HIGHWAY RESEARCH RECORD

Number 299

International Transportation Topics

4 Reports

Sign Uniformity,
Closing the Darien Gap,
Transportation in Europe,
and
Transportation in Great Britain

Subject Area

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DIVISION OF ENGINEERING NATIONAL RESEARCH COUNCIL
NATIONAL ACADEMY OF SCIENCES—NATIONAL ACADEMY OF ENGINEERING

Washington, D. C., 1969 Publication 309-01788-2

Price: $1.60

Available from

Highway Research Board
National Academy of Sciences
2101 Constitution Avenue
Washington, D.C. 20418

Special Committee on International Cooperative Activities

(As of December 31, 1968)

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Foreword

The first three papers in this RECORD were presented at a Session sponsored by the Special Committee on International Cooperative Activities at the Board's 48th Annual Meeting.

In the first paper Zuniga reports on efforts toward international uniformity of road signs and markings. He traces developments since World War II and describes the present situation. Progress has been made, but much remains to be done. He feels that the time has come for the countries to get together in a spirit of compromise lest the opportunity to achieve international uniformity of road signs and signals be lost.

Ghiglione tells of exploration and soil studies that led to the selection of a route across the Rio Atrato swamp to close the Darien Gap on the Pan American Highway in Panama and Colombia. The selection of a practical route across this swamp, which had been considered bottomless, is expected to save over $100 million in construction costs and shorten the line by about 200 miles.

In the third paper Owen examines transportation in Europe for results that can be applied in the United States. He notes that the United States knows considerably more about how to move in cities, but that Europe has demonstrated that it knows most about how to live in its cities. He concludes that European experience suggests steps that might be taken in the United States to make transport facilities and operations contribute to urban living rather than detract from it. In this regard he defines three specific objectives. The first objective is to redesign the streets to create a setting in which housing and community development programs can be effective. The second objective is to improve urban public transport capabilities to make public transit oriented toward goals in order to extend the benefits of urban living to the nondriving public. The third objective is to make the transport network an integral element in urban design and to apply transport financial resources to urban development.

Palumbo's paper is a report of a six-month study of public transportation in Great Britain under a fellowship from the U.S. Department of Housing and Urban Development. In his study, he concentrated largely on governmental rather than technical matters. In considering applications of British operations in his home state of New Jersey, among many recommendations, he suggests provision for county review of municipal decisions and state review of county decisions. He also recommends the establishment of county transport departments.

Contents

International Effort Toward Uniformity on Road Traffic Signs, Signals, and Markings

JOSE M. ZUNIGA, International Road Federation

In the last three years, a great effort has been made by the United Nations and the Organization of American States to achieve uniformity in the field of road signs, signals, and markings. These efforts have culminated in three major conferences: (a) the Highway and Highway Transport Subcommittee of the United Nations Economic Commission for Asia and the Far East (ECAFE) meeting in Bangkok, Thailand, from January 30 through February 9, 1967, at which the position of the Asian countries with regard to the new draft convention on road signs and signals was determined; (b) the Tenth Pan American Highway Congress in Montevideo, Uruguay, in December 1967, which recommended that governments of the countries of the Americas adopt as a guide the Inter-American Manual on Uniform Traffic Control Devices; and (c) the United Nations Conference on Road Traffic in Vienna from October 7 to November 6, 1968, where a draft convention on road traffic and another on road signs and signals were discussed. In the first two meetings, regional agreements were obtained on the subject of signs and signals. The major task of the U.N. Conference in Vienna was to bring about a convention that could be acceptable to many countries and continents of the world. In this paper an analysis is made of the regional sign systems and the significance and implications of the Vienna Conference. Recommendations are made for future steps to be taken by developing nations in the adoption of a suitable road sign system.

•BEFORE the second world war, various agreements had been made concerning road traffic and road signs and signals. After the war, these agreements became relatively obsolete. In 1949, the United Nations convened a conference in Geneva to update international legislation in this field and, as a result of this conference, two documents (1) were adopted: the 1949 Convention on Road Traffic, and the 1949 Protocol on Road Signs and Signals. This 1949 Protocol referred to as the Protocol, provided for a road sign system that relies almost wholly on symbols without words. It was based on European designs, which constituted the most widespread symbolized system.

A group of experts, under an assignment by the United Nations Economic and Social Council, submitted a report in 1952 on road signs and signals (2). This document, later designated as the 1953 Draft Convention on Road Signs and Signals and now called the 1953 Draft Convention, made some adjustments in the Protocol. The 1953 Draft Convention was the result of research carried out by these experts in a variety of climates and environmental conditions in France, South Africa, Chile, India, the United States, and Turkey; it represented an attempt to combine the best of the Protocol with the best of the United States system.

In 1957, the Central American countries approved a new sign system based largely on the 1953 Draft Convention. In 1963, Canada adapted the Protocol to its own needs

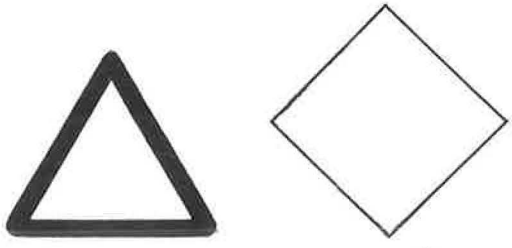
Paper sponsored by Special Committee on International Cooperative Activities and presented at the 48th Annual Meeting.

and introduced some new symbols and legends that appeared in English and French on the same sign. In 1964, the Ministry of Transport of Great Britain adopted the Protocol for British road traffic signs. At a meeting of the Highway and Highway Transport Subcommittee of the United Nations Economic Commission for Asia and the Far East in Bangkok, Thailand, January-February, 1967, a road sign system was recommended similar to the one proposed in the 1953 Draft Convention. The Tenth Pan American Highway Congress, convening in Montevideo, Uruguay, December 1967, recommended that the governments of the countries of the Americas adopt as a guide the Inter-American Manual on Uniform Traffic Control Devices (5). The sign system in this manual is similar to that in the 1953 Draft Convention.

There thus exists a wide range of sign systems in the world. The system in the United States, Australia, and New Zealand still uses many written-word messages. The Protocol system is widely used in Europe, where the messages are presented mostly in symbolic language without the use of words. The 1953 Draft Convention system uses symbols, but the shape of the warning signs is a diamond instead of a triangle; the red diagonal bar on the regulatory sign is consistently used as a prohibition; and prohibitory and mandatory signs are not distinguished by color. Variations of the Old British system are found in some parts of eastern and southern Africa where a combination of Protocol symbols and written messages are used. The Central American system uses the 1953 Draft Convention. The Canadian system relies mostly on symbols but introduces new symbols as well as different uses for the colors; the mandatory signs have a green ring, lane-use control signs have a black ground with white arrows, and the parking signs have a written message instead of symbols. This system utilizes the Protocol, the 1953 Draft Convention, the United States system, and other new signs.

Because both the Protocol and the 1953 Draft Convention were in wide use and in need of updating, the United Nations convened a Conference on Road Traffic in October 1968 at Vienna, Austria, that produced a Draft Convention on Road Signs and Signals, referred to as the 1968 Draft Convention (3). Naturally, the standardization of road signs at the international level should and must rely on symbols rather than on written messages. The absence of language barriers must be the basic requirement for signs intended for international traffic. On the other hand, to express everything by symbols would complicate any system beyond reasonable simplicity and comprehension. In writing about the Vienna Conference, Masson (9) also emphasized these requirements: "It is obvious that developing countries, where road traffic is very light, do not require the sophisticated rules and regulations that are indispensable in highly developed countries with dense road traffic. However, in view of the considerable development in international travel in general and the consequential increase in numbers of persons driving cars in foreign countries, be it their own or hired ones, it is most desirable that there be as few differences as possible between the systems applied in the various countries of the world." The spirit of these international conferences has always been one of laying foundations for a world system of traffic signs that could replace the many that now exist. To accomplish this will require many barriers to be broken, many political obstacles to be overcome, and some doubts to be resolved by much more research.

We will now discuss the Protocol and the 1953 Draft Convention, the two systems that are most widely used and were considered by the 1968 Vienna Conference on Road Traffic. Options from both systems are included in the 1968 Draft Convention.



border: red
ground: white or yellow

rim: black
ground: yellow recommended

Figure 1. Alternative signs warning of danger.

WARNING SIGNS

The 1968 Draft Convention contemplates the use of two shapes and two colors for warning signs. With regard to the shape, the alternatives are an equilateral triangle having one side horizontal and the opposite vertex above it, or a diamond-shaped square.

The triangle may have a white or yellow ground and a red border; the diamond has a yellow ground and a black rim (Fig. 1).

Which of the alternatives is technically better? In 1952, the experts reported to the U.N. (2) that "the two-color combination consisting of a black symbol on a yellow ground gave better legibility than the black symbol on white ground. The effect of the size of the symbol on legibility was studied and it was concluded that those of bolder design or strong outline and those of larger area gave better legibility results. It was further noted that the 'diamond' gave greater legibility distances in the black and yellow combination than in the combination having a white ground with a narrow red border, a black symbol of the same size being used in both cases. The narrow red border did not seem to contribute towards the improvement of legibility." It has been found that the diamond can accommodate a symbol 17 percent larger than can a triangle of equal area (8). Also, the Road Research Laboratory of England found that the diamond (American system) has a recognition range 10 percent longer than that of the triangle (European system) (7). Besides, the use of yellow as a color for warning is consistent with its use in traffic signals. Because of these considerations, the diamond with a yellow ground, black rim, and black symbol is recommended as the better sign.

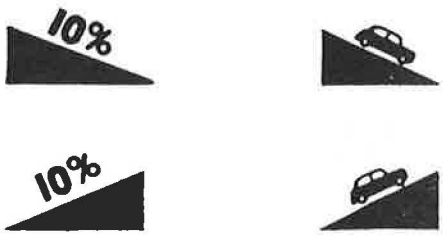


Figure 2. Symbology vs numbers in warning signs to indicate steep grade.

Symbology for warning signs does not present a problem because, even in the cases where there are alternative designs to be chosen, their meaning is not a matter of discussion. Perhaps one symbol is easier to understand than another, such as in the case of dangerous descent and steep ascent (Fig. 2), in which the symbol of an automobile is easier to understand than the one with a number for percentage of grade.

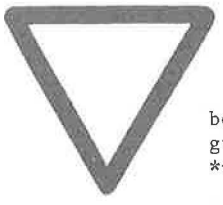
Of course, there is room for improvement in many of the proposed symbols. Article 8, paragraph 1, of the 1968 Draft Convention (3) states that "Where Contracting Parties consider it necessary to modify the symbols prescribed, the modifications made shall not alter their essential characteristics." If we take into account these provisions, we are safe in saying that a fairly uniform symbology has been attained for warning signs.

REGULATORY SIGNS

The 1968 Draft Convention divides the regulatory signs into the following categories: signs regulating priority at intersections, signs regulating priority at narrow sections of road, prohibitory or restrictive signs, and mandatory signs.

Priority at Intersections

In this category of signs are give way or yield, stop, priority road, and end of priority. The approved give-way or yield sign conforms to generally accepted recommendations with regard to shape. It is an equilateral triangle having one side horizontal and the opposite vertex below it (Fig. 3). It may be white or yellow with a red border; no symbol or message is inscribed. Here again we are confronted with an alternative with regard to color. It has been stated previously that yellow is a warning color and not a regulatory one. Also, red is characteristic of regulatory signs, meaning stop or do not. That is why the Special Committee on Color of the National Joint Committee on Uniform Traffic Control Devices of the United States has suggested that the color of the United States yield sign be changed from black on yellow to the Protocol-type of red on white (10). It then appears desirable to establish the inverted triangle with a white ground and a red border as the only one in the system.



border: red
ground: white* or yellow
*recommended

Figure 3. Give-way or yield sign.

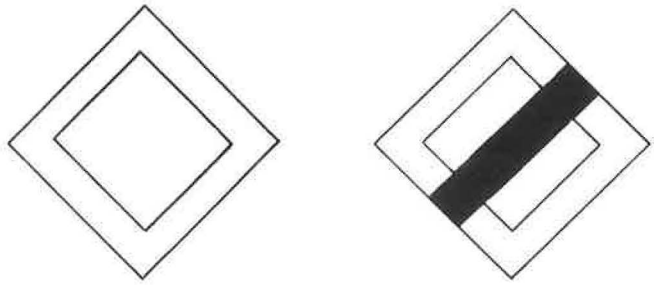
rim: red
border: white
ground: red
word: white
recommended

border: red
ground: white or yellow
symbol: red
word: black or dark blue

Figure 4. Alternative stop signs.

The stop sign has a double standard: the octagonal with red ground bearing the word "STOP" (or the equivalent in the language concerned) in white, and the circle with white or yellow ground and red border, a give-way sign within, and the word "STOP" (or the equivalent in the language concerned) in black or dark blue (Fig. 4). In any system, the stop sign is the most important, and for this reason its shape, color, and recognition must have an especially distinctive design that stands out among the other signs of its system. If the circular type is used, then all the prohibitory signs have the same shape and under certain circumstances, such as heavy snow or rain, the message could be lost and an unfortunate situation could arise. On the contrary, the octagonal shape is not used for any other sign and it cannot easily be mistaken even in snow storms. The Road Research Laboratory of England (7) found that "in the European system (circular) the identification distance for the STOP sign was only slightly greater than the mean for the whole system, whereas in the American system (octagonal) it was twice the mean." The octagonal sign stands out among the other signs of its system. Also, the recognition distance of the octagonal sign is 50 percent greater than that of the circular one, and the word "STOP" can be 50 percent larger in the octagonal sign than in the circular one (8). When there is a choice between the two signs, it is then recommended that the red octagonal sign be used as the stop sign of a system.

The priority road and end of priority road signs (Fig. 5) are typical abstracts signs in which neither the shape nor the color is consistent with the rest of the system. The shape and the color belong to the warning signs. Perhaps it would have been better to use a green circle for the priority sign with a slant for the end of priority sign. But, let us not introduce more alternatives; the use of these two signs in Europe is so widespread that perhaps it is too late to do anything about it. No apparent need for these signs has been found in the United States.

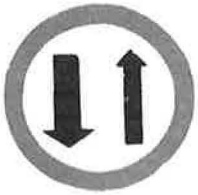


rim: black
ground: yellow
oblique bar: black

Figure 5. Road-priority signs.

Priority at Narrow Sections of Road

There are two signs in this category: one sign indicating priority for oncoming traffic, and another indicating priority over oncoming traffic (Fig. 6). The first of these signs is consistent with the rest of the 1968 Draft Convention because its shape and the use of red color are within the framework of its context. But the sign indicating priority over oncoming traffic does not conform in any aspect to its category; the shape and color belong to the informative signs. In any case, if the first sign is understood because of the position and color of the arrows, why couldn't a very opposite be understood the same way? It may be that there are other reasons more powerful than the technical ones that governed the the adoption of the second sign.



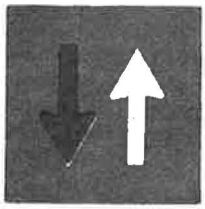


Figure 6. Signs indicating priority at narrow road sections.

Prohibitory or Restrictive

All these signs are circular with white or yellow ground, wide red border, and black or dark blue symbol. The oblique bars, if any, are red with their slopes downward from left to right. Included are signs that prohibit entry, following too closely, turning, overtaking, specified speeds, use of audible warning devices, passing without stopping, and parking; and those that indicate the end of prohibition or restriction. Because the color red has been consistently used along highways to indicate a prohibition of some sort, it is a suitable color to use for the border and oblique bars in these prohibitory signs. On the other hand, the alternative choice for ground (white or yellow) is subject to criticism; yellow is a warning color and must be reserved for that purpose and, therefore, the white ground in all prohibitory or restrictive signs is wholly appropriate.

Another very important subject to be discussed is the consistent use of the oblique bar to mean "prohibited" or "do not." It is very unfortunate indeed that the 1968 Draft Convention leaves open to contracting parties the option of omitting the red oblique bar from certain prohibitory signs such as several that prohibit entry and overtaking. And yet the oblique bar is required by the 1968 Draft Convention in signs that prohibit turning and the use of audible warning devices. This inconsistency produces a more dangerous situation when we realize that in many countries, following the 1953 Draft Convention, mandatory signs are circular with a red border and, of course, without oblique bar. That is to say, they are precisely what the 1968 Draft Convention allows optionally as prohibitory signs, but with an exactly opposite meaning. In other words, what is "no" in some countries is "yes" in others—an extremely unsafe situation.

England, perhaps, is the country where most of the study and research has been done in comparing different sign systems. On the subject of the oblique bar, the Road Research Laboratory expressed the following (7):

> The signs of the 1949 Protocol suffer from several defects which the 1953 convention avoided. One of them is the inconsistent use of the red cancellation bar across a sign. For example, to indicate a "No Right Turn" a white circle with a red edge bears a bent arrow cut through by a red bar. The reason for the bar here is obvious; if there were no bar, the sign would appear to be an invitation to turn right, the very opposite of what is intended. Now if the bar means "Don't do this" it should be used consistently; for example, the cycle in the "No Cycling" sign should also have a bar, similarly the overtaking car on the "No Overtaking" sign, but this is not done and these illogicalities and inconsistencies may make it more difficult for people to learn the meaning of the signs. The reason given for the omission of this bar is said to be that it tended to hide the symbol underneath, but tests carried out by the Laboratory showed that this is not a serious difficulty.

