Thoughts on Traffic

Re-imagining Traffic

Many of us are doomed to waste a significant proportion of our lives commuting in heavy traffic. There are a number of good ways of passing the time: one is by listening to the complete *Don Quixote* as read by David Case (Books on Tape, #2509-A, B); another is by thinking about the nature of traffic itself. We can begin by trying to come up with as many ways as we can of viewing traffic, just as we may did as children. For example, we can view traffic:

•as though the entire countryside, including the road, were vertical, and we are falling (driving) down the side of this wall;

•as though the road were moving past the countryside, the cars only moving relative to each other, at a few miles an hour, when they pass each other;

•as though the entire flow of traffic each minute of each day were previously programmed, every driver following a strict schedule of speeds and turnings of the steering wheel;

•as a kind of dance or game whose object is to make beautiful patterns which can only be observed from the air;

•as a kind of paperweight which is needed to keep the pavement from blowing away;

•as a parking lot which just happens to require that the cars move instead of stand still (similar to an early form of computer memory, in which the data never actually resided anywhere, but was kept in continual motion);

• as a solid ("solid traffic") composed of car-shaped units along which certain properties move, e.g., color, shape. Thus, instead of, e.g., this red sports car moving forward one carlength in bumper-to-bumper traffic, what really happens is that all the car-units remain exactly where they were; it is just that the red sports car properties move forward from one car-unit to the car-unit immediately in front of it, and similarly for other cars-units.

•as a form of amusement and human companionship in which we enjoy the sensation of going over bumps in the road, swerving to the left and the right, keeping up, dropping back, and simply sitting together, each in his or her separate metal and glass house. (Why ruin travel with having to "get somewhere"? Getting somewhere should rightly be regarded as merely a side effect of travel.)

Next, we may begin to think about the nature of motion itself. It may occur to us that:

• Motion as we know it is extremely inefficient. In order for a car to move forward one car-length, the car must:

(a) wait till one car-length of space in front of it is empty;

(b) vacate its current position;

(c) move into the car-length of space in front of it;

(d) leave its previous position empty.

Surely there is a better way!

We may think: why move each car? Just have replicas lined up, end-to-end, and move the people through them, e.g., on seats tied to conveyer belts. But that is only redefining the problem inside itself.

Why not let the car stand still, and move the empty spaces past it?

Why can't we store up empty spaces? Why shouldn't there be more spaces available on the freeways after a long period of relatively light traffic than there are after a short period of relatively light traffic?

If only we could get away from this whole business of having to deal with spaces!

• Why couldn't we settle for *a* car — anyone's car — reaching our destination? Why must we always be so selfish and require, in addition, that it be *our* car, and furthermore, our car with *us*

inside it? Why shouldn't the traffic reports give, in addition to reports on traffic, a continuing list of all the places that have been arrived at by cars, so that you need only listen for your destination and once you hear it, turn around and go home, your trip completed?

• We can imagine that still cameras are positioned a car-length apart at the side of a freeway. Each camera is aimed across the freeway, and has been adjusted so that its focal width is exactly one car-length. Assume that every car moves at the same speed and that every car is the same model of the same year in the same condition. At uniform time intervals, the cameras simultaneously take a picture (and automatically advance their film). Suppose traffic is so dense that at each interval, each car has advanced exactly from one camera's view to the next. Then the film in every camera would look the same. Would it be correct, or even relevant, to speak of the "motion" of the cars in this case? If the cars were motionless, the result would be the same. Or we might say that there is certainly motion from the drivers' point of view, but not from the point of view of a person examining the photographs.

• We can suppose traffic were so bad that everyone was on the road all the time. Then there would be no chance ever to go home, or, for that matter, to the office. But then why keep moving?

• We can imagine two different experiences: (a) to stand on the side of the road and watch a car go by, and (b) to be in a car that passes someone standing by the side of the road. Is there any way that the two experiences can be made into one? One might mount TV cameras along the side of the road, and transmit a moving image of the passing car to a receiver in the car itself. And similarly, one might mount a TV camera in the car and transmit the image to a receiver by the side of the road. The question, however, is whether it is possible, e.g., through training, for the driver continually and simultaneously to experience his trip as *both* driver and observer, in somewhat the same way as he experiences himself when he looks down at his leg and simultaneously moves it.

