THIRD SESSION

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The Port of New York Authority, Presiding

LAW, TRAFFIC AND ENGINEERING TECHNOLOGY

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The data on the highway traffic fatality problem in Figure 1 show the total number of automobile traffic-accident fatalities each year since records began. After a moderate start during the first two decades of the automobile era, the number rose rapidly and increased at the high rate of more than 2,000 per year between 1920 and 1930.

About 1930, a number of effects began to bear upon the problem significantly, and since then the average increase in the yearly fatalities has been a little less than 500, during the peacetime years. Among the factors which have averted the shocking increase of the 1920-1930 period are the increased efforts of all forces brought into the fray—professional safety programs, improved driver licensing, enhanced enforcement, public education and driver education, public relations, press, radio, television, the clergy, traffic and highway and automotive engineering, and others, including a depression lasting nearly 10 years. There is no thought on my part to establish an order of importance.

The sum total has provided a tremendous improvement, and without the effect of those efforts we would currently have a total of about 100,000 traffic fatalities per year. It is clear that this effort must be intensified.

However, the best of our efforts has only sufficed to almost stem the tide, and definitely not to turn it Can we expect hopefully that a continuation of more of the splendid same can really turn the curve downward as significantly as whatever did it in 1930?

The basis of this colloquy, as I understand it, is to inquire into the legal aspects of the problem, to see whether more can be done in terms of new regulations and application of existing regulations—better legal procedures, including enforcement and court actions. It may be more effective to see what the problem is fundamentally before trying more jigsaw solutions.

A passenger car traveling at legal speeds on a rural highway, where most of our fatal accidents occur, possesses high kinetic energy, as shown in Figure 2. Here the kinetic energy of a typical 4000-lb car is shown as a function of speed. At 60 mph, the car has nearly 500,000 ft-lb kinetic energy, and a 90-mm tank weapon projectile has approximately 4,000,000 ft-lb kinetic energy at the muzzle. Thus, as we drive to grandmother's house we guide a projectile with kinetic energy equivalent to 165 30-06 deer-rifle bullets, or more than one-tenth that of our best anti-tank weapon—possibly the equivalent of a 105-mm howitzer.