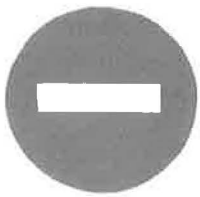
Technically, is it better to use the oblique bar or not to use it at all? The findings of the Road Research Laboratory of England (7) are as follows:

> Children can guess the meaning of signs with bars. A class of 11 year old children was divided into two groups, A and B, of equal intelligence. Group A was shown a set of Protocol signs, warning, mandatory and prohibitory; Group B was shown the same set of signs with bars added to four of the prohibitory signs which do not have them on the Protocol system (but do in the system proposed in the 1953 Draft Convention). Both groups were told only that triangles give warnings and circles commands (either do's or don'ts) and were asked to guess their meanings. It was found that 71 per cent of the answers given by Group B for the meanings of the four modified signs were correct, although they had never seen them before, whereas only 16 per cent of the answers given by Group A for the strictly Protocol versions of the same signs were correct. Moreover, 25 per cent of the answers to the Protocol signs were the exact opposites of the messages the symbols were intended to convey. There were no such errors with the modified signs.

In spite of these findings, England adopted, more for political than for technical reasons, the Protocol sign system already in use in the rest of continental Europe. Three years after that adoption it is not very surprising to find that the head of the Road Safety Division reported (8): "National Surveys make it clear that for the time being many motorists here are still in ignorance of what some of our new signs mean. For instance, at the end of last year one third of those questioned did not understand the meaning of the 'No Overtaking' symbol; half did not know the symbol indicating 'End of Dual Carriageway'; two-thirds failed to recognize the sign prohibiting entry to all motor vehicles; eighty per cent did not understand the symbol for a cross road; and four-fifths were mistaken about the sign which prohibits cycling." These findings corroborate those of the Road Research Laboratory that the omission of the oblique bar in the prohibitory signs causes them to be misunderstood. In short, technically speaking, it is advisable that all prohibitory signs be circular and bear an oblique red bar within a red border and on a white ground.

There are two models of the prohibition of entry signs (Fig. 7). The first model is entirely abstract, and the second, the canceled arrow, is more directly understood and is considered to be superior. Another abstract sign that could be replaced by the no-entry sign placed for both directions of traffic is that shown in Figure 8 to indicate the road is closed to all vehicles in both directions.

No-entry signs that indicate certain vehicles or pedestrians are prohibited from using the road are shown in Figure 9. The symbols are shown inside the red circle and may include those for power-driven vehicles, motorcycles, mopeds, goods vehicles, trucks and full trailers, pedestrians, animal-drawn vehicles, handcarts, and agricultural tractors. It is on these signs that the 1968 Draft Convention allows the oblique bar to be omitted; it is clear by now that this omission is not advisable. Figure 9 shows no-entry signs intended to prohibit the entry of those vehicles whose weight or dimensions exceed certain limits,



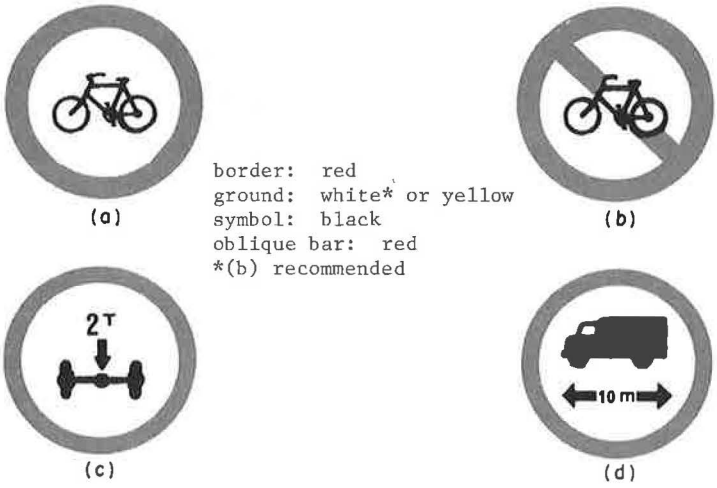
ground: red
symbol: white

border: red
ground: white* or yellow
symbol: black
oblique bar: red
*recommended

Figure 7. No-entry signs.

border: red
ground: white or yellow

Figure 8. Sign indicating road closed to all vehicles in both directions.



border: red
ground: white* or yellow
symbol: black
oblique bar: red
*(b) recommended

Figure 9. No-entry signs for certain road users and for vehicles with certain weights or dimensions.

as shown within the red border. The restrictive sign in Figure 10 indicates the distance that should be maintained between vehicles.

border: red
ground: white or yellow
symbol: black

Figure 10. Sign indicating distance between vehicles.

Prohibition of turning is shown by bent arrows that point toward the prohibited direction and are crossed by the oblique bar (Fig. 11). Prohibition of overtaking is shown in Figure 12 by two different sign models: The first one prohibits the maneuver only by means of the color red on the overtaking vehicle; the second model shows both vehicles in black color but with the oblique bar. It is obvious that if the second one means "no overtaking," the first one may be misunderstood for "overtaking allowed." Countries seeking a sign system consistent in all its elements will have to choose the sign with symbols crossed by an oblique bar.

The speed limit (Fig. 13) and the prohibition of the use of audible warning devices (Fig. 14) signs are appropriate to the system. The sign that prohibits passing without stopping (Fig. 15) warns of the proximity of a customhouse or police station, at which a stop is compulsory. This sign is abstract, and its meaning is dependent on the words "custom" or "police." With certain exceptions, it is accepted worldwide. Signs that prohibit or restrict parking are abstract and have to be learned. They include parking prohibited, standing and parking prohibited, alternate parking, and limited duration parking zone (Fig. 16). This group of signs is considered for an international

border: red
ground: white* or yellow
symbol: black
oblique bar: red
*recommended

Figure 11. No-turning signs.

border: red
ground: white or yellow
left symbol: red
right symbol: black

border: red
ground: white* or yellow
number: black
*recommended

Figure 13. Speed limit sign.

border: red
ground: white* or yellow
symbol: black
oblique bar: red
*recommended

Figure 12. No-overtaking signs.

border: red
ground: white* or yellow
symbol: black
oblique bar: red
*recommended

Figure 14. Sign indicating prohibition of use of audible warning devices.

border: red
ground: white or yellow
symbol: black
words: black

Figure 15. Sign indicating that a stop at a certain place is compulsory.

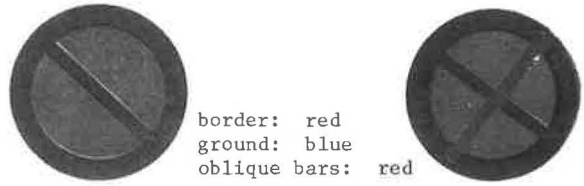
agreement; it is recommended that an explanatory plaque be added until the users come to understand the messages. More research for parking signs is needed.

The end of prohibition or restriction is shown by a white or yellow circular ground with no border, only a black rim, and with diagonal black or dark gray parallel lines. The yellow ground as an alternative to the white ground in this type of sign is not a good one, because yellow is a warning color and not appropriate in these signs; the white ground is recommended. These signs are end of all local prohibitions imposed on moving vehicles, end of speed limit, and end of prohibition of overtaking (Fig. 17). Of the three signs of this category, only the first one is wholly abstract; it has to be learned to be understood.

Mandatory

In accordance with the 1968 Draft Convention, mandatory signs are circular, have a blue ground, and have symbols of a white or light color; the alternative is a circular sign with a white ground, a red border, and black symbols. An analysis of both alternatives follows.

The fundamental defect of the blue circular sign (Fig. 18) is that blue is used in highway signs for informative purposes and to identify services of any kind; it is, therefore, not advisable to use it as a mandatory color. The argument that the circular shape



border: red
ground: blue
oblique bars: red

Figure 16. No-parking signs.

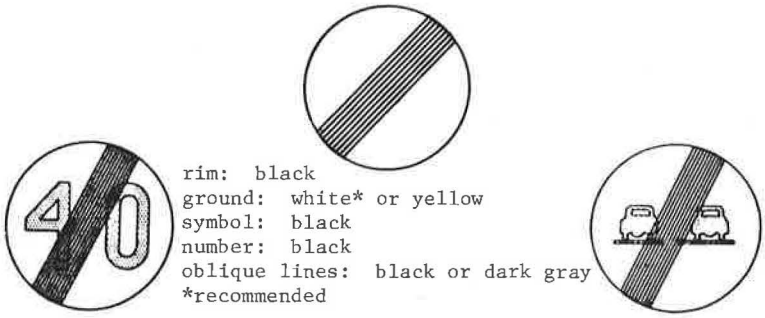


Figure 17. Signs indicating the end of prohibition or restriction.

provides the necessary distinctive meaning is refuted by research conducted on the comparison between colors and geometric forms in which it was found that "when color and shape are superimposed on a display, the color code will prove dominant in the visual separability it provides" (17). It can be concluded then that mandatory signs should not have a blue ground. On the other hand, the white ground as an alternative is consistent with the regulatory coding system recommended previously in this paper. So, the white ground, also shown in Figure 18, is here recommended for mandatory signs.

But let us examine very closely the fact that an alternative of this kind has been allowed to exist elsewhere in the 1968 Draft Convention. A mandatory circular white sign with red border and black symbol is essentially the same prohibitory sign that has been permitted by this same Convention when it left open to contracting parties the option to omit from certain signs the red oblique bar (Figs. 9 and 18). In effect the result is that while part of the world is saying "no entry" for some kind of road user, another part of the world will be saying "compulsory" for the same road user: Two absolutely contradictory messages with the same sign! This is what happens when we try to embrace two or more sign systems in their entire forms without sacrificing parts of one and taking the best and most consistent parts of the other or others. It is impossible to achieve an international consensus if the parties concerned do not reach a sound technical compromise.

Figure 18. Mandatory signs.

Let us try then to solve the problem. It must be recalled that the use of the oblique bar was recommended as the best means to convey the message of prohibition; it is more than logical that if we want to express a restrictive positive message we use the same sign without the oblique bar (Fig. 18b). This is exactly what the group of experts recommended in 1952, and it was proposed in the 1953 Draft Convention.

The signs in this category are direction to be followed, pass this side, compulsory roundabout, compulsory cycle track, compulsory minimum speed, and snow chains compulsory. Except for two of these signs, compulsory minimum speed and end of compulsory minimum speed, the rest do not present any problem with the recommended circular white sign with red border. If the black symbol goes inside the circle for these two signs, however, the message conveyed would be that of the maximum speed limit (Fig. 13). More research is needed to find a good solution.

GUIDE AND INFORMATIVE SIGNS

Guide and informative signs are grouped in the following categories: direction signs, place identification signs, confirmatory signs, pedestrian-crossing signs, information signs, and facilities or auxiliary-services information signs.

Direction

Direction signs can be classified as advance-direction and direction-of-place signs. The advance-direction signs are rectangular in shape and, according to the 1968 Draft Convention, the ground may be white or blue and the message may be in black or white characters depending on the ground color (Fig. 19). The white ground has been used in advance-direction signs in almost every country of the world; the dark ground has been specified for special types of highway signs like the freeways signs in the United States that have a green ground. So, the white ground with black characters is recommended for this type of sign. Included in the advance-direction signs there is a special one to indicate no through road (Fig. 20). It is rectangular with blue ground and white and red characters. To be consistent with our previous recommendations, we would have to suggest a white ground with black and red characters.

The direction-of-place signs may be rectangular in shape or may be an elongated rectangle with the longer side horizontal and with one end terminating in an arrowhead

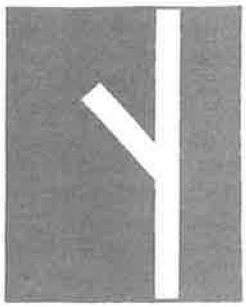
border: black
ground: white
symbol: black
words: black
numbers: black
recommended

ground: blue
symbol: white
words: white

Figure 19. Advance-direction signs.

(Fig. 21). The ground may be white or blue. The recommendation for the ground color is the same as that for the advance-direction signs.

ground: blue
symbol: white

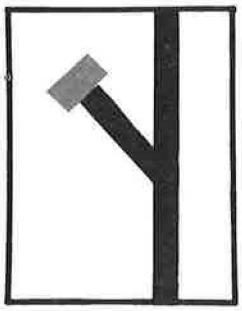


Place Identification

The 1968 Draft Convention makes a distinction between signs showing the beginning of a built-up area and signs showing the end of a built-up area. Of the two ground alternatives, white or blue, white appears to be the preferred color.

Confirmatory

Confirmatory signs confirm to the driver information given by the direction signs.



border: black
ground: white
symbol: black
short oblique bar: red
recommended

Figure 20. Signs indicating no through road.

Pedestrian Crossing

Pedestrian-crossing signs show pedestrians and drivers the position of a pedestrain crossing. Typically, the 1968 Draft Convention states: "The panel shall be blue or black, the triangle white or yellow and the symbol black or dark blue.... However the sign...having the shape of an irregular pentagon may also be used." Sometimes I wonder if the purpose of this Conference was to achieve uniformity or to perpetuate a chaos of road signs. For reasons stated before, the recommended sign has a rectangular shape, blue ground, white triangle, and black symbol (Fig. 22).

border: black
ground: white
words: black
numbers: black
recommended

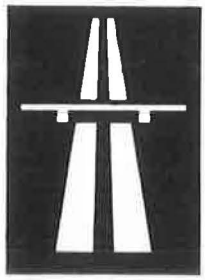
rim: black
border: white
ground: blue
words: white

Figure 21. Signs indicating direction of place.

ground: blue* or black
triangle ground: white* or yellow
symbol: black* or dark blue
*recommended

rim: black
border: white
ground: blue
symbol: white

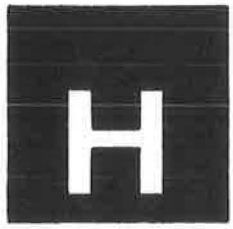
Figure 22. Pedestrian-crossing signs.



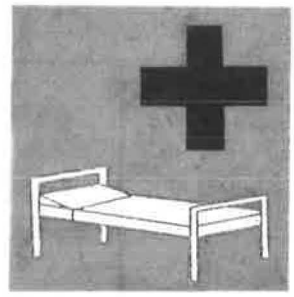
entrance to motorway

exit from motorway

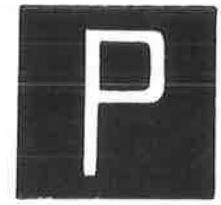
ground: blue
symbol: white
oblique bar: red
cross: red



hospital



hospital



parking

Figure 23. Information signs.

Information Signs

All information signs (Fig. 23) are rectangular in shape and have a blue ground. Among the most common signs in this category are hospital, parking, one-way road, no through road, entry to a motorway, exit from a motorway, road for motor vehicles, end of road for motor vehicles, bus stop, tramway stop, and road open or closed.

One of the hospital sign alternatives bears an H for hospital, and the other is symbolic. For countries using a different type of alphabet, the first sign is meaningless; that is enough reason to recommend the sign bearing a hospital bed and a first-aid symbol such as a red cross or red crescent.

The parking sign bears a white P inside a blue rectangle. This is a sign that needs to be improved because a Latin character is not good for countries that have other types of alphabet. Perhaps the blue rectangle alone could be enough; anyway, parking signs are abstract.

Auxiliary Services

The 1968 Draft Convention establishes (3) that these "signs shall have a blue or green ground; they shall bear a white or light yellow rectangle on which the symbol shall be displayed." For consistency with other informative signs, blue is recommended as the ground color with a white rectangle on which the symbol is displayed (Fig. 24).

ground: blue* or green
inside ground: white* or yellow
symbol: black
cross: red
*recommended

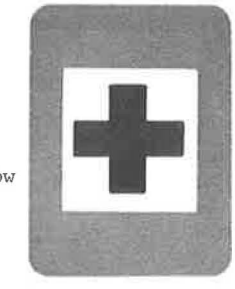


Figure 24. Auxiliary-services signs.

Some of the signs in this category are first-aid station, breakdown service, telephone, filling station, hotel or motel, restaurant, refreshments or cafeteria, picnic site, starting point for walks, camping site, caravan site, camping and caravan site, and youth hostel.

CONSTRUCTION AND MAINTENANCE SIGNS

The 1968 Draft Convention states (3) that:

> 1. The limits of road works on the carriageway shall be clearly shown.
> 2. Where the extent of the road works and the volume of traffic justify it, the limits of the works shall be marked by setting up continuous or discontinuous barriers painted with alternate red and white, red and yellow, black and white, or black and yellow stripes, and in addition, at night, if the barriers are not reflectorized by lights and reflecting devices. Reflecting devices and fixed lights used for this purpose shall be dark yellow.
>
> However, (a) lights and devices visible only to traffic moving in one direction and marking the limits of road works on the opposite side of the road from that traffic may be white; (b) lights and devices marking the limits of road works separating the two directions of traffic may be white or light yellow.

Because these signs are in the category of signs that warn of danger, it is recommended that the stripes of the barriers be yellow and black.

ROAD MARKINGS

Road markings are covered in very great detail in the 1968 Draft Convention, which is not usual for this kind of document, and should be very thoroughly studied before final acceptance. It would have been preferable to have had a more general coverage and a less detailed account of the technical procedures to be followed in performing the actual job of road marking. The 1968 Convention does not distinguish colors for different types of roads and situations. In this matter, the U.S. Manual on Uniform Traffic Control Devices (4) is more comprehensive and should be used as a guide for future discussions in this subject.

ROAD SIGNALS

The provisions for road signals are in accordance with their normal use throughout the world. There are two points to which we must pay some attention: The first is the use of a single flashing red light allowed for railroad crossings, and the second is the prohibition of the use of a single flashing red light for any other purpose. Using a single flashing red light for railroad crossings is considered a setback for the long-standing practice of using two flashing red lights at these crossings. A further complication is the fact that the flashing beacon is used in the western hemisphere for intersections or other locations that have special conditions. These locations do not include railroad crossings. A very unsafe situation may arise for an international traveler confronted with a single flashing red light that has been given this extra meaning. These are the reasons why the western hemisphere and many other countries will not be complying with the 1968 Draft Convention.

