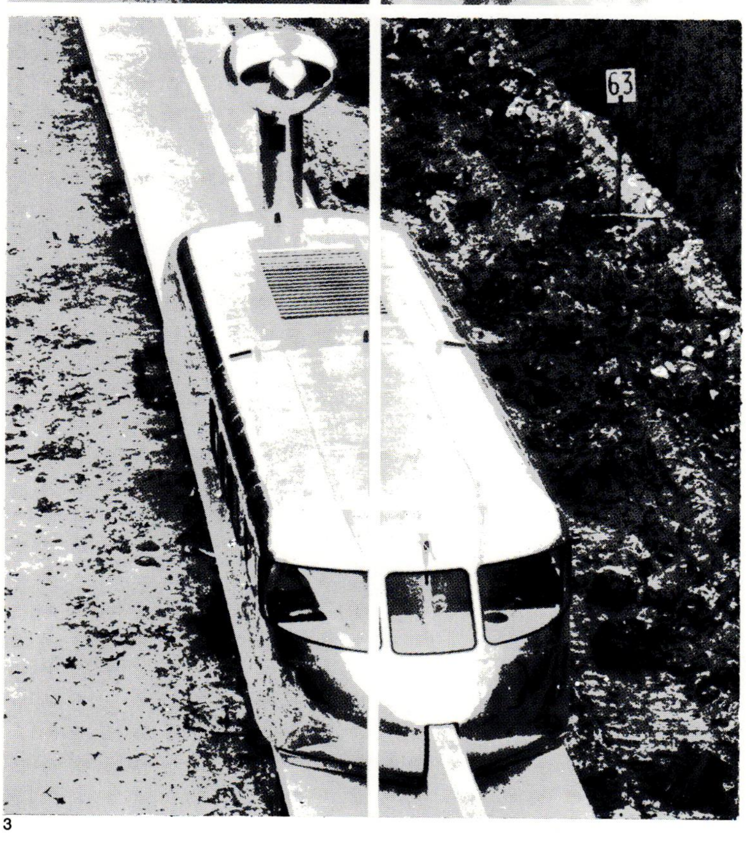

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Ground effect vehicles:
1. Hovertrain.
2. Hovercraft, in operation on San Francisco Bay.
3. Aerotrain.
4 and 5. Guideway and station of Uniflo system under development by Rosemount Engineering Co.

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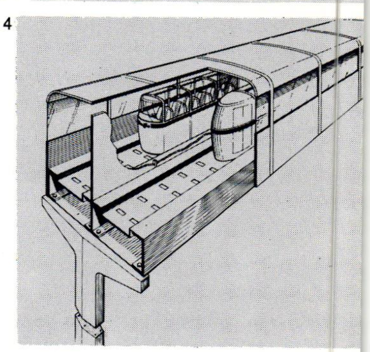

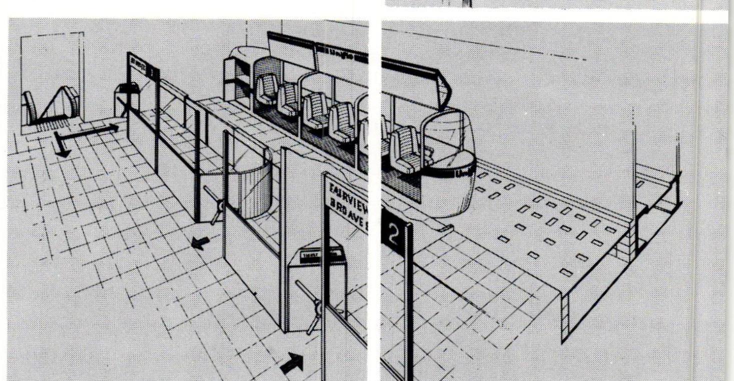

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General Motors has also been studying ground effect vehicles propelled by linear induction motors. Its system, called the "Hovair," assumes a guideway shaped like a shallow W, and is similar to the tracked Hovercraft. Speed potential of the "Hovair," however, is only half that of the British system. Several years ago, Ford proposed a system of multi-passenger ground effect vehicles operating on a special two-rail track. These "Levacars," as they were called, had pads instead of wheels, and the pads slid along the rails on a thin film of air. Speed potential for the system was claimed to be 150 to 400 mph. After experimentally proving the technical feasibility of the "Levacar," Ford abandoned the project in 1961. The company felt that engineering a full-size prototype would not have been worth the time or the money.