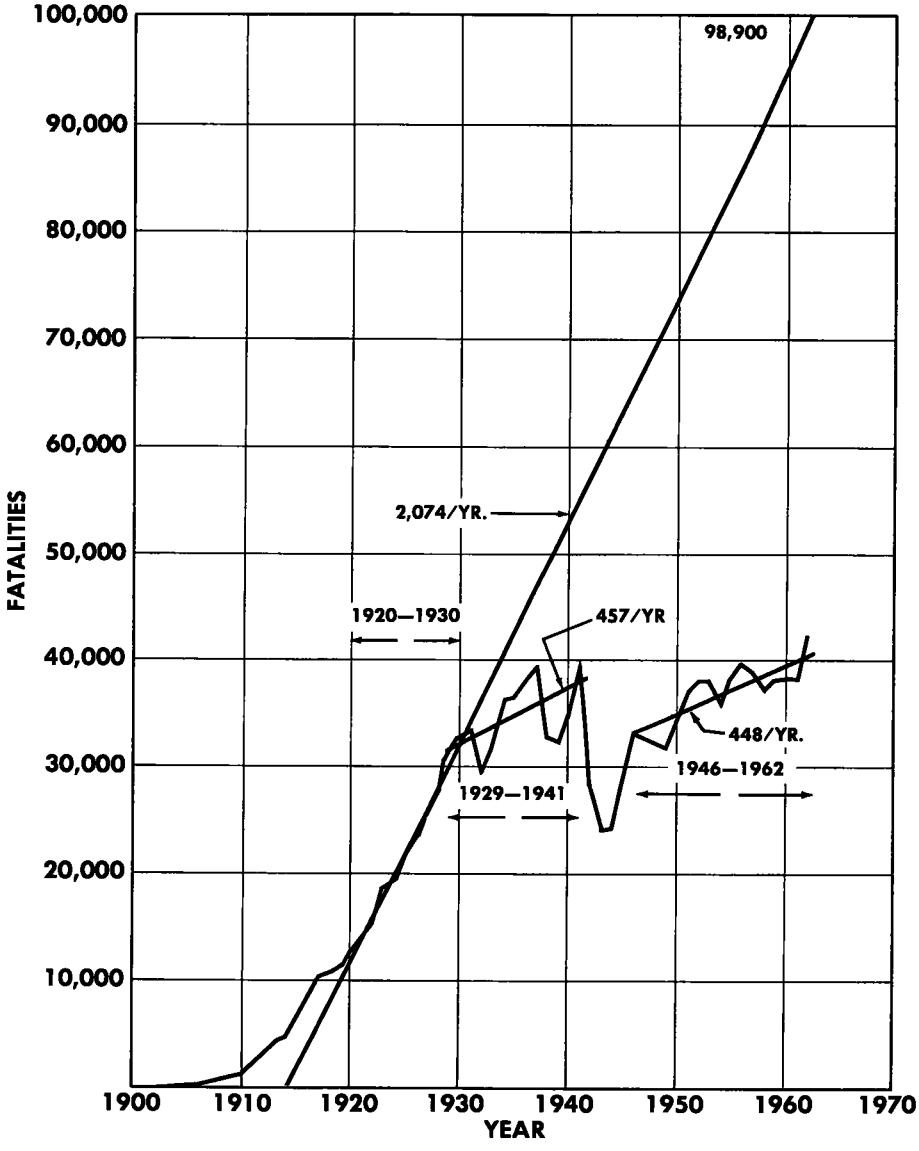

Figure 1 Highway fatalities by year.

And so we guide, happily and innocently, a projectile equivalent in energy to a medium artillery shell, along a path where we supply guidance moment by moment as it seems to be needed. This is driver skill, which we seek to impart, at the best, during a few hours of driver training.

The artillery shell is brought up to velocity very rapidly and aimed precisely along a specific path, and corrections have been made to firing-table data for air temperature, humidity, barometric pressure and wind velocity. And the outcome is predictable within a few yards laterally and several hundred yards longitudinally. Our projectile is brought up to speed gradually, with only local and

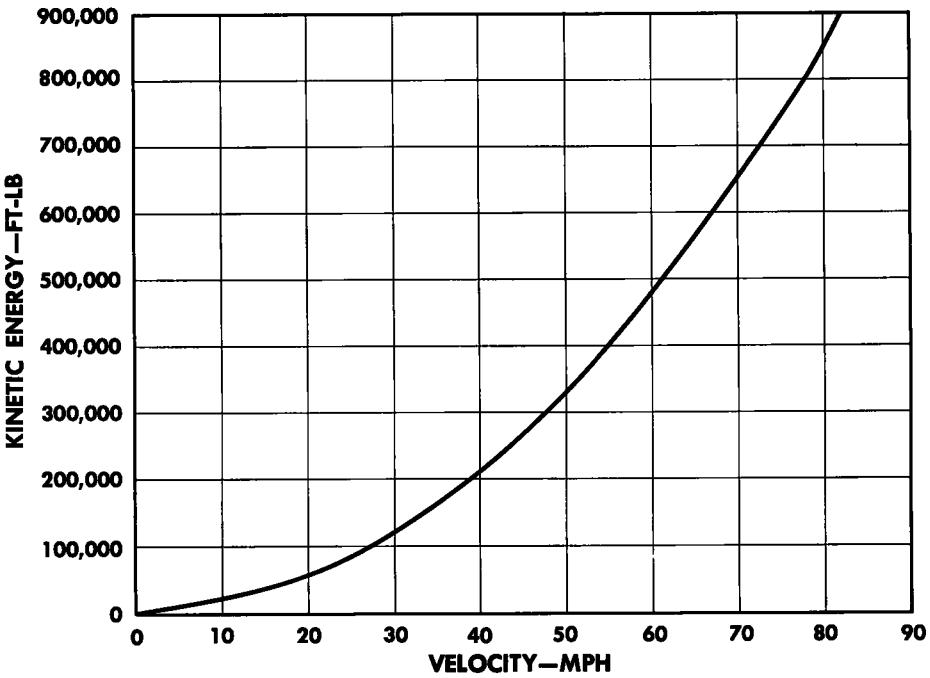

Figure 2. Kinetic energy vs. speed—4,000-lb vehicle.

incidental or casual aim or direction, and with no expectation that the path will lead directly to the objective—if, indeed, we know the objective. Ours is a guided missile, guided by the traffic lane and the driver's recognition of the traffic lane, and the only similarity is that the energy levels of our missile and the artillery missile are of the same order roughly; a sharp distinction is that our guidance must be much more accurate.