RECOMMENDATIONS AND CONCLUSIONS

There has been a great effort on the part of the United Nations and the Organization of American States to bring about a solution to the lack of uniformity in road signing throughout the world. Sometimes these efforts have not been adequately recognized, as in the case of the 1952 study made by a group of experts. This study provided the basis for the 1953 Draft Convention, which never was officially submitted to the members of the United Nations for ratification. This time, perhaps because of the experience of 1949 and 1953, the United Nations has made a renewed effort to try to find a consensus for both of the earlier propositions. Unfortunately, a document of this type tends to

perpetuate and not eliminate the differences among the main existing sign systems. When the conclusions of a technical conference like the one in Vienna are settled in political terms, they may be acceptable to everybody but they will not necessarily meet the purpose and conditions of the conference, which are uniformity in signs.

From the viewpoint of a developing nation, conclusions of this sort tend to confuse rather than to clarify the problems involved. Lack of experience may yield disastrous results, and the adoption of inconsistent alternatives may produce a completely new and undesirable sign system. The task ahead, then, is to avoid the proliferation of differences among not only systems but also neighboring countries. It is very urgent to bring under responsible sponsorship the development of regional conventions for road signs that will unify continents in this matter. For instance, the countries of Asia and the Far East, the Americas, and Africa must begin to plan for these kinds of agreements if they ever want to have safe intercontinental highways. The time has come to learn that unless the countries get together in the spirit of compromise, the time and the opportunity to achieve international uniformity on road signs and signals will be lost.

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Discussion

C. THOMAS VAN VECHTEN, District of Columbia Department of Highways and Traffic—The author's arguments against the Vienna decision to permit the use of identical signs to indicate mandatory and prohibited movements are fully persuasive. It is strange indeed that the dangers inherent in such a signing system were not sufficient to have prevented this most unfortunate decision. It was to avoid confusion between mandatory and prohibited movements that the Manual of Uniform Traffic Control Devices for Canada specified a red circle with a red oblique bar through the symbol to indicate prohibitions, and a green circle around the symbol to indicate mandatory movements. Use of some such means to clearly distinguish between the signs for mandatory and prohibited movements appears absolutely imperative.

In general I agree with almost all of Mr. Zuñiga's arguments and recommendations. However, I do not understand his reasons for grouping the pedestrian-crossing sign with the guide and information signs, and his consequent use of a blue ground and white triangle design. Perhaps this design is adequate in countries where pedestrians have few rights and where motor vehicles have the right-of-way over pedestrians in crosswalks. But there is clearly a good case for considering this sign to be a warning sign as is done in Canada, Central America, the United States, much of Europe, and parts of both Africa and Asia. A cattle-crossing sign is considered a warning sign, and it seems unreasonable to give greater attention to the safety of cows than to that of people. I also question Mr. Zuñiga's recommendation to drop the use of a yellow ground on the yield sign. Because a yield sign imposes the duty to stop if necessary, there seem good reasons for its having a yellow, rather than a white, ground. A yellow ground makes a yield sign stand out from the other regulatory signs because of color as well as shape, and underlines its higher level of urgency. The proposed modifications of the color schemes of both the pedestrian-crossing sign and the yield sign reduce their attention values and visual "punch." Until research proves that the performance of signs with the modified color schemes is at least as good as that with the present colors, I would question the change in the color of their grounds.

I am in full agreement with the author's statement that "...it is impossible to express everything by symbols unless we want to complicate any system beyond a reasonable simplicity and comprehension." Obviously that is exactly what we don't want to do. Those who are overly enamored with completely symbolic signs may wish to consider designing a symbolic sign for a pedestrian crossing to be used by deaf pedestrians. A reasonable, perhaps even a generous, minimum criterion for the sign of understandability is that at least 85 percent of the driving public correctly understand it the first time they encounter the sign by looking at it for no more than three seconds. Those who advocate universal adoption of one of the sign systems having only symbols might be interested in seeing how close their signs come to meeting this criterion.

Our experience with symbolic signs indicates that they have numerous advantages, but that many people do not understand them the first time they see them, and that a substantial proportion of the driving public does not understand the true meaning of some symbol signs even after seeing the signs repeatedly. The author points out that national surveys in England showed that more than half of the motorists did not understand some of the English symbol signs several years after they were adopted. Yet the English signs were developed after much effort by competent and dedicated professionals. Experience with other symbol sign systems indicates that they have given similar problems. The difficulty seems to be inherent in signs that have symbols alone. There appears to be very little likelihood that any system of purely symbolic signs can be developed that would be immediately understood by all motorists.

If this is so, then the sudden adoption of a purely symbolic sign system could possibly create widespread confusion, misunderstanding, and hazards. A transportation system that depends for its safety and efficiency on the speed and correctness of the decisions of millions of vehicle operators simply cannot accept an information system that doesn't work for even a small percentage of those operators, much less one that fails to work for a majority of them. Neither do signs that use only word messages reach all motorists because drivers may speak many different languages, some word

ground: white
circle and bar: red
U-arrow: black
words: black

Figure 25. No-U-turn sign in use in Central America.

message signs may take longer to read than symbol signs, and some word messages may have shorter legibility distances.

Signs that use both symbol and word messages offer one solution. Signs, such as these, have been extensively used in Central America and were also used to some extent in both France and Great Britain. A Central American no-u-turn sign that uses both symbols and words is shown in Figure 25. It shows a black arrow in the shape of a U, in the center of a red circle. A red oblique bar is through the U-shaped arrow; the round is white. This is similar to European signs except that, instead of using a square sign blank, the Central American system uses a rectangular blank with the long dimension vertical. The symbol is at the top of the blank. Below it is the word message "No U Turn" in the local language. Such a sign is meaningful to motorists either (a) who already understand the symbol or (b) who can read the language. Such combination signs also have the great advantage of automatically familiarizing drivers with the symbols and teaching them their meaning.

Similar designs could be developed for warning and information signs. For example, a possible design for a combination symbol and word message on a warning sign for a draw bridge is shown in Figure 26. It uses a white rectangular sign blank. The familiar yellow diamond with black border occupies the upper portion of the rectangle. The diamond carries the appropriate symbol (in this case a Central American, rather than a European, draw-bridge symbol) and below it a yellow rectangle on which the hazard is written out in the dominant local language. A simpler alternative would be to put the symbol on a conventional yellow diamond-shaped blank, with the word message on a supplementary rectangular plate mounted below the diamond. Figure 26 shows this arrangement for a narrow-bridge sign.

Designers of symbolic signs tend to have an emotional objection to destroying the "purity" of symbol signs by adding word messages. After all, if symbol signs are intended to do away with the difficulties caused by word messages, why should they be "corrupted" with superfluous word messages? The answer is simple: Unless the symbol is understood immediately and correctly by the vast majority of motorists, the word message is not superfluous, it is necessary.

Admittedly the use of sign designs similar to those shown in Figure 26 would somewhat increase the cost of signing. But the objective of any signing program is to give the motorist the necessary information, and neither a pure symbol nor a pure word

ground (a): white
diamond ground: yellow
small rectangle ground: yellow
symbol: black
words: black

Figure 26. Combination word-symbol warning signs.

sign system appears capable of reaching all drivers. In order to improve signs while maintaining reasonable signing budgets, perhaps we should carefully review the real need for some of the signs we now use. Savings by elimination of unnecessary signs might more than balance the increased cost of improving the signs we do use.

In view of the differences among languages, alphabets, and the meanings of both words and symbols throughout the world, uniform signs present monumental difficulties. Fully uniform international signs may never be reached, but significant improvements on the present situation seem possible, particularly by elimination of direct conflicts among the several existing systems. Our decisions must be based on facts and on the results of objective research, for ethnocentrism and prejudice can only increase our troubles. The proliferation of both vehicles and drivers continues, and each day's delay only makes the problem more difficult. The time for concerted action is now. But today's actions must be the correct ones if we are to make the situation better instead of worse.

JOSE M. ZUNIGA, Closure—Most of Mr. VanVechten's remarks may stem in part from the fact that the 1968 Draft Convention on Road Signs and Signals from the Vienna Conference have not been widely enough distributed to be known by most technicians in this field.

The question of having a pedestrian-crossing sign with the guide and informative signs is not an invention of my own but the result of that Conference in which certain European countries expressed the need to have a guide sign for pedestrians in urban areas where that crossing would be difficult to find, like the underground pedestrian crossings in Vienna. The use of the informative sign does not exclude the pedestrian warning sign (3, Fig. A, 11^a), which is intended mostly for drivers. Both are very different in shape and color; one is an informative and the other is a warning sign.

The question of the ground color in the yield sign is a matter that belongs to the general discussion on color coding. Robinson has written a very good paper on this subject (10). At this moment few countries retain the yellow ground for the yield sign; even the United States is considering the change from yellow to white.

With regard to the use of symbols and words, the 1968 Vienna Convention (3), in Article 8, Paragraphs 3, 4, and 5, is very explicit:

> 3. Nothing in this Convention shall prohibit the addition, in order to facilitate the interpretation of signs, of an inscription in a rectangular panel below the sign or in a rectangular panel containing the sign: such an inscription may also be placed on the sign itself, if this does not make the sign more difficult to understand for drivers who cannot understand the inscription.
>
> 4. Where the competent authorities consider it advisable to make the meaning of a sign or symbol more explicit or, in the case of regulatory signs, to limit their application to certain categories of road-user or certain periods, and where it would not be possible to convey the necessary information by an additional symbol or by numerals as provided in the annexes to this Convention, an inscription shall be placed below the sign in a rectangular panel, though such inscriptions may be replaced or supplemented by one or more symbols placed in the same panel.
>
> 5. The inscriptions referred to in paragraphs 3 and 4 of this Article shall be in the national language, or in one or more of the national languages, and also, if the Contracting Party concerned considers it advisable, in other languages, in particular official languages of the United Nations.

I would like to point out that my paper is by no means a substitution for the 1968 Draft Convention on Road Signs and Signals; it is merely an analytical comment that I hope is constructive.

Conquest of the Darien

ANGELO F. GHIGLIONE, U.S. Bureau of Public Roads and
U.S. Representative and President of the Darien Subcommittee,
Organization of American States

•SINCE THE discovery of America and the early explorations of this hemisphere, a means of connecting North and South America by land transportation has been the dream of explorers and engineers. This dream is now near realization.

Almost 100 years ago a formal project for uniting the Americas by land communication was proposed in the U.S. Congress. All attempts to do so, however, have been frustrated by the inaccessibility of the vast jungle region adjoining the Republics of Panama and Colombia in what has become known as Al Tapon Del Darien—the Darien Gap. The earliest studies in the Darien area for possible routing of a land connection between the continents encountered the tremendous Atrato River swamps in Colombia, and, understandably, subsequent explorations eliminated the swamps from further consideration. It was generally concluded that any rail or highway route crossing the Atrato River swamps would indeed be interrupted by a canal some 20 miles long. These early explorations had been limited to the local areas adjacent to the Atrato River swamps where great depth of unstable materials was encountered, and crude probings resulted in the description of these swamps as "bottomless." The highway route reconnaissance circumnavigated the swamp areas, resulting, by process of elimination, in the most southerly location being recommended for the Pan American Highway. Subsequent funding for surveys by the Pan American Highway Congress led to definitive studies for this southern route.

The Bureau of Public Roads, recognizing the tremendous savings that could be realized through a routing of the Pan American Highway across the Atrato River swamps—a line some 200 miles shorter—insisted upon questioning all previous assumptions that they were indeed impassable. After numerous diplomatic exchanges the Bureau was successful in negotiating an agreement with the Colombian Minister of Public Works permitting reconnaissance surveys to be undertaken in 1964. This paper describes these studies and the subsequent detailed geophysical surveys carried on under the direction of the Bureau of Public Roads. This work, which has just been brought to a conclusion, assures a saving in construction cost estimated in excess of $100 million.

Few maps of any type were available for planning detailed investigations of topographic and ground conditions of the Atrato swamps, and no maps of suitable scale and detail were available for acquiring survey data. The most formidable problem confronting the Bureau of Public Roads involved the logistics of providing access and support for field crews. The Atrato River swamps are approximately 65 to 100 km wide and more than 250 km long. The Bay of Colombia at the south end of the Gulf of Uraba is gradually being filled from the west by the numerous delta outlets of the Atrato River. The closest approach to this area is through the small shipping port of Turbo on the Gulf of Uraba, which is the north terminous of the highway leading from Bogota and Medellin called The Highway to the the Sea (Fig. 1).

Beginning in 1964 the Bureau made a thorough search of all likely sources of aerial photography, and partial photographic coverage was assembled with the assistance of the Army Map Service, the Defense Intelligence Agency, the Colombian Ministry of Public Works, and the Inter-American Geodetic Survey. Photography from these sources ranged in scale from 1:30,000 to 1:50,000. Quality of the photography varied

Paper sponsored by Special Committee on International Cooperative Activities and presented at the 48th Annual Meeting.

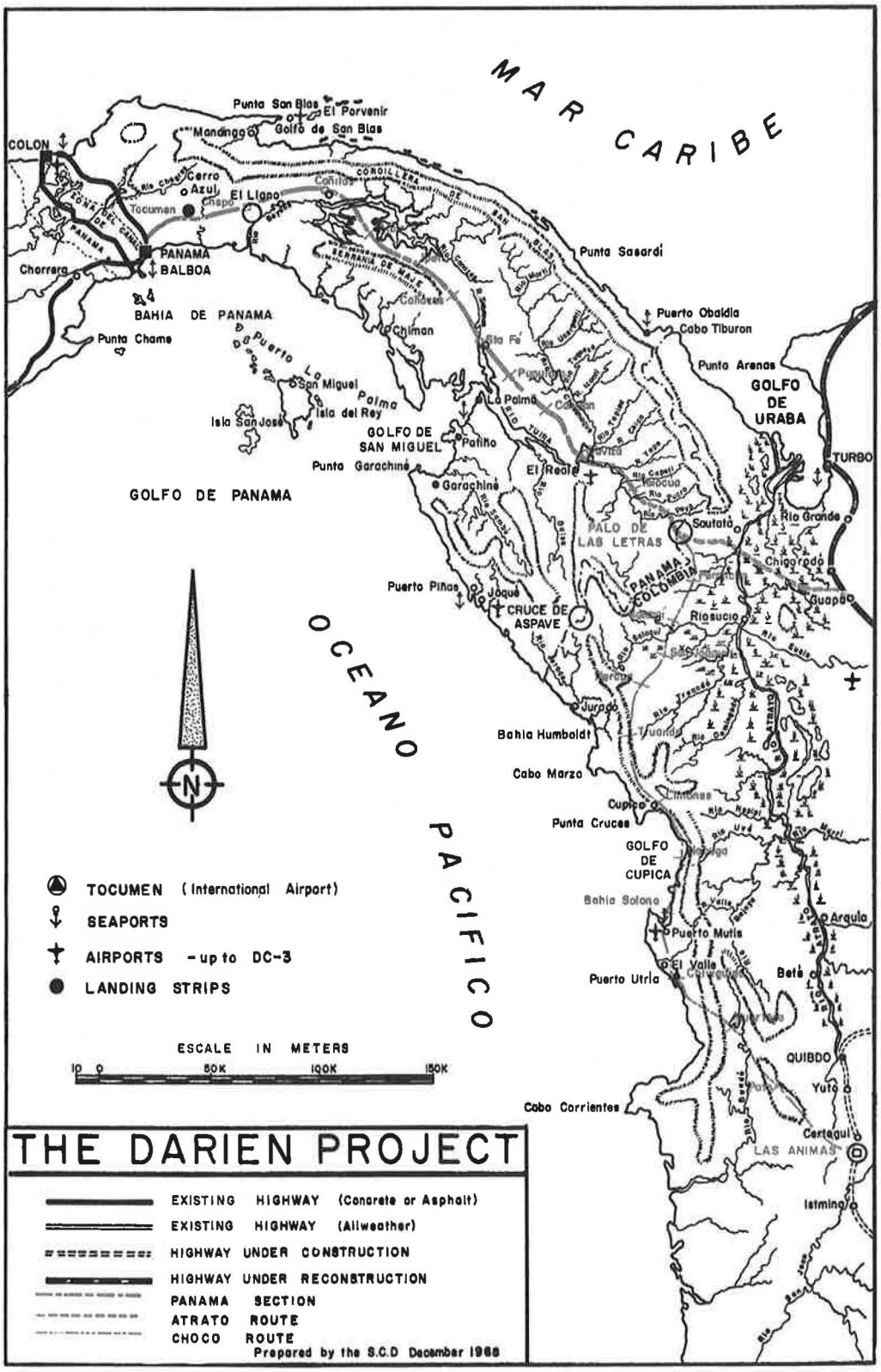

Figure 1. Location of the Darien Project.

extensively, and most included scattered cloud formations that totally obscured significant areas. Additional aerial photography had to be obtained and was provided through a joint operation wherein the Colombian Ministry of Public Works furnished the Ministry's plane and the Bureau furnished the equipment and technicians.

Stereoscopic examination and photographic interpretation of these uncontrolled early photographs led to the selection of five possible route locations that met the criteria established for the least difficult crossings of the swamp. A control point affecting all route locations was the crossing of the Panama-Colombia border at Palo de las Letras because this crossing had been specified by treaty between these countries.

The five selected routes were delineated on the uncontrolled photomosaic that had been assembled with all pertinent information shown. Comparative interpretation of the five tentative routes was then planned under a research project involving the application of aerial infrared imagery. The usefulness of infrared imagery for obtaining subsurface information in tropical areas had never been established; however, it was known that remote radiation sensing and scanning equipment had produced successful interpretive imagery in other areas.

A contract was negotiated with H. R. B. Singer, Inc., State College, Pennsylvania, with the expectation that small thermal anomalies could be detected and usable infrared imagery of the large swamp area would permit interpretation of subsurface foundation conditions. It was our hope that such detailed analysis of the extensive swamp area from the air would eliminate the need for prolonged and costly investigation and surveys on the ground.