Another concept is the "Uniflo", a system under development by Rosemount Engineering Co., which combines ground effect and small cars. In this system, six-passenger vehicles move along enclosed guideways that would, in reality, be the upper surfaces of air ducts. Power would be provided by jets positioned along the guideway. A main line track would operate at a constant speed of 45 mph, or 66 feet per second. In order to get vehicles up to this speed so that they could enter the main line without interrupting the traffic flow, a high-speed vertical acceleration guideway would be provided parallel to the main line. Extraction of a vehicle without interruption to mainline service would be accomplished by transverse jets that would deflect the vehicle through a small vertical arc. As soon as a vehicle passed off the main line, these transverse jets would shut off, allowing the following vehicle to proceed along the main line without interruption. An extracted vehicle would be decelerated at a rate of six feet per second in a vertical chute having a friction-coated surface. The "Uniflow" could thus transport passengers from point of origin to point of destination without intermediate stops. A high frequency of stations would assure accessibility, and passengers would select their destination before boarding the vehicle. Loading would be computer controlled, but actual vehicle movement would be regulated by multi-redundant open loop controls.

Critics of the ground effect systems feel that they are less desirable than air transport over long distances, and less desirable than conventional rapid rail at speeds below 400 mph because inherent stop delays limit their efficiency in providing way station service—the chief virtue of all high-speed ground transport. Furthermore, excessive noise might require a reduction of speed in urban areas, and there is a possibility that very high speeds near the surface might result in severe passenger discomfort. Also being questioned are air cushion stability at high forward speeds, vehicle stability in high crosswinds, and power pick-off at high speeds. It is quite likely that if a ground effect system is to be weather-independent and obstacle-free, it would have to be completely enclosed. This would increase construction costs and could result in an unsightly right-of-way.

Small car systems

Many planners feel that the most promising of the advanced systems are the small, tracked vehicles, particularly those that would permit both independent off-track operation and automatic on-track control. The latter are the so-called dual mode systems.

It should be noted here that a number of essentially dual mode systems do not fall into the small-car category, for example: the car carrying "Auto-Train," the helicopter-bus, and the automated highway. (The automated highway would accept full-size gasoline powered automobiles, whereas the small car systems can operate only with specially designed electrically-powered vehicles.) Still another type of dual mode system has been demonstrated in New York City, Philadelphia and Minneapolis. In the New York test, an ordinary looking bus approached a railroad bed, lowered four flanged steel wheels onto the tracks, and took off down the exclusive right-of-way. Miles later, it re-entered the highway by retracting the steel wheels and settling back down on its rubber tires. While a rather crude hybrid, such rail-buses exhibit the characteristic common to all dual mode systems: a combination of high line speed and local distribution flexibility.

One small-car system that does not combine these two operating capabilities is the "Teletrans." Originally designed as a system of automatically-controlled, electrically-powered vehicles running in an enclosed tube on non-metallic wheels and aluminum rail, the "Teletrans" was at one time scheduled for a $3 million one-mile demonstration in Detroit. This plan, however, was stalled because of political problems, and the "Teletrans" has since been converted to a baggage handling system. Its first practical application may come in the new Dallas-Fort Worth airport.

Another small car system now in prototype is the Alden "StaRRcar." Actually, there are two types of "StaRRcars," one a dual mode vehicle that can run on both automated guideways and ordinary streets, and the other a horizontal elevator that operates only on the guideways. William Alden, developer of the system, theorizes that a commuter could keep a rented "StaRRcar" at home, where its electric batteries would be recharged overnight. In the morning, he would drive it manually to the nearest guideway entrance. There he would push a destination button and relinquish control of the vehicle to the automated guideway, which would carry the "StaRRcar" into town at 60 mph. Arriving at his station, the commuter would leave his vehicle which, if not needed there, would automatically be sent to another station or stored in a garage. At the end of the day, the commuter would return to the station and pick up or in fact rent another "StaRRcar."

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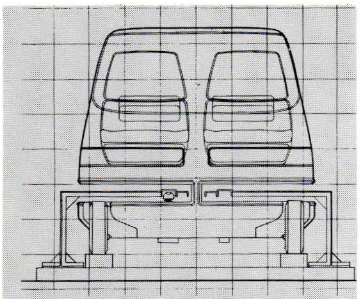

CROSS SECTION OF THE STARRCAR IN GUIDEWAY.