We can ask a similar question about a section of road which, at various times, we travel in both directions. It is very difficult to imagine driving in the opposite direction from the one we are currently driving in — difficult to imagine how the scenery we are seeing, would look. Is it possible to experience driving in both directions simultaneously?

Such thoughts make us wonder why it is that traffic doesn't proceed much faster when it is about equal in both directions — when, in other words, there is always a car wanting to get roughly where your car is, and vice versa. One should be able to "cancel" all these opposite motions — eliminate all this inefficiency — so that all the trips amount to a simple instantaneous replacement of cars in various garages, e.g., if A wants to drive from Palo Alto to Berkeley, and B wants to drive from Berkeley to Palo Alto, then, instead of the tedious exchanging of distances from each city which constitutes the two cars moving toward their destinations, A would instantaneously appear in B's garage, and B instantaneously in A's.

• What is "travel"? To get in a vehicle, sit down, experience certain joltings for a certain period of time, along with movement past the windows, then emerge from the vehicle into different surroundings? That can all be accomplished via simulator, with a scenery-change at the end. I.e., at times it may be simpler to accomplish "travel" by changing one set of surroundings into another without changing position, rather than by changing position and leaving the beginning and ending surroundings fixed.

Remove change of location from car travel and what have you got? A peculiar ritual in which one enters a very small house (the car) and sits in a chair facing in one direction for an extended period. No one would do such a peculiar thing without the firm belief that one was getting something for it, namely, a change of location. (Imagine a person, or family, or small tribe, that has no

idea of the meaning of "travel". They think of it as merely a way to make the door open onto a different room than usual: you get into a machine, sit for a while, bounce around, open the door, and you exit into a different room.)

- The writing of computer programs that simulate motion, e.g., the video game in which the player drives down a road at high speed and attempts to avoid various obstacles — the writing of such programs makes the programmer realize that there are several "properties" of motion: one is how fast the pavement moves underneath the vehicle; another is how fast the scenery by the side of the road (telephone poles, etc.) moves past; another is how fast a distant object (mountain, tall building, bridge) appears to approach; another is how long, in fact, it takes us to get from point A to point B, i.e., how long, in fact, it takes us to travel some previously specified number of miles at the speeds at which we travel. Each of these properties can be varied independently of the other. Those who have seen the movie, *The Graduate*, may recall the use of a long-distance lens to show Benjamin running at top speed to get to the church where Mrs. Robinson's daughter is about to be married; yet he seems hardly to move at all. Similarly, we can imagine the road passing under the car at, say, 90 mph, but the scenery at the side of the road moving past at only, say, 30 mph, while a distant building comes toward us at the speed it would if were traveling, say, 200 mph.

Attempting to Solve the Problem

There are two ways of dealing with the traffic problem, namely, by decreasing the number of cars on the road at a given time, and by increasing the speed at which traffic can move.

Ways of Decreasing the Number of Cars on the Road at a Given Time

Wherever there is a chance of increase in the local population, e.g., by people moving to the area, it is absolutely useless to attempt to decrease traffic by such measures as widening the roads. Every law of Nature and man dictates that the easier it becomes to get from A to B by car, the greater the reason to travel from A to B by car, thus reintroducing the original problem. The only practical way to decrease traffic on a particular road is to reduce the reasons for driving on that road, e.g., by moving businesses nearer to where employees live, or by making it irresistible (financially, and/or in terms of travel time) to use public transportation.

Considering the success of state lotteries, there is no reason why they couldn't be used to encourage car pooling. Thus at random times during peak commute hours, individual toll booths could be electronically selected and notified; the driver of the car which is present at the booth at that moment would win, say, $1000 for each person in his car. In the case of a bus, one or more randomly selected passengers would win a similar amount. (A cynical friend of mine remarked that this would only put every housewife and teenager on the toll roads during peak commute hours.)