A twin-engine Beachcraft was flown from Pennsylvania to Turbo, Colombia, where the thermal sensing and infrared imagery-producing equipment was installed. Because infrared imagery is best obtained at night, the test flights were made during the full moon period of February 1965 from the small airfield at Turbo by a brigade of lantern-toting natives. Regrettably the infrared imagery obtained did not contain sufficient thermal differences to reveal subsurface conditions and materials. It was generally accepted that the factors of intense humidity, very slight temperature differential between day and night, and the lack of sharp contrast of swamp materials contributed to this failure.

Our only alternative then was to work on the ground in the swamp where the best means of access proved to be by helicopter. The five previously chosen routes were given close inspection from low altitude helicopter flights and limited inspection on the ground when a helicopter landing could be made. Such landings involved lowering of machete men by cable first to cut the deep swamp vegetation that rose to a height of 12 to 15 ft. This visual examination of surficial conditions, supplemented by meager peat sampler penetration into the swamp wherever the helicopter landings were made, led to the elimination of four of the five routes. More extensive studies were concentrated on the one that offered the most promise. This route originates at the border crossing point of Palo de las Letras and extends southeastward to the edge of the swamp at a point near the mouth of the Cacarica River. From there it continues eastward in a straight line across the narrowest part of the entire swamp (approximately 22 km) to a series of small lomas or hills from which point the route extends easterly to a connection with the existing Turbo-Medellin Highway, 4 miles north of Guapa (Fig. 2).

Once the specific route had been recommended, a very limited geophysical survey was undertaken, utilizing electroresistivity methods augmented by soundings with a peat sampler and by probing. It was necessary that all personnel and equipment be lifted by helicopter to successive study sites where machete crews had to clear a resistivity corridor across the proposed line. Sufficient resistivity tests were made to substantiate that a relatively stable sandbase containing some sodium chloride existed some 20 to 35 ft below the swamp surface. The salt-laden sediment comprising an old seabed layer was interpreted from the significant downtrends in the resistivity depth curves.

Summing up the conclusions drawn from these limited tests, the Bureau of Public Roads reported to the Pan American Highway Congress that the highway crossing of the swamp appeared feasible and that the tremendous savings indicated by such a location

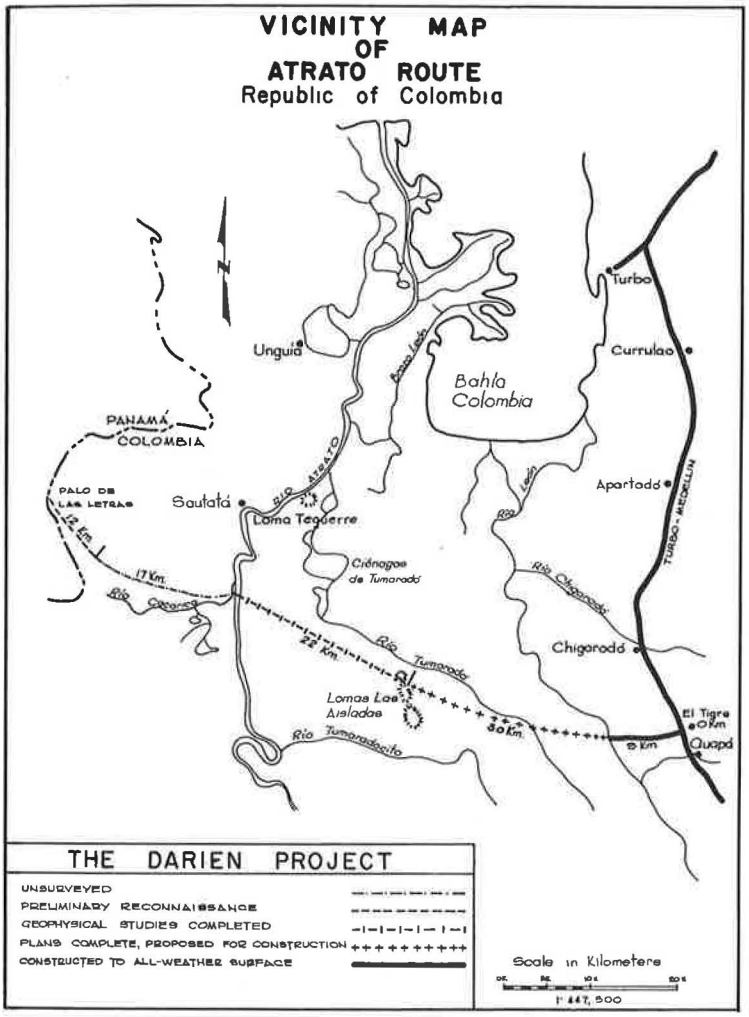

Figure 2. Highway route through Atrato River swamps.

justified the undertaking of more extensive geophysical studies for the development of a realistic design and cost estimates.

In 1967 the Darien Subcommittee of the Pan American Highway Congresses provided funding and requested the Bureau of Public Roads to direct the comprehensive geophysical studies of the Atrato area. The Bureau, in coordinating this program, set an outstanding example of international cooperation. Participating in the work were the following:

Colombia—Federal Ministry of Public Works; Engineer Corps., Colombia Army; Antioquia Department of Public Works; Petroleum Helicopters de Colombia, S.A.; and Solingral Laboratory of Medellin.

Panama and the U.S. Canal Zone—Atlantic-Pacific Interoceanic Canal Study Commission; Corps of Engineers, U.S. Army; Gorgas Hospital; Inter-American Geodetic Survey; and Panama Canal Company.

United States—Bureau of Public Roads, Regions 3, 8, and 15, and Washington, D.C.; and Law Engineering Testing Company, Atlanta, Georgia.

Organization of American States—The Darien Subcommittee staff and field forces.

A Bureau of Public Roads evaluation team, in consultation with a representative of the Law Engineering Testing Company, developed all plans for the entire program of geophysical investigation, recognizing the limitation of time (operations could only be accomplished in the dry season, February 15 through April 30), personnel available, and funding. This evaluation group participated in the field studies, interpreted all findings, and submitted final recommendations to the Darien Subcommittee.

FIELD WORK

Field work was started in January 1968 on the machete clearing for centerline and cross-sectional trochas and some 22 heliports in the area, on installation of base camps and assembling of all necessary field study equipment and fuel for helicopters, and on the many difficult logistical preparations necessary for the concentrated surveys.

BORING AND SAMPLING

Boring operations commenced early in February and followed the procedures outlined in the ASTM Method D 1586. Light Acker tripod wash-boring equipment was used for eight borings, spaced equally across the swamp. The drill rig was mounted on prefabricated wooden platforms, supported on oil drums that had been transported to the test locations by helicopter. Drilling water in large quantities was obtained from pits cut in the root mat of the swamp.

Undisturbed sampling of the peat and root mat was extremely difficult. In a number of instances the thin-walled 2.5-in. OD steel sample tube was forced through the root mat more than 10 ft, yet a sample only 18 in. long was recovered. In most cases these samples comprised the more fibrous portion of the organic material.

In all probability, densification or precompression was induced by the sampling operation of the organic mat. In the deeper silts and clays that are saturated, it is unlikely that any change in density occurred during the sampling. Instead, it is possible that some slight degree of disturbance occurred. Undisturbed sampling of the softer silts with sand seams was exceedingly difficult, and samples were not always recovered in these materials. However, a study of the boring records indicates that the undisturbed samples that were secured were representative of the total spectrum of materials beneath the swamp surface. All samples were sealed in the tubes immediately after sampling.

Borings on potential borrow sources in the Lomas Las Aisladas and in the hills west of the Atrato River were made using a Joy No. 7 rotary core diamond drill. The borings on the banks of the Atrato River were first advanced 60 to 70 ft by light tripod equipment and from that depth to final penetration by the Joy No. 7 core drill.

The deeper materials were identified from the cuttings washed to the surface, and the resistance of the materials was estimated from the penetration of the chopping and washing bit. Strength or resistance of the materials did not vary appreciably below 100 ft until hard materials were reached at substantially greater depth.

In the borings on the river banks, rocklike materials were reached at a depth of approximately 145 ft. In both cases diamond core drilling was commenced at these levels using BXM core barrels. In neither case was much core recovered because of the softness of the material drilled and probably because of the mechanical limitation of the lightweight drilling equipment at these great depths. However, small segments of core were recovered, indicating fine-grained sandstones and claystones. Complete logs of each boring were kept, including location and type of samples, drive penetration, and vane shear test data.

ELECTRICAL RESISTIVITY STUDIES

Electrical resistivity tests were performed along the centerline and cross-sectional trochas throughout the swamp, in all potential borrow areas, on the banks of the Atrato River, and, by use of a considerable flotilla of boats and canoes, in the river itself. A total of 163 such tests were made.

A simple milliammeter-potentiometer resistivity apparatus was used, employing direct current and using porous porcelain pots in the potential circuit. During a depth test, the four electrodes used were spaced an equal distance apart—3 ft, 6 ft, 9 ft, and so on—as the test proceeded, the assumption being that the spacing was the depth involved. The resistivity obtained was plotted against the electrode spacing or depth to produce a resistivity-depth curve showing trends to higher or lower resistivity as the test involved deeper portions of the subsurface and, thus, signifying subsurface layer changes.

The resistivity determinations do not necessarily indicate the engineering character of the soil to rock. Instead, they measure the degree of ionization of the soil or rock materials and, particularly, the ionization of any water in the pores. Therefore, a boundary of different resistivities may not always coincide with a boundary between strata of different engineering properties. This is particularly true in formations consisting of interfingered layers—sands and clays with varying amounts of salt left over from the deposition of the soils in the sea and with varying amounts of organic matter whose decomposition produces organic acids. In the swamp and along the river bank, therefore, the greater reliance was placed on the direct evaluation of the soil properties by borings and by laboratory tests of the materials below the organic zone where the resistivity changes may not reflect the engineering property differences.

SEISMIC TESTS

Refraction seismic tests were made in the hills at both ends of the line, at the river crossing, and at one location in the swamp. The work was done using a 12-channel seismograph and utilizing small charges of Primacord (1 to 4 lb) as the source of the shock wave picked up by the 12 geophones.

The conditions in the hills at both ends of the proposed swamp crossing were favorable for a rational interpretation of underground conditions. Most of the seismic work was concentrated in those areas. Four seismic profiles were made in the largest of the three Lomas Las Aisladas, one in Loma Tumara, and one in Middle Loma. Two seismic lines were run in the West Hills at the west end of the line. In general, these tests proved the availability of ample fill material for construction of the swamp crossing.

The conditions for seismic determinations in the swamp were definitely unfavorable because of the high energy absorption of the peat. Furthermore, the velocity in water, which saturates all of the strata in the swamp, may obscure the rigidity of the soil materials that the seismic work attempts to identify. Therefore, reliance in the swamp areas was placed mostly on the direct boring tests results.

FIELD TESTS

Because of the difficulties in obtaining good samples for testing of the organic mat and of the softer silt, two types of field tests were utilized. First, the vane shear was employed in the softer organic and silt formations and, second, a loading test was made on the surface of the organic mat.

The vane shear test employed a cross-shaped metal vane attached to a small diameter probe rod. The vane shear was used in the soil borings in much the same manner as the standard penetration test. The vane was attached to drill rods and forced into the soil well below the bottom of the hole. It was rotated by means of a torque wrench. The torque required to initiate movement was recorded as a measure of the undisturbed shear strength of the soil. The vane was then rotated at least two revolutions, and the torque was measured again as an indication of the remolded strength of the soil. The vane produces shear on a cylindrical surface having the same diameter as the width of the vane. From the dimensions of the vane and the torque required to produce movement, the undisturbed shear strength of the soil was computed. These vane shear strengths were included in the soil boring records.

The load test was made with 143 fifty-gallon oil drums transported by helicopter and placed in a circular configuration in four layers pyramiding up above the swamp surface. The load was applied by filling the drums with water, one layer at a time. The

settlements were measured on the perimeter of the lowest layer and on the bottom of the second layer by level observations. These were made at intervals of one to five days after loading. A point of reference for bench mark was established using a 1-in. galvanized pipe forced approximately 28 ft into the swamp far enough from the load test that there should be no influence of load test settlement.

A major factor in this load test was the submergence effect of the oil drums that took place with the settlement. The settlement after the placing of the final load was nearly one meter. As a result, much of the lower tier of drums was submerged, which reduced their effective load substantially. Thus, the gross loading over the area of the test was 380 lb per square foot, but with four tiers of drums loaded, the net loading was only approximately 220 lb per square foot.

Later observations of this load test were needed to expand the time-settlement study, but these were precluded by a completely unexpected development. Observation during the height of the wet season was attempted by special helicopter flight in September, but it was discovered that the natives of the Darien had penetrated the "impenetrable" swamp by cutting a 2-mile canal for their canoes and had lifted all 143 drums.

SAMPLES

Four types of samples were recovered from the field operations: (a) undisturbed Shelby tube samples obtained by use of the light tripod equipment in the swamp; (b) jar samples recovered from the barrel of the split tube used in performing the standard penetration tests; (c) rock cores and fragments recovered from operation of the Joy No. 7 core drill; and (d) bulk soil samples obtained from exposed strata and in the hills west of the Atrato River.

Those samples on which tests were to be performed were transported by airplane and automobile to the Solingral Laboratory in Medellin. It was necessary to have a courier transport each transmission of samples to insure against undesirable shock or damage and also to obtain release from internal customs inspections in Colombia, as such inspections, if performed on the undisturbed samples, would have destroyed their usefulness for laboratory work. Because emerald smuggling is prevalent in Colombia and the Atrato area is under hoof and mouth quarantine, we had some problems in satisfying inspection officials.

The testing program included moisture content, unit weight, void ratio, grain size analysis, time consolidation, Atterberg limits, and shear strength. For some selected samples, organic content and chloride content were determined. On a few of the rock samples, petrographic examinations, including thin sections and X-ray diffraction tests, were performed by the staff of the Law Engineering Testing Company or at the mineralogy laboratory of the Georgia Institute of Technology.

SURVEYING AND MAPPING

Early in the planning, arrangements were made for photogrammetric mapping of the work area by the Aerial Surveys Branch of the Bureau of Public Roads, utilizing a photo plane of the Colombian Ministry of Public Works.

Targets and control towers had been prefabricated and lifted by helicopter to the swamp as the field work progressed. These control points were tied to the work line and to the established Inter-American Geodetic Survey controls by a crew of the IAGS, utilizing electrotape and theodolite equipment.

The survey data and photo negatives permitted the development of an uncontrolled photomosaic of the line and a planimetric map to accurate scale.

SUMMARY

On the basis of all findings accumulated during these geophysical studies, the evaluation team concluded that construction of a highway across the Atrato River swamp is both feasible and practical. Three methods of construction are considered acceptable though the first is recommended as least costly and one that best fits the anticipated funding, timing, and service requirements although it entails some disadvantages.

1. Placement of fill material obtained from the Lomas Las Aisladas and the hills west of the Atrato River on the organic mat with consequent compression of the organic material and the soft subsurface layers.
2. Removal of organic material and the softer subsurface material and replacement with fill material obtained from the Lomas Las Aisladas.
3. Use of trestle construction across the entire swamp.

A complete report, including recommendations and design details has been furnished the Darien Subcommittee by the Bureau of Public Roads. The Darien Subcommittee will submit its final report in February, summarizing this study and the findings of all surveys made in the Darien over the past 10 years. This report, recognizing the Bureau of Public Roads findings, will recommend the short-route crossing of the Atrato swamps for bridging the gap between the American continents. Unquestionably the tremendous savings realized by adoption of the short route will encourage early consideration of funding for this project. The findings of the comprehensive geophysical studies described in this paper, which were accomplished at a total cost of approximately $100,000, could well generate a savings return in construction cost alone of over $100 million.

Transport Lessons From Europe

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EUROPEANS protest politely at the suggestion that Americans might learn from them about solving problems of urban transport. First impressions suggest that the reaction may be justified. For with 60 million motor vehicles, traffic jams in Europe are reminiscent of the United States in the 1920's, before much had been done to cope with them. Space is now so tight in some big cities that triple parking on the streets is being augmented by double parking on the sidewalks.

Despite their traffic, Europeans have cities that Americans like to visit, and if we ask ourselves why, the answer is obviously not because Europe has discovered a nostrum for urban mobility. The United States knows considerably more about how to move in cities. But Europe has demonstrated that it knows most about how to live in them. One reason is that European cities have insisted on using the transport system to help ensure a pleasing environment. The result of this policy is that although there are traffic troubles in the short run, the approaches to their solution may achieve a smashing success in the long run. Countries like France, Italy, and Sweden are not being tempted to win the battle against congestion at the cost of losing the cities themselves.

MAJOR TRAFFIC ARTERIES

European cities cannot boast many high-capacity urban expressways, but they do have a large number of broad boulevards that carry substantial volumes of traffic and at the same time add immeasurably to the charm and function of the metropolis. The wide center strips of European boulevards do double duty. They not only separate traffic but they accommodate pedestrian malls, parks, subway entrances, and commercial areas for outdoor refreshments, bookstalls, periodical stands, and flower shops. Gardens and rows of trees along these boulevards contribute to the quality of the neighborhood. Cars take advantage of the shaded reservations for parking. The same dual uses are repeated on a smaller scale along the green areas that separate the main road from the service roads.

The boulevards of Paris, Milan, Copenhagen, Turin, Lisbon, Madrid, and Barcelona give these cities character and beauty, and help supply them with park and recreation areas. Widths are frequently a hundred yards. What they add to the city is far more than a surface to ride on. Many miles of these main streets perform non-transport functions that are an integral part of the life of the city.

Federal highway legislation in the United States is just beginning to make this possible in urban areas. What is needed is joint planning and financing of roadways and related community facilities to ensure that rights-of-way serve both transport and non-transport objectives, and that a combination of programs creates a package approach to meet multiple purposes.

The assumption that a limited access road is always the best answer for main roads in cities is made highly questionable by European example. A larger mileage of boulevards incorporating some of the design features of the expressway may be preferable. Lack of complete access control can be partly compensated by service roadways on either side, and by the construction of underpasses at selected intersecting streets.