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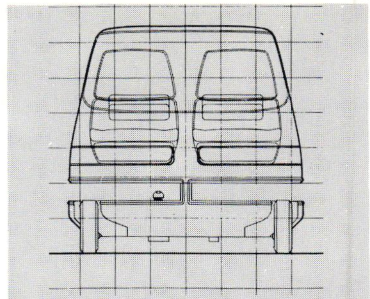

CROSS SECTION OF THE STARRCAR ON REGULAR ROAD.

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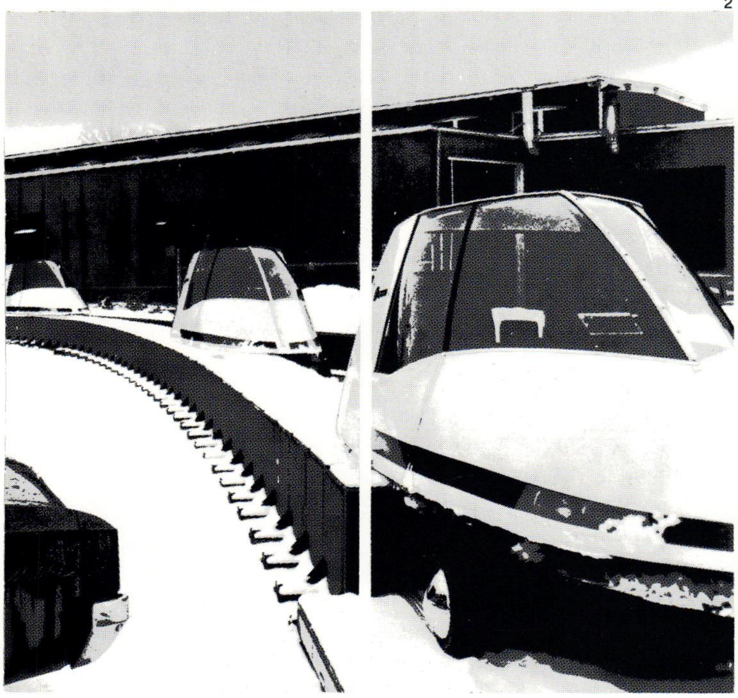

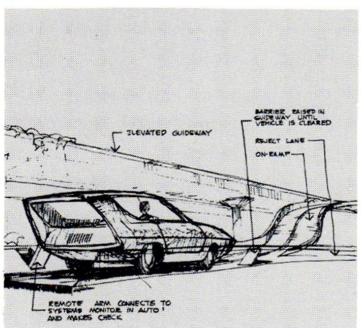

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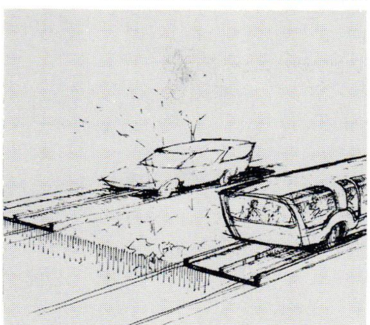

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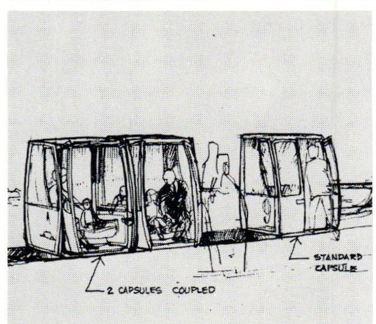

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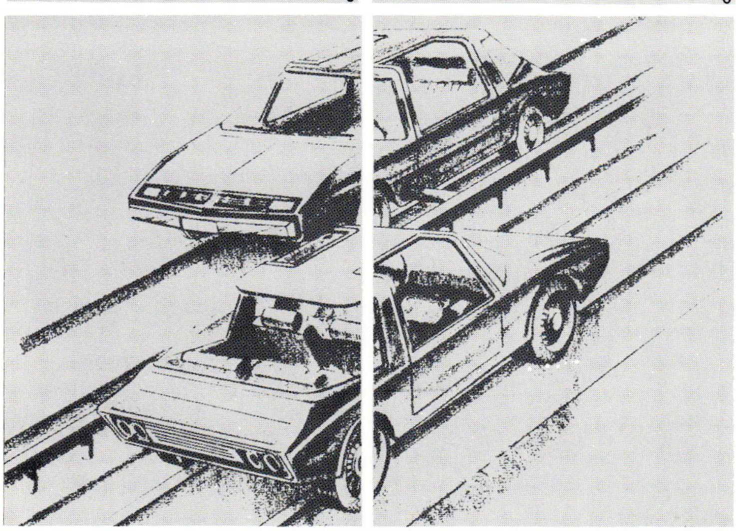