Or special license-plate stickers could be issued which permitted the car to be on certain commute roads only between certain times. These could be denied to persons living in new housing developments who wished to use already congested commute roads, thus discouraging developers from building homes which the existing road system could not support.

Or companies could vastly expand the at-present only occasional practice of flexible working hours, so that many workers can choose, within a certain range, when their workday begins and ends.

Ways of Speeding Up Traffic

How many experiments have been conducted on ways of speeding up traffic? Crossing the San Francisco Bay Bridge during morning commute hours, a distance of a few miles, often takes 40 minutes. Traffic lights located shortly beyond the toll booths are used to "randomize" the release of cars in an attempt to create an even flow of traffic across the bridge itself. Would it be better to release an entire row of cars at a time from these lights, at such intervals that if drivers accelerated to the speed limit, they could not reach the cars in the previous row? A friend tells me that he recalls reading that the speed that maximizes the total number of cars across a bridge per hour is 20 miles an hour, because at faster speeds, the minimum safe distance between cars lowers the number, and at slower speeds, the decrease in this safe distance is offset by the slowness of the speed itself. On the other hand, what we would like to maximize is the speed at which most drivers can cross the bridge, and this may not necessarily be the same thing as maximizing the total number of cars crossing it per hour. It may already be possible for data on number of cars on roads in a given area to be given to a computer which would then compute what the average speed *should be* on each road in order for each car to move the fastest; those speeds could the be broadcast on the traffic reporting stations.

Certainly one of the major causes of heavy traffic is the toll booth, an anachronism which should be eliminated. The argument that only those who use a bridge should be forced to pay for it is easily refuted by the fact that, through taxes, we all pay for roads and freeways we never use. Toll booths, as long as they remain, should be equipped with electronic detectors so that commuters with pre-paid electronic commute boxes in their cars could pass through at full speed. TV cameras such as those in banks could be used to photograph violators.

It is important to keep in mind that when a road narrows, drivers typically slow down, when in fact they should speed up, which is, in fact, what Nature does when asked to keep the rate of flow of a liquid constant through a pipe of varying diameter. The important measure for traffic is number of cars through a unit distance per unit time. More formally,

No. of cars through a mile in each hour = No. of cars through each lane in each hour

times

No. of lanes

Thus, if the no. of lanes decreases, the no. of cars through each lane in an hour must increase, i.e., the speed of the cars must increase, in order to maintain the same flow of traffic.

Ways of Making Traffic Jams More Pleasant

Among these are developing a way of flavoring exhaust fumes, so that, sitting in traffic jams, one could enjoy a variety of smells such as eggs-and-bacon, pine woods, steak dinners, women's perfume...

Additional Thoughts

Imagine you and all other drivers on the road as being inside a large hall. The floor is old, highly polished wood. Each of you stands at your steering wheel, which is vertical, like a ship's helm, and is attached to the floor via a vertical black post of some sort. Movement takes place outside the windows, but each of you stands sullenly, resentfully turning your wheel and glaring at the other drivers. When one of you reaches his or her destination — perhaps I should say, when the scene outside the windows becomes the destination that one of you wants to reach — s/he sets a lever in the side of the post, gathers whatever belongings are piled on the floor next to the post, and walks resolutely to the door of the hall.

The correct away to think about traffic jams — and indeed about any continuous movement of a large number of entities in a confined space — is by ignoring the question of *movement* altogether, and instead viewing the phenomenon as that of a changing *surface*. At one extreme we have, say, traffic in which identical cars move continuously, night and day, at the same speed and the same distance from each other. A sequence of aerial photos of such traffic taken from a fixed location overhead, and at a constant time interval, namely the time interval needed for one car to traverse the distance to the position of the car immediately in front of it, would reveal no change at all! If the sequence were projected as a movie, the cars would all appear to be parked in their orderly pattern. The "surface" consisting of the cars would appear to be unchanging. On the other hand, if car speeds differed, then the surface would appear to be "boiling": this bubble (car) here disappearing and another bubble (car) appearing nearby, or this bubble here seeming to cycle through a succession of colors (namely, those of the different cars which successively occupy that space).