Paper sponsored by Special Committee on International Cooperative Activities and presented at the 48th Annual Meeting.

This kind of boulevard will move fewer vehicles per hour, but it will create a lively, interesting, and aesthetically attractive environment that attracts both residential and commercial users and supplies the walkways, play space, and recreation areas that could be desirable side effects of the urban transport system.

The redevelopment of American cities affords an opportunity to create this kind of major arterial in the course of the demolition required for new housing and community facilities. An existing street can be combined with the next parallel street through acquisition of the entire intervening block of buildings.

Europeans have placed particular emphasis on esplanades built along the waterfronts of rivers and lakes within the cities. Rather than permitting these natural (and sometimes artificial) features to be monopolized by industrial uses and the least attractive growth, Europe has turned them to magnificant advantage. Good examples of waterfront developments include the lake highways of many Swiss cities, including Geneva, Zurich, and Lucerne. Zurich has created an excellent combination of park lands, restaurants, and transport routes along the water. Among the big industrial cities of Germany, the waterfront transport and park system in Hamburg is especially impressive.

In Naples the frontage on the Bay of Naples is used for a major dual highway, with special reservations for transit, a median strip for parks, playgrounds, and gardens an eighth of a mile wide. Other examples of effective joint transport and nontransport projects are found along the Seine in Paris, the Thames in London, the Rhine in Heidelberg and Frankfurt, and the oceanfronts in Copenhagen and Stockholm. Many cities turn their backs on the water or destroy waterfront sities with elevated structures. Boston, Providence, Baltimore, Philadelphia, and Georgetown's Potomac River front are examples.

Rewarding uses of waterfront properties stem from acceptance of the idea that joint uses and combined resources are essential to an effective waterfront design. Preoccupation with one project at a time and the search for least-cost solutions that are inherent in such an approach have led to squandering the advantages for urban development that are inherent in waterfront land. A combining of recreation and housing programs with transport undertakings can remedy this mistake and demonstrate, in the broader context of multiple uses, that the objective of economy is better served by pooling resources than by cutting corners.

ORDINARY STREETS

Many ordinary streets today are a depressing gridiron of asphalt, and streetsides are a jumble of poles, wires, signs, and weeds. This mileage of barren pavement requires an imaginative face-lifting program to create an acceptable environment for the new housing, community facilities, shopping centers, and recreation areas that urban redevelopment will entail. Because at least a fourth of the area of American central cities is in streets, any program to improve the environment starts with the streets.

Europe has made many lesser streets attractive by the creation of streetside parks and playgrounds, attractive designs for street lighting standards, tree planting and landscaping, and the selective acquisition of land at intervals to provide an entrance from the street into rear property for off-street parking. The removal of utility poles and wires has been of basic importance. When these measures are taken to improve the public way, there is a tendency for private properties also to be improved. Aesthetically desirable standards for advertising signs are also essential.

In rural areas, highway departments provide roadside parks and landscaping, remove poles, control signs, and regulate commercial developments. These responsibilities do not extend to the urban links of state highways, and no agency is concerned with similar matters on local streets. Urban highway programs should provide for these ancillary features, and highway funds should be made available as in rural areas.

Private enterprise has a major stake in the viability of cities and could be the most important factor in turning the tide against streetside blight. The same companies that build unsightly service stations and other commerical establishments in the United States are already creating well-designed facilities in Europe that make a definite con-

tribution to the community. Landscaped fuel pumps at curbside in Rome and other cities, and the larger service stations with gardens and outdoor restaurants are a notable departure from the community eyesores imposed by gas stations in America. Service stations in Europe are often built into the corner of office buildings or installed in a median strip of grass and trees.

Such improvements in the urban environment could be duplicated by the location and design of automobile showrooms and used car lots. Most of Europe not only has been spared the blight of retail outlets for automobiles but has made these establishments among the most attractive commercial structures.

Retail merchants can also join in the campaign to make the street scene a welcome addition to the environment. Sidewalk and streetside restaurants and cafes are important embellishments. In Rome, Berlin, and other cities, the use of glass-enclosed sidewalk restaurants makes heating and air conditioning possible.

Advertising can be an attractive streetside embellishment. Neon advertising lights flush against the building rather than extending outward from it illuminate the building front itself and create an excellent effect. German cities in particular have demonstrated the aesthetic and commercial value of such lighting. The art of outdoor advertising is witnessed in Geneva, which concentrates neon advertising along the tops of the buildings; on the Champs Elysées, which makes predominant use of white light; and on Rome's Via Veneto, where the symmetry of signs creates an impressive total impact.

PEDESTRIAN TRANSPORT

The most economical short-haul transport with the best safety record is walking, and European cities are developing significant systems for improved pedestrian circulation. In at least a dozen European countries, city governments are working on pedestrian transport facilities that are an important central-city transport solution as well as a boon to shoppers and a distinctive addition to the charm of urban living.

The major pedestrian city is Venice. Mechanized traffic is confined to the canals, which accommodate both freight and passenger carriers, but dry land is reserved for the walker through an intricate network of alleys, walkways, stairways, bridges, plazas, and promenades. A modern new city could be served by a network of depressed highways similar in design to the main canals, with parallel walkways of various shapes and sizes, and underground parking accessible from the roadways. A simulation of the Venetian pattern would separate people from vehicular traffic and make the traffic network upgrade the environment.

For most cities some less ambitious and less costly pedestrian accommodations are suggested by European experience. One is simply to bar vehicles from certain streets during specific daylight hours, which involves no more than the cost of appropriate signs. Streets of this kind are located in the old town centers of Stockholm, Amsterdam, Barcelona, and Copenhagen. Pedestrians in these reserved streets have a tendency to trip over the curbs, however, encouraging the next step of paving the street to curb height with attractive building blocks, making a permanent pedestrian reservation that excludes vehicular traffic altogether. An impressive result is the Hague's Noordeinde, a brightly lighted picturesque street with shops and restaurants, tastefully designed lighting standards, decorative shrubs, and satisfied merchants whose retail sales have doubled since cars were banned. Comparable conversions on relatively narrow streets half a mile to a mile in length include Amsterdam's Kalverstrasse and a network of walkways in Cologne.

Restoration of bomb-damaged centers has led to the creation of larger pedestrian plazas, such as downtown Rotterdam's Lijnbaam shopping center across from the main railway station. The Rotterdam plan covers several blocks, and the promenades are bordered by stores with living quarters above them. England's Coventry provides another large-scale but less impressive pedestrian downtown.

Transport terminals can also contribute to the city's pedestrian preserves. Generally speaking, European transport terminals are designed to enhance surrounding properties and to make the life of the traveler more satisfying. Because the transport

user appears destined to spend a large proportion of travel time in waiting time, terminals should be made convenient for shopping, resting, recreation, and cultural activities.

Milan, Florence, Rome, Vienna, Copenhagen, and Turin have rail stations that are pleasing on the outside, are well equipped inside, and face large open squares and gardens. These stations provide colorful restaurants and drinking places on the concourses, moving picture theaters, attractive stores, and inside landscaping. There is strong evidence in favor of consolidated terminals built by public authorities over the current U.S. tolerance for inadequate private depots. Air terminal architects could contribute by applying some of their recent accomplishments to surface transport terminals.

The ultimate triumph of European pedestrians, however, is in new towns, especially in England. All of them provide central pedestrian shopping centers and a complete network of pedestrian paths from residential neighborhoods to the town center. Safety and easy access are afforded on a community-wide basis.

PUBLIC TRANSPORT

Most American cities depend far less on public transit than European cities. With the exception of a half dozen of the biggest U.S. cities, transit patronage is only 50 to 80 rides per capita per year. For Cincinnati, Memphis, Atlanta, and Seattle the figures are in the 70's. For Kansas City, Minneapolis, Providence, and Indianapolis they drop into the 50's.

In Europe, where densities are higher, incomes smaller, automobile ownership lower, parking scarcer, and transit better, public carriers are depended on to a much greater degree. An average of 330 transit rides are taken per person per year in West Berlin, Rome, and Madrid, and over 500 rides in Prague. London and Paris, with something over 250 rides per person, are below the New York figure but far above other U.S. cities.

European experience suggests that more acceptable public transit in American cities will require a much larger number of buses and a greater route coverage if the needs of the public are really to be met. It would perhaps be necessary to double the fleet of buses, but the cost of this expansion, if reflected in bus fares, would increase the price per ride substantially. Any increase in fares would lead to declining patronage so that, even though the quality of service would be higher, the number of people enjoying it would be reduced and there would be more demand for street space to accommodate private automobiles. In addition, the higher level of fares would increase the financial burden on low-income families.

It appears, therefore, that the improvement in services necessary to make transit users more mobile would have to be financed out of general taxes rather than from fares, and this suggests a re-evaluation of the idea of charging for public transit in the first place. The cost to the community of providing free transit, on the surface, might be minimal if any appreciable number of automobile owners shifted to transit in the rush hours, eliminating the need for additional street capacity and reducing the economic losses from congestion.

Additional questions are raised by European rapid transit. Europe is making major additions to existing rail rapid transit, much of the work in subways. Half a dozen cities are getting subways for the first time. Altogether 190 miles of new rail rapid transit lines are being built, and another 500 miles are planned. Only in Zurich has the electorate voted down a proposed subway system.

Riding European subways, and the surface and elevated rail lines that comprise these, creates a variety of reactions. Obviously some cities could not survive without the underground, and London and Paris are the two principal examples. These two cities have more rapid transit lines than all the rest of Europe. They also have the largest subways—96 miles in Paris, 85 miles in London. Moscow is runner-up with 62 underground miles, West Berlin is next with 35 miles. (No system in the world is as large as New York's 138 miles.) The rest of Europe's rapid transit systems are of relatively modest size. For example, Madrid has 20 miles, Stockholm 13, Barcelona

10, Milan 8, Glasgow 6, and Lisbon 5. All of these are completely underground except the Stockholm system, which is 37 miles long altogether, with about a third beneath the surface.

New systems are very different from old-style rapid transit. Ancient subways are generally dirty, overcrowded, and unpleasant, but the new ones are generally clean, cheerful, and not too crowded. All of them have the common attribute of moving the passenger quickly, except on trips that involve transfers in rush hours. Specifically, London subways are speedy ways to move in off-peak hours, but they are dingy and depressing. They are neither clean nor attractive, and they involve a great deal of walking and waiting, in queues for tickets and later for ticket inspection; in long, steep descents by escalator; in front of elevators; and in long passages and on dismal platforms.

But new lines in Milan, Berlin, and Stockholm are pleasant, clean, and quiet. The orange and brown system in Milan operates steel-wheeled cars that are almost silent compared to the older equipment in London and Paris, although the new rubber-tired equipment in Paris is quietest of all. The Stockholm subway has spacious and well-decorated stations, good equipment, and plenty of space. The Berlin system is also attractive and offers a civilized ride. The Rome system is clean and uncluttered but is not sufficiently extensive to make a noticeable contribution to the total network. The new Rotterdam subway is less impressive. Much of the line is above ground on an elevated structure that detracts from the area. The Lisbon system is clean and noisy, Madrid grossly overcrowded, and Glasgow and Hamburg inadequate in a variety of ways. Some of the new but unfinished projects appear to offer high standards, particularly the one in Munich.

Rapid transit in Madrid brings the whole question of traffic relief through subways into better focus. This city has very broad avenues, a relatively low ratio of automobile ownership to population, good bus service, and moves 500 million passengers annually on its subways. But Madrid, despite all these points in favor of low levels of street congestion, seems to be the most congested of all. In the central area of the Puerto del Sol, it is extremely difficult to find space enough to move comfortably on the sidewalks.

The reason for Madrid's plight is that a million more people moved into the capital during the past 7 years. There are now 3 million people altogether. Population density per square mile is about the same as that in Manhattan. Subway extensions and modernization cannot change the basic fact that growth has been too rapid and densities are now too high to permit increases in transport capacity to relieve the pressures.

The one thing clear in Europe is that cities with the most extensive rapid transit systems often have the biggest traffic tie-ups. Subways do not automatically relieve congestion on the surface. What they do is allow more people to move and to move faster. The presence of a subway creates pressures for further concentration, so that the decision to go the subway route is a decision to accept greater size and density. But, if a new level of congestion is to be avoided, the subway decision should be accompanied by positive plans that put limits on the allowable population through ceilings on employment opportunities and economic activities within the built-up areas, and through the creation of alternative sites for urban expansion.

Sweden seems to have found a logical solution. The rapid transit system is part of the metropolitan city-building program that includes a renewed downtown for Stockholm plus a series of satellite suburbs planned specifically to absorb projected metropolitan growth. The transport system is aided both by planned developments and by the preservation of open spaces between the city center and the suburbs. Paris is now planning a comparable approach, with 6 satellite cities of 500,000 persons and rapid transit between each one and the central city. But elsewhere the approach is to design the subway to accommodate more crowding.

The lessons for the United States should find useful application in present plans for rapid transit in Washington. The plan for 98 miles of line, three times that of Stockholm, will not provide lasting relief unless it is combined with a definite plan for future metropolitan growth and control over other growth patterns. A rapid transit system could help to bring into being a federation of satellite towns connected to the capital

city, with surrounding open space preserved for useful purposes. This fourth largest rail rapid transit system in the world should not be construed simply as a traffic reliever, but as the means for accomplishing a new pattern of regional development that will provide permanent congestion relief through urban design.

INTERCITY TRANSPORT OPTIONS

One of the principal features of European transport that differs from ours is the reliance on intercity travel by rail. In 1965 the total volume of rail passenger service in 14 West European countries was 200 billion passenger-kilometers. The figure for the United States was 28 billion. And while U.S. rail patronage dropped 22 percent in the period from 1960 to 1965, eight of the European countries registered an increase. The only sharp drop was 15 percent in the United Kingdom. But the 50 million people in the United Kingdom were still doing more travel by rail than the nearly 200 million people in the United States.

These high levels of intercity travel by railway in Europe reflect in part the smaller number of automobiles in relationship to population, the short distance between cities, and in some areas the inadequate highways and heavy congestion. Shorter distances reduce dependence on air travel, and highway congestion and public policy combined may account for the lower patronage of intercity buses. But the staying power of the railways lies also in the speed, frequency, and convenience of rail service, the modern equipment, pleasant terminals, courteous service, and the scenic attractions that go with a train ride.

For Europeans the railways offer a welcome option—people can elect to go by automobile, plane, or train, and they exercise the option according to mood, distance, time of day, weather, season of the year, and a variety of economic considerations. The important point is that there is a choice, and often that choice is lacking for Americans. The urban dweller in the United States has an extensive network of air and bus services as well as good roads for automobile travel, but service from city center to city center is not as good in congested areas of the East and Midwest as it is by rail in Europe.

The question is particularly relevant in the eastern United States, as air delays and highway traffic combined with less than ideal weather conditions make the railway option for short hauls theoretically inviting. Where large cities that generate sufficient travel are fairly close together and as urban concentrations increase in magnitude, there is a case for the rebirth of surface transport by rail—with or without wheels.

On balance it appears that if intercity travel by rail is to be revived, the process will be similar to rail revival in cities. There are urban routes and urban areas in the United States where it is not possible to get along without rail rapid transit. These services will have to be modernized to far better standards than those now available. A comparable future is indicated for intercity rapid transit on the surface.

But the future of intercity travel may lie in the creation of opportunities to use it rather than in meeting an existing demand. Plans for new medium-haul passenger transport could be related to projected patterns of urban settlement and used to help achieve such patterns. Methods might include electronic guidance for highways, possible breakthroughs in the performance and economy of the helicopter, and the advent of guideways for wheelless cushioncraft such as France's Aerotrain.

It is a public responsibility to ensure an appropriate network of intercity passenger services, and to allow the situation to evolve on the basis of what individual airlines, bus companies, and railroads independently decide to do is not enough. The federal government should be projecting intercity public transport demands in the light of economic and technological trends, making a judgment as to what services are required, and arranging with private operators for the standards to be met and the options to be maintained. And networks of intercity transport should be designed as part of a program to bring about a pattern of urban settlement in the United States that leads us away from planless overcrowding toward a more thoughtful and rewarding use of the land.

TRANSPORT FOR NEW CITIES

The art of combining transport with other urban investments has reached an advanced state in the efforts of several European countries to create new towns and new cities. England, Scotland, Sweden, Italy, Yugoslavia, France, and others are resorting to new patterns of urban settlement to cope with the demands that confront them.

The relationship of transport to new towns lies in the basic concept of using the transport plan as an element in the design itself, delineating neighborhoods, providing adjacent lands for industry or parks, separating through traffic from living space, protecting pedestrians, and supplying the options of walking, driving, and using public transport. The idea is to balance the supply of transport capacity with the demands that may conceivably arise for their use. And though the objective has been thwarted by miscalculations, the important thing is that the calculations are made and the adjustments required to pursue the goal have followed.

Most of Britain's 22 new towns, in various stages of completion, were designed to accommodate 60,000 to 80,000 people. These towns were built on publicly acquired land—generally about 10,000 acres. The new towns have succeeded in creating a pleasant environment in scenic rural areas, with housing, shopping, schools, and recreation that far surpass conditions in the older cities. Considerable variety of industrial employment has been possible, but it is now recognized that much larger towns must be built to afford the variety of economic activity necessary for self-containment and interest. The newest new towns will be double the size of their predecessors.

Transport is a key factor in Scotland's new town of Cumbernauld. The city has been designed for good circulation with safety, using motorways, pedestrian underpasses and bridges, and an extensive system of pedestrian pathways. There is a local bus line focusing on the center of the town. A unique feature of Cumbernauld is the half-mile-long 8-story town center, which resembles an airport terminal. On the top are penthouse apartments, restaurant, central library, and meeting halls. On the lower levels are banks, department stores, beauty parlors, health center, eating places, offices, nursery, hotels, and recreation. At the bottom of all this is the roadway, the bus lines, and parking areas—ultimately 5,000 covered spaces. But transport is not necessary for every purpose, because local shopping needs are met by a general store for each 300 persons within the neighborhoods, and recreation needs are filled locally by play spaces at frequent intervals and by a playground for every 200 houses.