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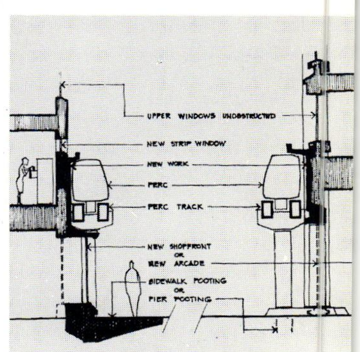
Small car systems
1 and 2. Dual mode StaRRcar, on slotted guideway, under development by Alden Self-Transit Systems Corp.
3 and 4. Alden StaRRcar on street.
5 and 6. Dual mode vehicle of Metran system proposed by Massachusetts Institute of Technology.
7 and 8. Two-person capsule (PERC) for urban travel in Metran system.
9. Urbmobile, designed by Cornell Aeronautical Laboratory.



Using the second type of vehicle, the commuter would drive his own car to the nearest "StaRRcar" station, park it, and board a "StaRRcar" at the entrance to the guideway. Worcester, Massachusetts, is reported to be seriously considering this version of the "StaRRcar" for its central business district.

Backed by a $100,000 development contract from the Department of Housing and Urban Development, the Cornell Aeronautical Laboratory is studying a similar guideway system using dual mode vehicles called "Urbmobiles." Like the "StaRRcars," the electrically-powered "Urbmobiles" would have a guideway speed of 60 mph. On the street, their top speed would be 40 mph, with a range of 40 to 80 miles. The most significant difference between the two systems is that the body of the "Urbmobile" vehicle could be built by any of the auto makers in a variety of styles, the only requirement being that it fit the track and the third rail.

In its study of integrated, evolutionary transportation for urban areas, Massachusetts Institute of Technology has proposed the "Metran" system which would include a guideway and lightweight, electrically-powered dual mode vehicle similar to the "StaRRcar" and the "Urbmobile." The other components of the MIT system are: soft-wheeled buses running on exclusive rights of way (every third or fourth street might be reserved for buses); lightweight, automatically-controlled two-man capsules serving as a horizontal elevator in high-density urban cores; and a series of small, 10-passenger soft-wheeled vehicles providing mass transit in suburban areas (these, too, would be dual mode).