Nine miles from Glasgow is Scotland's first new town, East Kilbride, which covers an area of 10,000 acres with over 50,000 people and a projected population of 70,000. A large pedestrian area is set aside for the town center. Roads lead from housing areas to industrial estates that contain 4 million square feet of floor space with employment for 18,000 workers making jet engines, Schweppes tonic, telephone equipment, electric razors, record players, and thermostats. Transport requirements for East Kilbride were miscalculated. Originally it was planned that a one-automobile parking space would be provided for every 10 residents. The main highway was to pass directly through the town center. The allocation of land for industrial development was made without concern for parking. Along the residential streets now there are endless rows of parked automobiles forced to use the street because there is no other space.

Many of these limitations have been corrected in subsequent plan revisions. The town center has been designed for pedestrians only, and the main highways go around it. Loading and unloading are accomplished underground. One of the main highways is now being made a dual roadway, thanks to a spacious right of way. Pedestrians are provided with bridges and underpasses across major thoroughfares. A fourth industrial park has been acquired for the additional land needed by industry for parking of workers' automobiles, and shoppers' needs have also necessitated a redesign of the town center, including multiple-level parking.

East Kilbride's center is spacious and easy to get around in. Pedestrians are protected from rain by the large overhang roofs, and signs and advertising are used tastefully. New buildings at the center include moving picture theater, hotels, government offices, and close-by recreation in an adjacent park, including an enclosed swimming

pool and youth center. Another section of the town center yet to be built will be fully enclosed and air-conditioned. Neighborhoods also have their small shopping centers with limited parking, on the assumption that shoppers will come principally on foot. Typically the few shops include a baker, butcher, and grocery store; and a larger neighborhood center has in addition a health center and more variety in shopping as well as churches, dentist, and small cafes. There are also primary schools in the neighborhood and play fields and open space—10 acres per 1,000 population.

The atmosphere of East Kilbride is the outcome of many different factors—the countryside, the altitude, and the varied architecture and skillful use of color. But the street and transport plans have also made a major contribution. Trees and plantings and the use of remnants of land along the right-of-way for small parks add to the total picture. The underground installation of telephone and electric wires makes the street additionally attractive. And the street layout itself avoids uniformity, making good use of crescents and dead ends that can be passed through only along pedestrian walkways or stairways, sometimes with apartments using the air rights over the walkways.

The possibilities of minimizing travel by design are illustrated by the new town of Stevenage, England, 15 years after its construction. This town of 60,000 persons has one automobile for every two families. About 87 percent of employed Stevenage residents now find work within the town. Of all trips made within the town limits, 43 percent are made on foot, while 12 percent are by bus, and 24 percent by automobile. Bicycles and other two-wheeled vehicles account for about 20 percent of all trips. Individual transport by all methods, walking included, makes up 87 percent of the journeys, and public transport is the least important method of travel. Where distances are short, both old and young can make their own way on foot. On a typical Saturday, nearly half of all shopping trips are made in the neighborhood. The rest are destined for the larger town center, where 59 percent of the customers arrive on foot. Three-quarters of all school children walk to school; one-eighth ride bicycles. For social and recreational trips, 42 percent go on foot.

The principal explanation for so much walking in Stevenage is that 75 percent of all trips are less than 2 miles in length. In the outer ring of large cities in England, a third of all city journeys extend more than 5 miles one way. Little more than a tenth of the trips by Stevenage residents are that far. Perhaps the key to the success of Stevenage transport is a city plan that has permitted three-quarters of all workers to live less than 2 miles from their jobs (1).

In all these efforts, it is the combination of transport and structures that produces the results. Streets form the framework of the community, motorized traffic is separated from pedestrians, and the roadsides lend the commercial areas and living areas their unique character. The effect is to create roominess in the same amount of space that for unplanned urban areas of the same size would undoubtedly be a jungle. The new towns have made transport facilities play the dual role of moving traffic and at the same time of forming an integral part of commercial and residential neighborhoods.

A new approach to transport will be featured in one of the newest new towns, Milton Keynes, 40 miles northwest of London. This will be the largest British new town yet proposed, with 150,000 people. Construction began in 1969, and capital investment will be over a billion dollars. Goals include a wide range of living conditions to attract a broad range of social classes. Emphasis will be on employment in the service industries; on extensive recreation facilities, indoors and out; on high standards of educational and health services; and on the accommodation of increasingly complex and overlapping social activity patterns. Communications for the new town will be designed to provide uniform coverage and capacity over the whole town, or as near that as possible, with greater flexibility for the expansion that may come later.

The effort to deal with urban growth in Europe has produced other types of developments that take advantage of transport to create new planned suburbs. In Belgrade the response has been to move across the Danube and erect a whole new city of New Belgrade where there was previously almost no development at all. The result is a concentration of high-rise apartments with spacious green areas and parks, wide boulevards, and an outward migration of some government offices. Altogether, 100,000

people are being accommodated across the River, and the living conditions are vastly superior to the crowded and obsolete housing in the old city.

Belgrade's problems, with less than 2 million to care for, are of the same order of magnitude as Stockholm's. Stockholm has attacked congestion by creating satellite towns about 10 miles out. It has been public policy since the turn of the century for the city to buy land outside its borders to accommodate the long-term demand. Most of the new developments now taking place around the metropolis are on government-owned land. In some cases these suburban areas not immediately needed were leased back to the owners to be continued in agricultural uses, and the revenue earned has been used to pay interest on the funds borrowed for acquisition. As in England, the increased value of the land resulting from new town construction accrues to the public and helps make the venture self-supporting.

The subsequent uses of these publicly owned lands have been linked to the design of transit facilities. Suburban centers were planned around transit stations, with a main center at selected stations to serve the needs of several smaller communities. Thus there were developed a series of small suburbs of 10,000 to 15,000 people and an occasional main center of 50,000 to 100,000 people, all easily accessible to Stockholm.

In the past 18 years, 18 suburban units have been built, clustered into three groups around three main centers. There are about 250,000 people living in these suburban areas, and two more major clusters are planned. Undeveloped land has been preserved between the central city and the new suburbs. The suburbs themselves, with their attractive shopping centers at the transit station, are pleasant places that afford good multiple-family dwellings with spacious recreation areas. In the United States the same result might be accomplished with limited-access highways.

In suburbs of 40,000 to 60,000 there has not been a sufficient growth of suburban employment opportunities as yet, and only about 25 percent of satellite residents work near home. The percentage is declining. For this reason the new suburb of Jarva is being planned for 120,000 people, and it is hoped to supply 70,000 jobs to minimize commuting. The central city will then be used more as a regional shopping center rather than a focus of employment for the suburbs.

The new towns and new cities to come provide dramatic hints of how transport can be combined, physically and financially, with the whole city-building effort. Transport facilities can help build an urban community, and urban design can help resolve community transport problems. The same principles apply and the same possibilities can be exploited in central city rehabilitation and in conventional suburban growth.

In the United States what is needed is not new towns but new cities. Perhaps they should contain 250,000 people to 500,000 or more, and perhaps as many as a million. They could be one unit or a group of settlements comprising a regional city—a federation of communities with common services and other cooperative relationships. The achievement of this more orderly kind of development offers the possibility of using modern transport and communications to create the goals of improved urban living.

Tens of millions more urban people will have to be accommodated in the remaining years of the twentieth century. This can be done by spreading ourselves all over the countryside in suburban developments that never achieve integrity of design or a sense of community; by packing ourselves into denser and denser developments with fewer amenities; or by a combination of new cities and redeveloped old cities specifically designed to provide manageable communities adapted to economic conditions and technological realities.

A FEDERAL URBAN TRANSPORT PROGRAM

In conclusion, European experience suggests some steps that might be taken in the United States to make transport facilities and operations contribute to urban living rather than detract from it.

The first objective is to redesign the streets to create a setting in which housing and community development programs can be effective. This is the nontransport aspect of the urban transport program, and it introduces new concepts of public responsibility in the field of transport:

1. Revise the concept of city streets by shifting some of the emphasis from moving traffic to nonmovement functions that upgrade the environment.
2. Extend conventional roadside improvement programs in rural areas to include the urban streetsides.
3. Convert sections of streets to pedestrian walkways with appropriate aids to walking.
4. Add off-street parking and transport terminal responsibilities to those of public agencies in charge of streets.
5. Make available the necessary land for retail shopping, parks, play space, and parking through the elimination of unnecessary street mileage and marginal acquisitions at intervals along the streets.
6. Remove poles and wires from urban rights-of-way.
7. Provide appropriate lighting, street signs, and standards and limitations for signs and advertising, based on progressive practices on rural highways.
8. Construct major boulevards with semicontrol of access in conjunction with urban redevelopment programs, using rights-of-way for combined transport, parking, recreation, pedestrian promenades, and restaurants.
9. Undertake cooperative programs with private industry to enhance neighborhood values through appropriate location and design of commercial structures using the streetsides for business sites.
10. Provide full-time employment for low-income urban residents in a combined public-interest street remodeling effort designed to upgrade 100,000 miles.

The second objective is to improve urban public transport capabilities to make public transit goals-oriented in order to extend the benefits of urban living to the nondriving public:

1. Combine transit aid and highway aid to create city-wide systems of bus transit, partly on exclusive rights-of-way.
2. Increase the frequency and coverage of bus transport, improve communications, and take other measures to upgrade passenger service standards.
3. Extend public transport responsibility to the provision of transit terminals to accommodate buses and to provide for passenger transfers among transport modes.
4. Apply the school bus concept in education to transit services for other social and economic goals in urban areas, such as operating buses as part of the recreation system, or as aids to the functioning of medical and hospital services.
5. Experiment with free transit, using Washington, D. C., to establish the costs, assess demand, and measure the impact on street traffic.
6. Modernize stations and equipment of rail rapid transit and subway systems in cities now served, but experiment with bus rapid transit before extending subways to cities not clearly needing them.
7. Make use of rail rapid transit or other high-speed transit investments as a means of implementing new urban regional patterns designed to create less congested cities.
8. Create joint public-private corporations for the provision of intercity passenger services by all methods to ensure that passengers have a complete service by the most appropriate combination of methods—an extension of the container concept in freight movement.

The third objective is to combine transport with urban structures and land use to make the transport network an integral urban design element and to apply transport financial resources to urban development. Included in this process is the design of new cities:

1. Extend the concept of corridors in a building to the design of street and transit facilities serving groups of buildings, making transport networks an integral part of community development programs.
2. Pool public funds for transport, renewal, recreation, and other community programs to achieve new urban designs and economies in land purchase and construction. Pool public with private funds where transport can be combined with structures to save

space, improve the quality of the urban environment, and resolve transport problems through building design and use.

3. Focus model city and redevelopment design on land uses and land use relationships that will help to overcome transport problems through nontransport solutions.

4. Establish a federal-state commission on future urban development, empowered to designate and acquire sites for new cities and to establish appropriate policies for preserving agricultural and park lands as buffer areas.

5. Shift the emphasis from transport planning for the relief of existing congestion to transport planning for the creation of new patterns of urban development designed to prevent congestion.

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Urban Transportation in Great Britain: Policy and Problems

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•TO ANYONE interested in urban transportation problems and government's response to them, London is exciting. The most important and instructive thrusts in British transportation today are those involving regionalism in local government, enhanced local responsibilities, the integration of transportation functions (in the broadest sense of the term) at the regional level, and the marriage of transportation to strong land use planning powers. The epitome of these developments so far is London since 1965, where the concepts are in operation and are soon to be expanded.

REGIONALISM-PLANNING-TRANSPORT INTEGRATION-LOCAL RESPONSIBILITY

London is one of the world's oldest metropolises. Covering over 600 square miles, it sprawls across a giant chunk of Great Britain and is the home of 8 million people. It contains a historic center city within its boundaries and suburban communities as well. It is troubled by all the urban ills.

What happened in London in 1965? In that year a maze of almost 100 independent-interdependent local governments (much like Trenton and its suburbs, Newark and its suburbs), having no locally developed overall direction, widely differing resources, and confused lines of jurisdiction, were reorganized into a new two-tier system of government.

What brought London to this state? In a word, growth! Or, as reviewer Reyner Banham once put it "...ever expanding...growth which alarms the town planners, delights the speculative builder, moves the motorist to obscenities, enrages the lover of the countryside and baffles legislators..." (1, p. 6). He might have been describing New Jersey or any of a number of America's expanding urban areas.

By the 1950's, it had become apparent that a change of some kind was necessary if London was to avoid either local paralysis or virtual outright control by the national government. The response was creation of a prestigious Royal Commission on Local Government in Greater London.

From the beginning the Commission's basic philosophy was aimed at serving the common good by harnessing London's vast energy to the engine of self-government. Two fundamental assumptions had been made in approaching this task: (a) that the borough should be the basic unit of government in Greater London, and (b) that there were certain functions whose impact was so broad that borough government could not or should not be made responsible for them. Among the major activities identified under the second assumption were planning, and highways and traffic.

The movement of people was perhaps one of the most critically difficult problems, for in London the increased mobility offered by the automobile is mocked by a road pattern that predates the automotive age. Streets wind their way from point to improbable point. Parking is at a premium, and all is made more complex by the practice of affixing similar names to different thoroughfares. Thus, one is bewildered by the word Kensington appearing on 10 separate streets, Cadogan on 5, Gloucester on 8, to name just a few.

Paper sponsored by Special Committee on International Cooperative Activities and presented at the 48th Annual Meeting.

These physical problems were compounded by the diffusion of responsibility for streets and traffic controls among the myriad of local jurisdiction. The Royal Commission found that, in order to establish one-way street patterns, the approval of no less than 6 different authorities was required.

Planning, crucial for any sensible scheme of development or redevelopment, was suffering from the same malaise. In fact, there was no overall plan for Greater London. Rather, there were 9 different plans, 4 of which included areas beyond Greater London. The only general plan in existence had not been developed locally but had come from the national government's Ministry of Housing and Local Government. And, shockingly, there was no agency, local or central, responsible for the collection of basic information on factors such as population, housing, traffic, and industrial and commercial development.

The Commission had begun its work in December 1957. Almost three years later, in October 1960, its findings were reported unanimously. After lengthy discussions and evaluations, the national government released its views on the subject in a 1962 White Paper that largely accepted the Commission's findings. In 1963 Parliament passed the London Government Act, and in 1964 the first elections under the new system were held.

What replaced the old maze? Today Londoners are served by a regional government covering 32 reshaped boroughs and known as the Greater London Council (GLC). The GLC was established as an elected regional government to undertake those functions and activities that were either clearly regional in scope or clearly beyond the capacity of small local jurisdictions. When the reorganized system of boroughs was established, a strong effort was made to balance their populations and economic resources. Of course, nothing involving humanity can ever be truly perfect, and government is no exception. Thus, the London system is not as clear-out as I have described. Nevertheless, in these general terms is found the goal of the reorganization.

How then are the transportation and planning deficiencies being resolved through the establishment of the GLC? Administrative arrangements are such that the Department of Highways and Transportation works closely with the Department of Planning. To appreciate the significance of this requires that two facts be clearly understood: (a) Planning in the British context is equivalent to planning and zoning in New Jersey's context, and (b) transportation functions in London, in a very real sense, is a tool of strong planning.

But what is the transportation structure in Greater London today and what changes are planned? First, let me briefly review my impression of the system's operations and outline some of the goals that have been established for it.

Fortunately for London's millions, there is an impressive network of rails, subways, buses, and taxis. In fact, London's subway was the world's first. In a 1967 report of the Greater London Council, 26 percent of the area's work trips were credited to rails (including subways), 38 percent to buses. Although figures for taxis were unavailable for all of Greater London, taxis make up a healthy proportion of central-area vehicles, totaling 11 percent of the traffic.

Public transportation accommodates a large percentage of travel for a variety of reasons, two of which are negative: the challenge of driving and the inability of a large number of the population to purchase automobiles. But there are positive reasons as well, the most important of which, to me, is the extent of service interchange.

On the 8 subway routes, there are over 40 interchanges with British Railways as well as a large number of interconnections among the lines themselves. But beyond rail, there is extensive coordination with buses and taxis. To illustrate, upon leaving the Sloane Square subway station the traveler happily faces a stand of taxis directly across the street and several bus stops a short distance beyond. Thus, he is provided with a number of options all within close proximity of each other. This is typical.

Although interconnection seems the key, there are additional factors militating in favor of public transportation. For one, the traveler has little difficulty in finding his way. Posted at each bus stop are the numbers of the buses servicing that location and their routes and schedules. Subway stations have large multicolored systems maps showing all stations and interchanges, supplemented by prominently displayed signs

listing the destinations accessible from specific platforms. Each subway car has several maps showing the entire route that it travels. Pocket-size booklets of the subway and bus systems are free for the asking. Maps, more comprehensive and easily understood, are now being introduced. All have contributed to minimizing the deterrent caused by confusion.

Two other positive factors are reasonable fares and frequent schedules. Subway and bus fares are based on distance. The minimum charge of 4 cents per mile tapers off after 12 cents so that the average cost falls somewhere between 3 and 4 cents per mile. Taxis charge 24 cents for the first three-fifths of a mile and 6 cents for each additional three-tenths. Time is also a cost factor. However, serious consideration is being given to fare boosts for both buses and taxis as of this writing.

Subway schedules fluctuate depending on the time of day. During rush hours, some lines maintain service at intervals of less than 90 seconds. During off-peak periods one seldom has to wait longer than 5 minutes. Bus schedules are more difficult to maintain because of traffic conditions, but some routes aim for frequencies as low as 6 minutes.

Center-city London comprises only about 10 of Greater London's 620 square miles. Yet, it is the commercial and financial heartland for the metropolis, indeed, for the entire United Kingdom. Into it each day pour over 1,000,000 commuters of whom more than 90 percent come by rail or bus. Although the total arriving by automobile is small, it has increased in the last 10 years by over 30 percent. The full implications of this must be viewed in the light of a predicted rise in automobile ownership, from 1.2 to 2.5 million by 1981, and against the backdrop of the street network already described.

How will London cope with the seemingly irresistible tide of automobiles and the inexorable flood of traffic with which so many of our cities are all too familiar? While all levels of American government agonize over the question of costly urban highway construction and demonstrations increasingly mount against its disruptive effects, Londoners have charted a course of action.

By any standard it is a courageous decision: The automobile shall not be king in center-city. Whether for good or ill, it was taken only after years of extensive study of land use and transportation, population and economic growth, travel habits and travel demands. In any event, the decision-makers will be comforted by the knowledge that they utilized a projection of travel patterns reaching into the 1980's and grounded in intensive research.

Some may say, Why restrict the automobile? Clearly people want to drive or they would not purchase cars to the extent they do. They might even add that to prevent someone from traveling in the manner he chooses is an infringement on individual freedom. London's answer to these arguments is quite simple: Unbridled freedom for the automobile is too costly and destructive to permit. To build the highways required to accommodate the demand for center-city access would be frightfully expensive, as it is in all urban areas, and unacceptably damaging to the densely populated and built-up environment. The GLC intends, therefore, to manage the demand rather than capitulate to it. And it will attempt to do so with a number of approaches.

First, an Inner London Parking Area (ILPA) has been defined in which fees and time limits will be set to discourage commuting by car. The ILPA consists of 40 square miles, and rigid enforcement of regulations is expected throughout. Large areas have already been metered, and steps are being taken to control off-street parking as well. New building construction will provide significantly less parking for employees than was previously required. With this program the GLC hopes to ensure that "...on-street and off-street parking will be related to the capacity of the road network, land use, density of development, and economic and social needs" (2, p. 1).

Can such an approach succeed? At the Imperial College of Science and Technology I asked a transportation expert about a recent rise in the number of passengers using public transport. The professor walked to his office window and pointed to a large number of empty metered parking spaces on the street opposite. "It used to be quite impossible to get a parking place on that street before the meters were installed, and now look at it. Perhaps that is one of the reasons for the increase," he said.

The second method the GLC will use is the simple device of not building any additional major roads into the ILPA. Existing roads will still be improved to assist in speeding traffic flow. The lack of new construction is expected to have the effect of driving people out of their automobiles because of congestion and onto public transportation, the third major element.

The GLC is as committed to rail and bus improvements as it is to the first two weapons in its arsenal. It recognizes that all three are intimately bound and that to emphasize one and not the others would be foolish and unfair. The goal is balance among the travel modes, and public transport is to undergo subway extensions and improvements, a fundamental reshaping of bus services, and an expansion of park-and-ride facilities at rail stations outside the ILPA.

Despite the emphasis on automobile restriction, it would be wrong to give the impression that the GLC is ignoring highways. Far from it. But what it has decided is to build them in the suburban areas where traffic studies have predicted the greatest demand will occur. Moreover, it is in suburbia that the conditions are considered best for highway emphasis; the population is less dense though automobile usage is high, public transport is weakest, and parking is less susceptible to control. To fill the void caused by years of little or no construction, the GLC has outlined a limited-access highway network of over 100 miles that will cost more than $2 billion on its completion in 1983. All will be built outside of the ILPA.

If the GLC's goals are ambitious, the obstacles in its path are no less impressive. For example, although it can regulate on-street parking, its off-street powers are limited and depend largely on cooperation from the London boroughs and private operators. And enforcement, the crucial phase of any parking program, rests not with the GLC but with the Metropolitan Police who are responsible to the national government. In the construction of highways the national government retains power, except for inner London, to build or not build the major primary routes known as trunk roads. Conceivably, it could decide to do so in areas where the GLC believes them to be unwarranted, or not to in locations where they are felt to be necessary. Rails and buses are outside the GLC's sphere of control, and responsibility for them is divided between two autonomous agencies. Hence, the possibility always exists of stalemates over policy in this very vital field.

Aside from the organizational weaknesses, Britain's financial crisis looms like an evil spectre. Already two extensions of the London subways, which had been agreed upon, have been deferred for economic reasons. The drive to save the pound may claim more victims, perhaps in the suburban road program.

And yet, with all the problems, progress has been made. Widespread agreement on the concepts, requiring as it did so much cooperation, is an achievement of considerable note. Moreover, as a result of hammering out the policies, some of GLC's deficiencies are soon to be corrected.

Today the GLC's Highways and Transportation Department has responsibility for the construction and maintenance of the principal (nontrunk) roads within its area. It is also responsible for traffic control, a critical area in which in New Jersey the jurisdiction of the Department of Transportation is minimal and for which no regional responsibility exists anywhere throughout the state.

Under the latest proposals for London, as outlined in a July 1968 Ministry of Transport White Paper, the GLC would assume still greater control over traffic and parking, particularly off-street parking. Jurisdiction over major roads would be expanded. The British Railways Board, which operates the bulk of the rail commuter services, would be placed under statutory obligation to consult with the Greater London Council on decisions regarding matters such as fares, levels of service, and new investments within the London area. Most important, however, the GLC would take over policy and financial control of the London Transport Board, which now owns and operates the bus and subway systems and has some commuter rail responsibility in the Greater London area. About the only aspects of transportation that would remain beyond the jurisdiction of the GLC are the taxi fleets and the actual enforcement of traffic and parking policy. These would continue to be a function of the Metropolitan Police, who are responsible to the national government through the Home Office.

If the British government and the GLC agree on the Ministry of Transport's proposals and they are enacted into law, the GLC's Highways and Transportation Department will be equipped with an incomparable array of tools to deal with the problem of movement on a systematic basis. This will, I believe, prove to be a healthy approach and one to observe carefully for the lessons it will no doubt teach.

These truly impressive transportation tools will not be used arbitrarily nor in a vacuum, for guiding and rationalizing them will be the strong planning powers mentioned earlier. Through its Planning Department the GLC "...must prepare and maintain a strategic development plan for the area—The Greater London Development Plan. [The Plan]...will have transportation proposals providing for a pattern of communications related to the use of land and seeking to make the best use of all forms of transport in harmony with the environment... [and] one of the main concerns...will be to achieve a right balance between population and employment. This will directly affect such problems as the journey to work and traffic congestion" (1, pp. 33-34).

Under the zoning aspect of the planning powers, "The London Borough Councils must refer to the GLC all applications for planning permission for large concert halls, stadia, university buildings and other developments likely to attract large numbers of people: for airports, heliports, car parks, railway termini, and stations for public service vehicles.... All other applications are dealt with by the borough councils but they must seek the direction of the GLC before granting permission for major shopping development...development which might affect metropolitan roads or the GLC's responsibilities for traffic and transportation..." (1, p. 35).

Thus it is clear that the GLC has, or will have, powers to deal decisively with virtually all aspects of transportation. And they are powers that the authorities give every indication of willingness to use. To illustrate, I mention again the decision to restrict the automobile in central London. Basically this flows from a planning decision to preserve the center's historic character as well as its role as Greater London's major commercial area.

The question could fairly be asked, What if big stores decided, as they can and do decide in the United States, that they don't like the restrictions and are abandoning Central London? Under the system they would be forced to seek approval for their new locations from the very people who are determined to keep the center viable. Their chances would appear slim. Thus, one can readily see that, were this concept in effect in our urban areas and had planning decisions been made in them to revitalize the downtown centers as the major commercial foci, the new shopping centers springing up in suburbia would be judged on a different set of criteria from those now applied. Their relationship to regional planning goals would be paramount. In my opinion, this is how it should be.

That, in brief, is the structure of, and attitude toward, public transportation in the metropolitan area of Greater London. But what about the rest of the country?

One of the hottest political issues in Great Britain while I was there was the Transport Act of 1967. It is a massive document attempting massive changes in virtually all fields of transportation. The subjects of its more than 250 pages range from inland waterways policy, to the carriage of goods by train vs truck, to the organization of public transport in the country's major urban areas.

Through the Transportation Act of 1967, the British government is establishing a regional transportation approach in four of the country's largest metropolitan areas (referred to as conurbations) outside of London. These are Manchester, Liverpool, New Castle, and Birmingham. In none of these conurbations does a regional government exist. Rather, they are like an Essex County without a county government. Because the Transportation Act is limited to transportation matters, it does not establish land use planning on a regional basis, nor create elected regional governments. However, it does bring about a level of integration of public transportation services unheard of previously in these areas and, in doing so, involves local government every step of the way.

What is the philosophy behind this effort? The Ministry's 1967 White Paper answers this question quite clearly: "All the studies...suggest that our major towns and cities can only be made to work effectively and to provide a decent environment for living by

giving a new dynamic role to public transport as well as expanding facilities for private cars. Unless we recognize this we shall down the centers of our towns in an attempt to get rid of congestion; and at the end of the day we shall find congestion still with us, and the character of our towns destroyed" (3, p. 2).

The makeup of the Passenger Transport Authorities (PTA) will be established only after consultation by the Minister of Transport with the local governments to determine the exact area to be included. The Minister will appoint one-seventh of the members, and the other six-sevenths will be drawn from the local governments involved. Thus, local control will be assured.

It will be the job of the PTA to coordinate, rationalize, and, in general, oversee all public transportation within their areas. It is strongly felt that such a system is made necessary in order to prevent the ultimate dominance of the automobile and the consequences that flow therefrom. Over and over again in Britain one hears, "We don't want to happen to our cities what's happened to so many American cities."

The mandate for the kinds of bus and rail operations in which the PTA can engage is broad. But the government has made it clear that, although it intends to render financial assistance, the local governments will have to bear the brunt of whatever deficits are incurred as a result of decisions made on the local level. Apparently, the idea is to force some responsibility on the local people, whose task it will now be to decide what sort of services they want.

The Transportation Act provides for a series of aid programs to the PTA: 75 percent of the cost of constructing public transportation facilities (on the strength of this Manchester is planning construction of a new rail line and reorganization of its bus services); 25 percent of the cost of new buses; and, a 90 percent declining grant to cover the deficits of rail lines. This last program is of special interest because of the nature of the PTA rail and bus operation. The PTA can, if they wish, contract for services with British Railways, and the new National Bus Company to be established under the Act, or with other bus operations existing within the area. In the case of buses, any deficits incurred will have to be met by revenues raised locally.

In the case of rail, however, the 90 percent declining grant has been decided on evidently because there is far less flexibility with rail than with bus operations and because some of the rail services will be deficit-ridden from the start. The declining feature of the grant is pictured as an inducement to improve operations to the point where they become either self-sustaining or incur a deficit that is at least tolerable and can be made up on the local level. Its duration is set for a 7-year period after which the PTA, supposedly, will be on their own.

This scheme is a giant step toward rationalizing transportation in metropolitan areas, but it suffers as previously indicated from not having, like London, an elected regional government with regional planning powers, traffic and parking controls, and highway powers. However, London was apparently the herald of things to come; for the entire British system of local government has undergone a detailed study by another Royal Commission, and it has recommended regional governments for the conurbations on somewhat the order of the London system.

Given the normal time span between filing of recommendations, acceptance by the government, approval by Parliament, and final implementation, the PTA will probably have broken some very useful ground in the public transportation field for the new regional governments before they begin functioning. As a Labor Party publication has stated, "... no individual or local authority... can at present carry out proper studies on ways public transportation could be improved or new methods of rapid transit employed. The setting up of a passenger transport authority is a vital step towards the proper planning and operation of public transport as a whole" (4, p. 5).

This activity in Great Britain makes great sense to me. It bears close watching by those in the United States concerned with and involved in the acute difficulties of urbanization and the transportation needed to serve it. If we are to make any headway toward the solution of the monumental traffic problems we face in our urban areas, then surely the organizational tools required to do the job must rank in the first order of priority. Money, alone, is not enough.

BUSES—PAST AND FUTURE

The admixture of regionalism, local responsibility, and broad transportation integration coupled with strong land use planning powers appeared to be the most impressive developments in Great Britain. There were other items of interest, however, that, because of their potential applicability to our own situation, deserve mention in this report. For example, those who give increasing attention to the faltering bus operations in New Jersey might benefit from a short description of London's recent bus experiences. The picture there is not bright, but action is being taken.

The difficulties of the London buses are not readily apparent, unless one is a steady customer or involved in transportation. For in visitors' London few things are as visible as the famous double-decker with its passengers hopping on and off the open back and scrambling up and down the narrow winding stairs that lead to the top. It is an amusing, almost appealing sight; part of the charm of a charming city. But visitors' London doesn't tell the tale. It masks the statistics reflecting average passenger losses in excess of 100 million yearly, and an annual deficit now of approximately $20 million.

It was not always so, this decline of the bus. At one time, not long ago, buses, virtually monopolized road traffic and happily earned profits for their owner the London Transport Board. Two factors have undermined this supremacy: prosperity and automobiles. Prosperity has meant automobiles, which compete directly with buses for passengers. Prosperity and automobiles have meant different shopping and recreation patterns resulting in sharply reduced bus patronage in off-peak service hours. Automobiles have brought traffic congestion, especially during peak hours, which in turn adversely affects bus service reliability, the quality most demanded by passengers (5, p. 4). Prosperity has spawned suburbia, at once contributing to both demand for commuter bus services and traffic congestion caused by automobiles. Prosperity has meant a labor shortage and, because most London buses require two-man crews, this has also affected service reliability. Most of these factors are applicable to New Jersey.

Transportation people in London are unwilling to accept that past trends inevitably determine the future. To do so would be to accept the bus's ultimate demise, and disaster simply cannot be permitted to overtake an operation that, though in trouble, carries almost 2 billion passengers annually. The national government, Greater London Council, and London Transport Board have all thrown themselves into the battle. Many efforts are under way to enable the buses to cope with the present and come to grips with the future. Some are in the nature of short-term expedients, others are more fundamental.

In the first category are measures that largely serve to improve traffic flow, such as the elimination of bottlenecks, banning of cross-traffic turns (except for buses), parking controls to create unobstructed streets (called clearways), and establishment of exclusive bus lanes. These are sensible steps, and some degree of success has been achieved. Their value, however, is limited because improved traffic conditions often tend to generate additional vehicles and renewed congestion; and the exclusive bus-lane concept is constrained by the intensely built-up nature of any densely populated city. What these measures can do is buy time; they cannot solve the basic problem.

The question can then be asked, Is the problem solvable? Although not at all sanguine, officials believe that if there is an answer it lies in a major shift of policy and financial powers among existing agencies, restructuring of bus operations, some pretty heavy investment, and restrictions on the use of automobiles by commuters.

The major power shift has been discussed in the previous section. It is the rather logical step of taking away responsibility for policy and finance from the virtually autonomous London Transport Board, whose functions are restricted to rail and bus, and giving it to the elected Greater London Council, which will thenceforth be responsible for the total transportation network, including highways and traffic control. This shift will, it is hoped, result in a more balanced allocation of resources among the modes based on the vastly improved coordination expected in transportation planning. In such a context, the argument goes, the viability of all modes of transport will be maximized. This, at least, is the theory.

The restructuring of operations is under way in a new approach to routing and scheduling. Bearing in mind the passenger's desire for reliability and basing its decisions on masses of data about future travel patterns, the London Transport Board is making major changes. In the suburban areas, where growth in automobile travel will be greatest, routes and schedules will accommodate demand for movement between business and commercial centers, and for feeding passengers to rail and express-bus commuter services to central London. Within central London itself, short-distance, almost nonstop services between rail terminals and other major movement points will be vastly expanded.

Hand in hand with route and schedule changes is the heavy investment feature. A large number of interchange points between feeder buses and commuter services will have to be built. In addition, a decision has been made to replace much of the two-man double-deck fleet with one-man single-deck buses to reduce labor costs. The national government, through the previously mentioned provisions of its new Transport Act, is committed to aid this kind of investment and will do so with grants for constructing interchanges and acquiring buses. Without such assistance it is doubtful that the Greater London Council and London Transport Board could implement the program as quickly as they would like.

Restrictions on the automobile have already begun with parking charges designed to discourage commuting into central London. Moreover, the possibilities of road pricing and special licensing schemes, which would really amount to tolls on those using central London streets, have been raised. Because the commuter uses the streets most frequently, he presumably would receive the most discouragement. However, at this point it is difficult to determine whether the references to these schemes are trial balloons or veiled threats. They may be both, but in any event the basic decision to restrict the automobile commuter is firm.

It is quite possible that after all the steps have been taken, the buses will still lose money. The deficit-inducing disparity between peak and off-peak patronage will probably continue, and even grow worse. This will not be reason enough to abandon the buses, however, for commuter railroads have shown that failure to pass the test of profitability, or to break even for that matter, does not mean that their peak-hour passenger function is not necessary, even vital. Indeed, it is likely to become more so with each passing year. The role of the bus is reasonably assured, therefore, it only as one of the principal carriers of a group causing it such severe problems today—the commuters.

The situations in New Jersey and London are by no means precisely comparable. Yet in light of growing concern with traffic problems and our desire to "save the cities," London's struggle to rationalize its bus services should prove most interesting.

WEST END TRAFFIC CONTROL EXPERIMENT

Those bedeviled by the traffic problems of American cities would be most interested in an operation under way today in London. Its nerve center is a room on the fifth floor floor of Scotland Yard, which looks as though it might be a set for a science-fiction film. On one of its walls, framed by 24 television screens, is a huge map with dozens of tiny lights flashing constantly. In front of the wall are 3 larger television screens, as well as more detailed patterns of key portions of the map. Facing these are operators' desks with enough switches and handles to evoke nostalgic memories of the once exciting, but now old-fashioned, Buck Rogers.

Alas, this is not the command post of some imaginative space age effort. It is, instead, the control room for a traffic experiment in a portion of London's famous, busy, and crowded West End. It is operated by Britain's Ministry of Transport, which is, in an age of moon exploration, still wrestling with the mundane problem of preventing traffic jams on the ground.