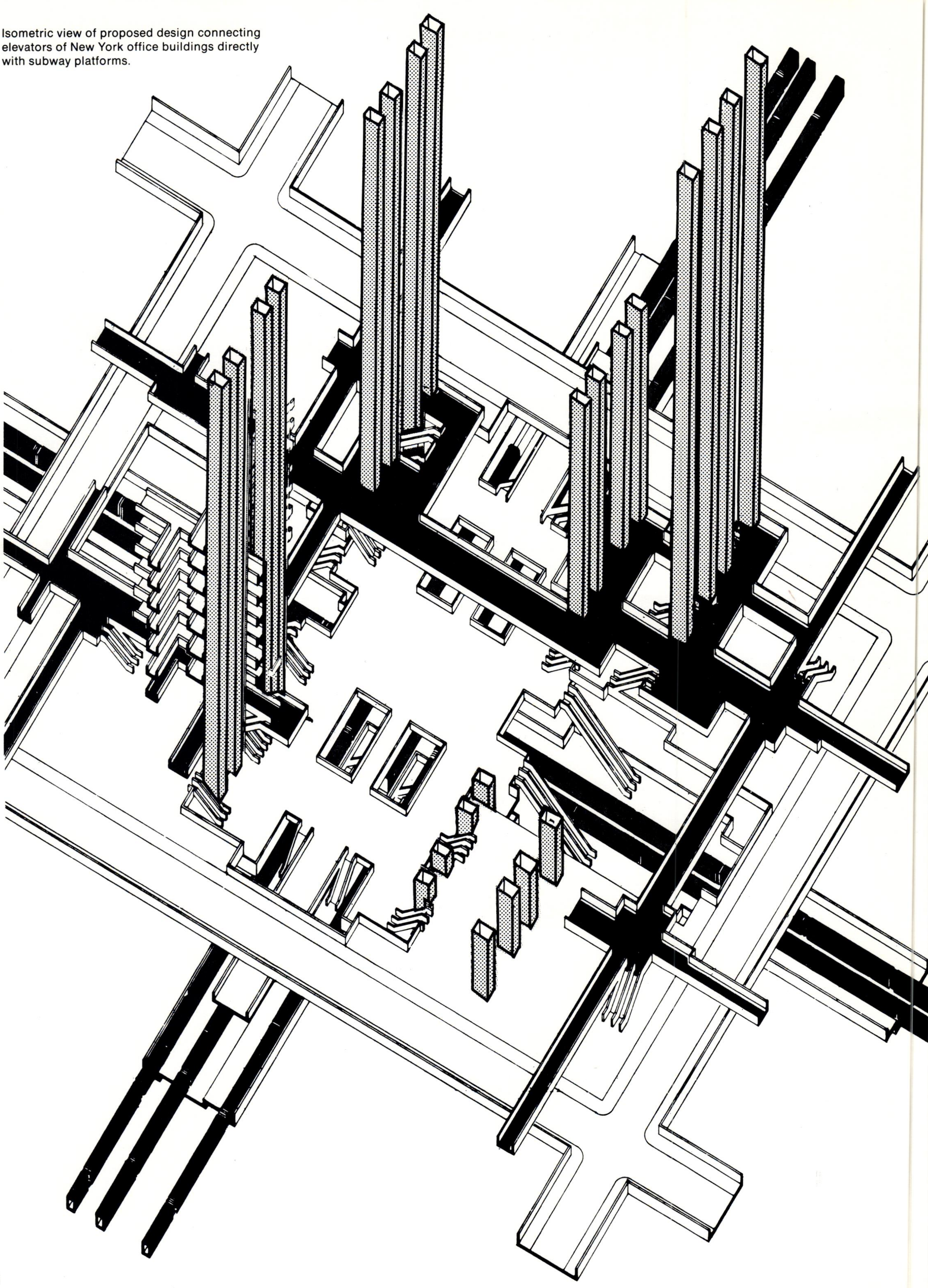
At the heart of this country's transportation crisis is the automobile. Its merits and defects are all too familiar and need not be recited here. The question is: will the automobile survive in its present form if and when mass transit becomes widely available? The standard answer is that mass transit and the automobile will work hand and hand. But this is dodging the issue. All indications are that if the private automobile is to survive mass transit, it will, itself, have to become a form of mass transit. The growing demand for safer vehicular design, exhaust controls, speed governing mechanisms, tire standards, highway monitoring devices, uniform traffic signs, and better engineered highways, points to the day when the automobile and its operation will be much less a matter of independent choice than they are today.

At the moment, many people resent having to pay for "safety" features that they feel they don't need; their position is about as tenable as someone refusing to pay for headlights because he never drives at night. As the same principle that makes headlights mandatory is applied more broadly to the automobile and its operation, fewer and fewer real options will be available to the car buyer and/or driver. For example, seat belts and now headrests were at one time optional; today they are standard equipment and recently the courts have refused to award damages to accident victims who were not wearing their seat belts at the time of the collision. By the time automated highways and electronic guideways become a reality, people will no longer be buying private automobiles at all. Rather, they will be buying—or, more likely, renting—one element of a highly regulated mass transit system. The current trend to long-term automobile rental indicates a willingness on the part of many people—particularly higher-salaried, better-educated people—to relegate the car to its proper function: that of a public utility. Who today insists on owning his private power plant when he can "rent" electricity at the flick of a switch?

Of course, the automobile is a form of recreation as well as a mode of transportation, and it is in recreational vehicles that the internal combustion engine is most likely to be retained. As leisure time increases, there will be a growing market for off-road vehicles and true sports cars. The latter, like racing cars today, will probably be assigned their own special roadways apart from the main automobile transport system.

If all this sounds slightly Orwellian or un-American, it should be remembered that Detroit is already conditioning people to the idea of "standardized" personal cars by styling all its models very much alike. Moreover, mass transit is a threat to the private automobile only insofar as the automobile creates chaos and confusion. By systematizing the vehicle and its operation, much of this chaos and confusion can be eliminated. In other words, if people want to enjoy the freedom and mobility of the private automobile, they will have to sacrifice a certain amount of autonomy in their choice of vehicle and the manner in which they operate it.

Isometric view of proposed design connecting elevators of New York office buildings directly with subway platforms.



MASS TRANSIT AND URBAN FORM

Although the power of transportation to shape or reshape towns and cities seems to be widely recognized in theory, there is, in practice, distressingly little coordination between transportation planning and the many other processes which determine the development of urban areas. All too often, this lack of coordination results in or contributes to the major problems plaguing our cities today: (1) social and economic discrimination; (2) unintelligent, inefficient planning; and (3) failure to realize opportunities for visually exciting urban form.

Looking first at the problem of social and economic discrimination, one finds that the tendency in mass transit planning is to remedy immediate crises rather than avoid future ills, and to respond only to the demands of the most vocal, influential members of the community—the white, middle class, suburban commuters. For example, the section of New York that will benefit most from the city's subway expansion program is the affluent Upper East Side, while many lower income neighborhoods remain cut off from major employment centers. Similarly, Montreal's Metro serves only the thriving downtown area, while San Francisco's new system is essentially a suburban commuter line. And in Washington, D.C., transit officials recently dropped a proposed subway line that would have linked a low income Negro neighborhood to the central business district in favor of a line that will serve government office workers. Yet transit experts and planners agree in theory that adequate mass transportation could do a great deal to alleviate hard core unemployment, racial tension, and ghetto conditions.

The Washington, D.C., area also offers two excellent examples of problem number two—inefficiency resulting from failure to coordinate transit development with other planning functions. The first example is Dulles Airport, a multimillion dollar white elephant that sits in deserted splendor 27 miles from downtown Washington. Both airlines and air passengers prefer to use National Airport, an obsolete and dangerously overcrowded facility that operates at peak capacity in an impacted area only 5 miles from heart of the city. Incredibly, plans for future expansion of the District's rapid transit system do not call for a line to Dulles. Yet, again, transit experts and urban planners insist, on paper, that jet ports should be located well outside high-density areas and connected to urban cores by high-speed ground transportation.

Another example of unintelligent planning is found in Reston, Virginia, a new town now under construction between Dulles Airport and Washington, D.C. The largely unused highway that now links Dulles with Washington runs right through Reston, but—through no fault of the developer—residents are denied access to this road and must commute to work via a much slower, less direct route.

Possibly the most encouraging attempt to integrate transit planning and urban development is a recent proposal to locate office buildings in New York directly over subway stops, linking the subways with building elevators. This would allow commuters horizontal and vertical movement with only a few intervening steps, and would greatly increase the efficiency of communication between various buildings.

Problem number three—failure to realize opportunities for exciting urban form—is best illustrated by those new towns that have not incorporated mass transit into their basic plans. In the Rossmoor retirement community in New Jersey, minibus service has been added as an afterthought, the point of view toward mass transit characteristic of most so-called "planned" communities. Reston, one of the more ambitious of these ventures has no internal public transportation system at present, although the plans call for bus service to connect the development's seven separate community centers. But by the time Reston has grown large enough to support this service, the character of the town will have already been determined by the necessity of owning and driving a car. Whatever the economic range of the housing made available (and, so far, none of it is really low cost), the old, the poor, and the handicapped are effectively being excluded from Reston, and teen-agers too young to drive are cut off from outside recreation and entertainment. Despite the original planner's desire to make this a truly diversified community, Reston is in danger of becoming just another middle class suburb with all the attendant social liabilities.

There are indications, however, that mass transit may be integrated into the plans of several new towns now on the drawing boards. Disney's "EPCOT" (Experimental City of Tomorrow) may have a monorail for high-speed travel over long distances, supported by Disney's low-speed WEDway distribution and collection system. In Columbia, Maryland, plans are underway for a transit system to connect the development's nine separate community centers, total projected population of which is 110,000. Based on a professional transportation study, the Columbia proposal originally specified minibuses running on exclusive rights of way, but the developers are now discussing with HUD the feasibility of installing a more advanced system, possibly something based on the EXPO "minirail."