What the Ministry is doing is, in a sense, inevitable. It is attempting to computerize the business of traffic control. To do so, it has chosen an area of roughly $6\frac{1}{2}$ square miles containing 150 miles of streets, and encompassing a "...wide variety of traffic problems resulting from...exhibition halls...football grounds, commuter traffic, and

...shopping areas..." (6). Some 100 traffic signals have been connected to the computer at Scotland Yard. The experiment began in January 1968. The British claim it is the first of its kind in the world to combine computer control of vehicle-actuated traffic signals with closed circuit television surveillance at critical points. Its cost is over $1.3 million.

At this stage of the experiment closed-circuit television is vital, for the computer's automatic qualities have yet to be completely refined. When this happens, television will not be necessary, and human involvement will be reduced to a minimum. This will mean, of course, that the computer will automatically respond to data on traffic volume fed to it from a network of detectors sunk into road surfaces at vital locations. It will put into action for the area a series of plans that will vary with the increase or decrease in traffic flow. These plans will control the workings of all signals until traffic volume drops to a level at which an area plan is no longer required. At that point the computer will cut-out, leaving each signal to operate independently on the vehicle-actuated basis.

This is, to say the least, a large and exciting undertaking, and the Ministry's technicians have been encouraged by the results thus far. Their calculations reflect an increase of 7 percent in traffic flow since the experiment's start. For this early in the program, the results are above expectations and more than sufficient to justify the expenditure. The Greater London Council has been watching this progress with more than casual interest. As indicated earlier, it is the traffic control authority for all of London, and this may be one of the more important answers to its problems. Without awaiting the experiment's end, the GLC has decided to extend this approach to an additional 14 square miles containing about 300 signalized intersections.

The roles of the Ministry and the GLC are significant given the fact that the experiment area involves territory from three separate London boroughs that were, until a short time ago, their own traffic authorities. Traffic flowed over their streets for years, as it does today, oblivious of borders. And yet, it was not they who launched this experiment that benefits them but, rather, governments with broader outlooks and regional powers and responsibilities.

The technical achievements of London's West End project are doubtless impressive, but equally important is the fact that there was a regional approach to the problem. This is something that should not be overlooked by anyone interested in its application to an urban area in which there are multiple municipalities. Just as traffic congestion recognizes no artificial boundaries, the remedy for it should be free from the same constraints.

AIRPORT RAIL LINKS

The final item to be covered in this report, but by no means the final item studied, has to do with the increasingly important question of how to improve ground access to airports. Every so often an idea comes along that, without respect to its ramifications, captures the public imagination and seems to be so sensible that it becomes almost conventional wisdom. One of these is rail access to airports. For example, almost every proposal for a new jetport in the New York metropolitan area seems to be accompanied with an excusatory phrase that goes something like this: "...and even though it is far away from the main population centers, a high-speed rail connection will solve that problem." In the abstract it is a great idea, and it would be in reality were it not for the cost.

Whether or not rail access is provided to new jetports depends on careful study of the individual circumstances of each proposed jetport. And circumstances always vary from case to case. London's experience helps, I think, to demonstrate this point, for it is served by two jetports, Gatwick and Heathrow. Heathrow is by far the busier of the two, but Gatwick has a direct railway connection from Victoria Station in London. Heathrow is slated to receive one.

In Gatwick's case the rail line carries about 50 percent of the air passengers. Although this is an impressive percentage, the number of passengers flowing in and out of Gatwick in 1967 was only about 2 million. Because this is hardly enough to support the costly construction of an exclusive multimillion dollar rail link stretching 28 miles

from the heart of heavily built-up London, I made inquiry as to how and why it had been accomplished. The answer is that the line is not an exclusive rail link as it was already in existence when the airport was built. Further, and more important, it is a busy line in its own right servicing a good number of well-populated stops in southern England.

What happened in Gatwick's case was that, when the airport was built, a slight bend in the existing line was straightened for a nominal sum so that the airport became another stop on the existing line. Because the line has substantial business in its own right, the trains that stop at Gatwick can be operated without crushing deficits. If, however, Gatwick had been the only stop on the line, and even if the capital cost had still been as low as it was, it is doubtful that an exclusive service could be run to the airport without massive losses on the operating side.

Because of Gatwick's good fortune, service is good and in the peak vacation season trains leave the London terminal every 15 minutes during 14-hour daily periods. In the off-peak season, they leave every half hour. Tickets and baggage can be checked at the Victoria terminal. In all, it is a smooth operation even though the number of passengers handled is relatively small. But, clearly, Gatwick's special circumstances make it impossible to use its rail link as a justification for an exclusive rail link any place else.

Heathrow is a different story. The size of its operations greatly overshadows that of Gatwick's. It claims to be the busiest international airport in the world, handling 13 million passengers in 1967; the number of passengers has been growing over the past 5 years at a rate of 14 percent annually. Expectations are that by 1971 nearly 20 million passengers will enter or leave Heathrow.

At present, Heathrow, 15 miles from central London, is reached by car, taxi, or airport buses. The latter leave from several major downtown terminals, which provide complete ticket and baggage checking facilities. The problem of ground access is simply that traffic congestion on the highway serving Heathrow is growing rapidly and is increasingly interrupting the reliability of the vehicles that serve the airport. One can legitimately raise the question, Why not improve the highway instead of building a rail line? Here the story gets complicated, but it should be told for the enlightenment of those devoted to the concept of exclusive high-speed rail lines.

Heathrow's proposal comes as the result of a variety of forces, some of which are negative and some positive. The negative forces are as follows: (a) The expansion of the existing highway would cause severe environmental disruption given its present location through built-up areas; (b) highway dollars are scarce, and the need to spend them is seen to be greater in other areas of London, i.e., balanced against other highway needs the priority of a highway expansion to Heathrow is not high; and (c) it would take far longer to build the additional highway capacity than it would the rail link even if the money were available.

The positive factors come as a result of a confluence of interests that make the case for it exceedingly strong. To begin, the downtown rail-link terminal would be Victoria Station. This facility is now one of the busiest, if not the busiest, commuter station in London. It serves a huge area of southern England. It is the rail terminal for Gatwick Airport. It is old and decrepit in appearance. It is the focal point in an area that both the GLC and Westminster Borough want to redevelop. Thus, two important local governmental entities wish action at Victoria. Moreover, the British government plans to go ahead with the cross-channel rail tunnel to France, for which the English passenger terminal will be Victoria. The government desires this gateway to be impressive to the visitor, and thus it wants action at Victoria.

At Heathrow the terminal buildings are surrounded by runways and cannot easily be expanded. The British Airports Authority, therefore, believes it must have substantial check-in facilities at downtown terminals. Because that normally means passengers must take some form of public transportation to the airport, and because highway access is patently becoming congested, and because Victoria is centrally located and would provide interconnections with existing subway lines, rail service, bus service, taxi service, and the Gatwick terminal for air transfers, the British Airports Authority wants action at Victoria.

The British Railways Board sees these disparate desires as an opportunity to make a substantial real estate investment beyond the mere building of a new station. It wishes to construct either a major hotel or an office facility above it. To ensure the most profitable utilization of such an investment, British Railways wants an airport rail link with its terminal at Victoria so that the millions of persons who would yearly come from or go to Heathrow would have the opportunity to take advantage of whatever the new facility ultimately is. It is estimated that 8.4 million air passengers and 1.1 million other people would use the rail link in 1971.

Furthermore, the rail link could be constructed by 1971 (highway construction could not be ready until 1974) and would entail a minimum amount of disruption to the environment because most of the rail mileage is over tracks already in existence. The rail link, the development necessary at Heathrow and Victoria, and the rolling stock are estimated to cost $57.8 million, of which the rail cost is approximately $44.8 million (predevaluation figures). Here again, somewhat like the Gatwick link, the cost is significantly lower than what it would be if an exclusive link on an entirely new track were to be built. It is expected that patronage will be more than sufficient to cover operating and capitalization costs. Indeed in 1972, the first full year of operation, a profit of over $5 million is projected (predevaluation figure).

The stories of Gatwick and Heathrow are significant, I feel, in demonstrating the futility and irresponsibility of blind faith in the construction of exclusive rail links to ensure the success of jetports built at great distances from population centers. In Gatwick's case, exclusivity would have been financially impossible; in Heathrow's case, the rail link appears close to reality in part because powerful governmental jurisdictions are interested in it for reasons other than those of improving ground access for passengers, in part because funds for a road solution are not available thereby ensuring rail patronage, and in large part because the proposition will pay for itself even though it will provide exclusive service. In both cases existing trackage within close proximity of the airports saved what, in all probability, would have been prohibitive construction costs.

RECOMMENDATIONS

What, then, does one recommend for New Jersey after study of Great Britain's policy and problems? First, one must point up the more important differences between Britain and New Jersey. These are as follows:

1. In Britain, a much smaller share of local government costs is borne by local governments than in New Jersey.
2. In London, transportation is more broadly defined as the role of one department than it is here, and more of the components either have been or will be integrated into one department.
3. In London, an elected regional government with real powers has been established. This system will probably spread elsewhere. This is in direct contrast to the tradition of local home rule in New Jersey, which stultifies efforts to achieve even the most sensible cooperation among municipalities.
4. In Britain, strong planning powers exist on both the regional (London) and national levels, and planning goals are established and pursued; London's green belt and the preservation of central London come to mind immediately. In New Jersey, planning and zoning controls are vested in more than 550 municipalities, severely hindering meaningful regional or state approaches. Those planning functions that do exist on the county and state levels are virtually without enforcement powers.
5. In London, transportation is married to land use planning and is a tool for implementing it, at least in theory. In New Jersey this is hardly true. The counties with planning departments do not have transportation departments, and the fragmentation of land use planning powers at the municipal level, rather than concentration at the county or state levels, forces the New Jersey Department of Transportation to respond to the accumulation of scores of scattered and unrelated decisions over which it has little or no control.

6. In Britain there is a greater willingness to rely on automobile restraint than in New Jersey. Indeed, one hears the words used often there, whereas such daring phraseology has not yet crept seriously into our vocabulary.
7. The degree of public ownership of transportation in Britain is enormous. Public ownership is virtually nonexistent in New Jersey.
8. Resources in Britain are in much shorter supply than they are here.

After outlining the differences, one is struck by the fact that some solutions to transportation problems like ours may well be unattainable; some surely are outside the realm of the State Department of Transportation. Supporting this contention are two basic facts about New Jersey government: (a) The excessive reliance on local property taxes for local revenue forces our municipalities to engage in vicious competition for tax ratables virtually without regard to its effects on their neighbors; and (b) to permit themselves maximum flexibility in the pursuit of ratables, the overwhelming majority of municipalities are willing to relinquish few, if any, powers, particularly planning and zoning powers.

It is almost unnecessary to point out that these forces fly directly in the face of, and powerfully undercut, our oft-stated goals of saving the cities and making urbanization a livable proposition. Because of our system, each municipality seeks to develop land in a way that is best for it rather than in a way that is best for the region of which it is a part. After all, under an elected system of local government, officials are subject to incessant demands to keep taxes down. The only way to oblige these demands is to develop tax-producing property on open land. The implications of this for transportation are obvious. Without systematic regional planning, transportation becomes only a response to a multiplicity of unrelated municipal decisions. This is not system, it is confusion.

Every effort must be bent to have more of the cost of local government borne by state government. Ideally we should aim at the complete underwriting of education, the heaviest of the local tax burdens. When the point is reached that local property taxes are not viewed as confiscatory (in the older cities this is the case, but in the suburbs officials are trying to avoid that position), only then can the municipalities be induced to think of the region as a whole, and only then can regional transportation systems truly be implemented.

Despite its manifest desirability, greater state financial participation is something that will not occur overnight. In all probability, it will continue to grow piecemeal as it has historically, though at perhaps a more accelerated rate because of the intensity of local problems and the reapportionment of the Legislature.

Just as a major overhaul of our revenue structure seems an elusive goal, so does also the basic realignment of powers and responsibilities in order to create a new set of regional governments unrelated to existing jurisdictions. The New Jersey County and Municipal Government Study Commission conceivably could have suggested this in its recent report but did not. And even if it had, in my opinion major realignment would not have a chance of success. It is another recommendation of the kind that must be relegated to the category of the ideal. From that lofty plane, we must descend to the less glamorous but usually more productive realm known as the possible. Even here, the path to progress is strewn with difficulties.

Despite the obstacles, however, there are ways to approach the establishment of regional planning and transportation. For we have now in existence political entities that, although they do not make the most sense from various points of view, have the virtue of being going concerns. These are the counties, and it is no accident that the County and Municipal Government Study Commission has chosen to recommend their strengthening. Not only are they in existence and operating, but most have the kind of central area problem that requires a planning-transportation solution. Essex has Newark, Union has Elizabeth, Passaic has Paterson, Mercer has Trenton, Camden has Camden, Bergen has Hackensack, Atlantic has Atlantic City, Middlesex has New Brunswick, and so on.

The greatest difficulties will be found in any attempt to alter the distribution of planning and zoning powers. Yet, as I have indicated, transportation powers alone are

not sufficient for the solution of transportation problems. Steps must be taken to broaden the base of land use control; the counties and the state government must become more deeply involved. A regional approach must be found. To accomplish this, the following changes in our planning and zoning powers would be desirable:

1. Give to the County Planning Boards, in addition to review powers, the power to approve or disapprove the decisions of municipalities with respect to major facilities such as shopping centers, office complexes, and industrial parks. The counties' decisions should be based on carefully developed county plans.
2. Grant the New Jersey Department of Transportation the right to challenge these same decisions when they would impact directly on the state's transportation facilities. The Department's criteria for judgment should be the capacity of the facility to absorb the additional traffic.
3. Require that county transportation departments (or agencies) work closely with the county planning departments.
4. Establish the State Planning Division as, among other things, an appeal board to which municipalities may appeal the decisions of the counties or the State Department of Transportation or both. In the event that the first change listed cannot be achieved, then at least grant the municipalities the right to challenge each other before the State Division of Planning.

These recommendations may also prove impracticable because of New Jersey's strong home-rule tradition, but they should serve as a bare minimum toward which the state should strive in planning.

Probably the most attainable of my recommendations deals with the creation and operation of county transportation departments. To effectuate this and thereby induce counties to act as transportation rather than highway units, an addition should be made to New Jersey's present aid programs. A major new grant should be legislated that would be available to each county for transportation purposes other than highways. It should be contingent upon two factors: (a) the establishment of a county transportation department and (b) the submittal to, and approval by, the Commissioner of Transportation of a comprehensive transportation plan that both serves the urban center or centers within the county and dovetails with a master state plan for transportation. Of the criteria used to determine the amount of aid per county, the two most important should be total population and population density. Others may be suggested, but these are, in my opinion, the most important.

The enactment of the new State Road Aid Program in 1967 may pose problems for the creation of still another large grant program at this time. This proposal should not be rejected for this reason, however, but kept ready for recommendation when the political climate seems more propitious.

Once established, county transportation departments should assume the responsibility previously held by county highway departments for the construction and maintenance of county roads, as well as the responsibility for the major municipal thoroughfares within their respective areas of jurisdiction. In addition, and equally important, the transportation departments should be free to acquire or initiate public transportation services of an intracounty nature.

Next in sequence, the parking and traffic functions now held by municipalities should be absorbed by the county transportation departments. These are too intimately bound to the success of any comprehensive transportation program to permit them to continue in the atomized state that now exists. The existing policy whereby permission must be granted by the state government before a traffic control device can be erected on a county or municipal street should be abolished. Instead, the counties should be granted broad permission as part of their new comprehensive transportation plans to institute those controls deemed necessary for the success of regional transportation networks. A different situation exists where traffic control devices are proposed for state highways. Here there is a clear case for requiring counties to seek permission from the State Department of Transportation. The present system that requires this seems both adequate and workable.

The importance of centralizing parking controls in the organization responsible for transportation has been stressed already in this report. Uncoordinated decisions on parking can undermine attempts to relieve urban traffic congestion, and, conversely, a coordinated and rational parking policy can serve as one of the principal weapons for bringing order to traffic turmoil.

I am sure that these planning and transportation goals will be approached in New Jersey with great caution. However, if we are to prevent an engulfment of our urban areas by an ever-growing number of automobiles, they are goals that we ignore at our peril.

The traditions of freedom of movement, home rule, exploitation of land, and locally raised revenue are extremely powerful in the Garden State. It will be difficult to overcome them. But I do believe that unless we break with these traditions, and quickly, the face of New Jersey will some day be like the face of a teenager with a bad case of acne. Unrelated blotches will cover what otherwise could be a handsome countenance, and we will be capable of doing nothing other than allowing the problem to run its course Unlike acne, however, which ultimately passes, New Jersey's surface will not revert to smoothness but will remain devastated, forever. And the name Garden State will in the end become nothing more than a cruel joke.

ACKNOWLEDGMENT

In applying for the U.S. Department of Housing and Urban Development Fellowship that enabled me to study public transportation in Great Britain for 6 months, I was careful to point out that I intended to look at the governmental rather than the technical approach to this activity and that the best way to do this was by discussions with people directly involved rather than the traditional method of a formal course of study. Consequently, although I was connected with University College in London, I did not attend classes but had my research activity guided by a qualified faculty member.

The man who served as my adviser was Professor A. H. Chilver, Chairman of the University's Department of Civil Engineering and also Executive Director of the Centre for Environmental Studies, an organization established in London about 3 years ago and financed by both the British government and the Ford Foundation. The Centre served as my base of operations, providing desk space, secretarial help, and telephone service, as well as contact with many of the people with whom I discussed transportation. The Centre proved invaluable to me and I am deeply in its debt.

The series of meetings and discussions was extensive, varied, and supplemented by a considerable number of publications. A list of the people with whom I met and a detailed bibliography are available from the Highway Research Board at cost of reproduction and handling. When ordering, refer to XS-28, Highway Research Record 299.

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