Perhaps the reason so many planned communities are designed without provisions for public transportation other than the service already available on established franchises is that the relatively low density of these developments calls for flexible, low-speed, high-frequency systems, for which the technology is still in its infancy. Despite the promise of more sophisticated systems, at the moment mass transit boils down to a choice of noisy, smelly, internal combustion buses—scheduled for the convenience of the bus company and run on public thoroughfares—or conventional rapid rail, which is totally inapplicable in low-density situations. Many of the advanced systems, like the Alden StaRRcar, are intended more for circulation in central business districts or for connection between suburbs and urban cores than for distribution within low-density residential areas. And all dual mode systems cease to be mass transit at that point where a licensed driver has to take over operation of the vehicle. Thus, they are not suitable for transporting children to school or carrying older people from their homes to other destinations. Since the trend in housing is to low-density development, this lag in transit technology represents a serious threat to the concept of planned communities.

Meanwhile, given the rising number of traffic accidents, the threat of increasing air pollution, the scarcity of parking space, the evils of highway construction, the enormous costs of building new transit systems, and the physical condition of the average sedentary American, it would seem that the cheapest, most practical solution to our transportation crisis has thus far been overlooked. Bicycles, anyone?

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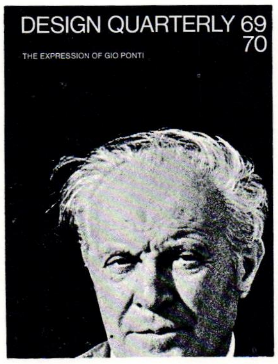

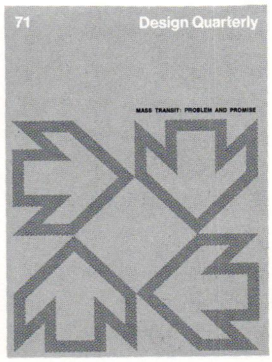

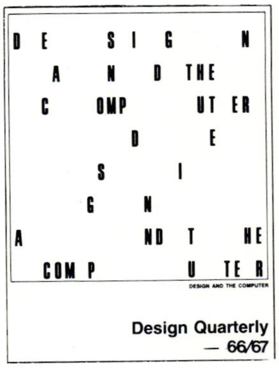

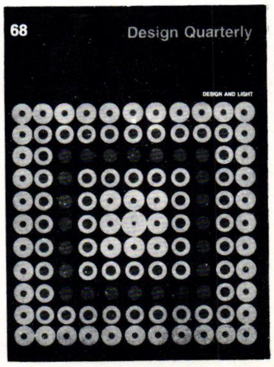

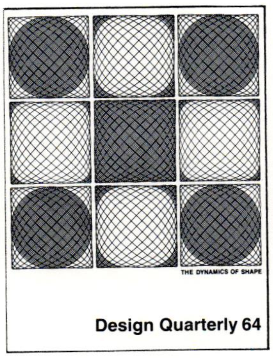

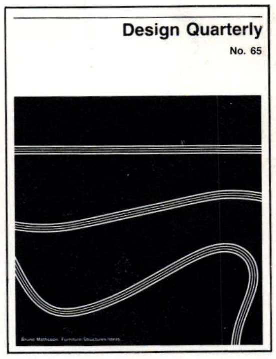

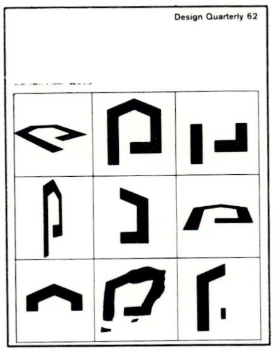

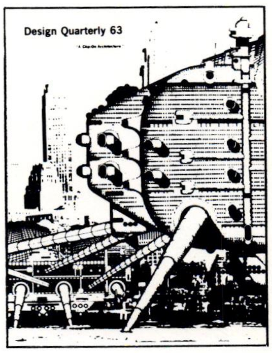

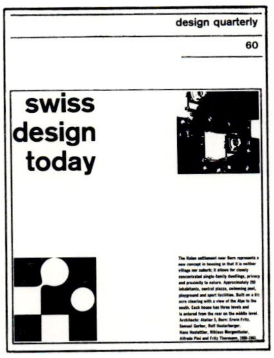

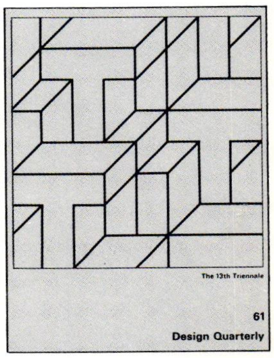

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