When we fire a 105-mm howitzer—or whatever piece develops the energy equivalent to that of our 4000-lb car at legal speeds—we expect to transfer a lot of energy in a short time at the strike, and blow the target up. If by mischance our passenger-car projectile hits a solid obstacle, an equivalent energy transfer occurs, and equivalent damage results.

Every day 20 or 30 or 40 million of us take these missiles out of our garages or carports, and guide them along ribbons of concrete or blacktop to the office, or shop, or school, or shopping center, or the World's Fair, or Yellowstone, or Yosemite, or the corner drugstore, or on a transcontinental vacation. The interesting thing is that, except for a small fraction of this mileage, we are face to face with similar "ballistic" missiles, with only a 6-in. traffic paint stripe separating us. We don't even fire bowling balls in alternate, opposite directions. Our guidance must always be more precise than the ballistic tables, because only a paint stripe separates opposing streams.

I propose that our highway system design and operating practice is precisely that which we would have built if our objective had been to kill as many people as possible. We have made a game of it by some qualifications such as "drive to the right," "yield to the car on the right at an intersection," "stop at stop signs,"

"keep your car under control," etc. The people play the game with astounding skill and aplomb; they kill one about every 18,000,000 miles of travel, and they don't object to these odds, generally. Only a few of us wear seat belts.

If we are to approach this problem realistically, we must accept the premise that the solution is to avoid these high-energy impacts. In trench warfare it is possible to provide structures which will provide security against 500,000 ft-lb artillery projectiles, but it is not possible in automobile traffic. Obviously, then, we must eliminate the roadside obstacles and the opposing traffic, and give us time to bring our missile back on track when guidance is lost temporarily.

Examples of the success of the engineering approach to the problem stand out magnificently. The New York Thruway and the Garden State Parkway show fatality rates below 1.0 at times, the Interstate System average is about 2.7, and the nearly ideal system at the General Motors Proving Ground has shown no personal injury off-the-road accident for the last 80,676,724 miles.

At the Proving Ground, management came to recognize in 1958 that General Motors usual industrial safety standards could be applied to road operations only by eliminating roadside obstacles, flattening the slopes, and rounding the ditch bottoms. Even drivers in this select and trained group were leaving the road about once every 240,000 miles, and the consequences depended entirely on chance. One such driver might run off into a level field, and the next might collide with a tree. It was recognized intuitively that no assurance of safety or survival could be provided in high-energy collisions, and the solution obviously was to prevent severe collisions by removing all possible targets. After this improvement, drivers have continued to leave the road about once every 240,000 miles for a variety of reasons, most involving some driver error.

Since even the well-trained and closely supervised Proving Ground drivers leave the road occasionally, it is certain that the less skillful drivers on the public highways will also leave the road occasionally, and here, too, the consequences are a matter of pure chance. Every year about 12,000 people are killed in such accidents, and the solution is as obvious as it was at the Proving Ground.

When a car hits a solid obstacle squarely, all its kinetic energy is given up in a fraction of a second. The rate of transfer of energy is power, and the conventional unit is horsepower Figure 3 shows the power developed during three crash tests reported in the literature. The first was a barrier block test at approximately 25 mph, the second a barrier block impact at 33 mph, and the third a car-to-car impact test at 45 mph. Peak values of power developed were 2900, 5500, and 6300 horsepower.

To study the effects of a more severe collision such as might occur on a rural highway, we ran a car into a large tree at 64 mph. To do this, we had to go out on a public highway, because there are no large trees conveniently close to Proving Ground roads.

Figure 4 was taken at near the peak severity of this collision This picture makes it clear that little can be done by vehicle design modification to assure occupant security.

Figure 5 shows the power developed during the impact. The peak value is about 13,500 horsepower.

Figure 6 is a comparison of several values of horsepower relevant to this consideration. The first bar represents the range of advertised horsepower in 1964 family-type cars, from 94 to 390. The second bar represents the range of

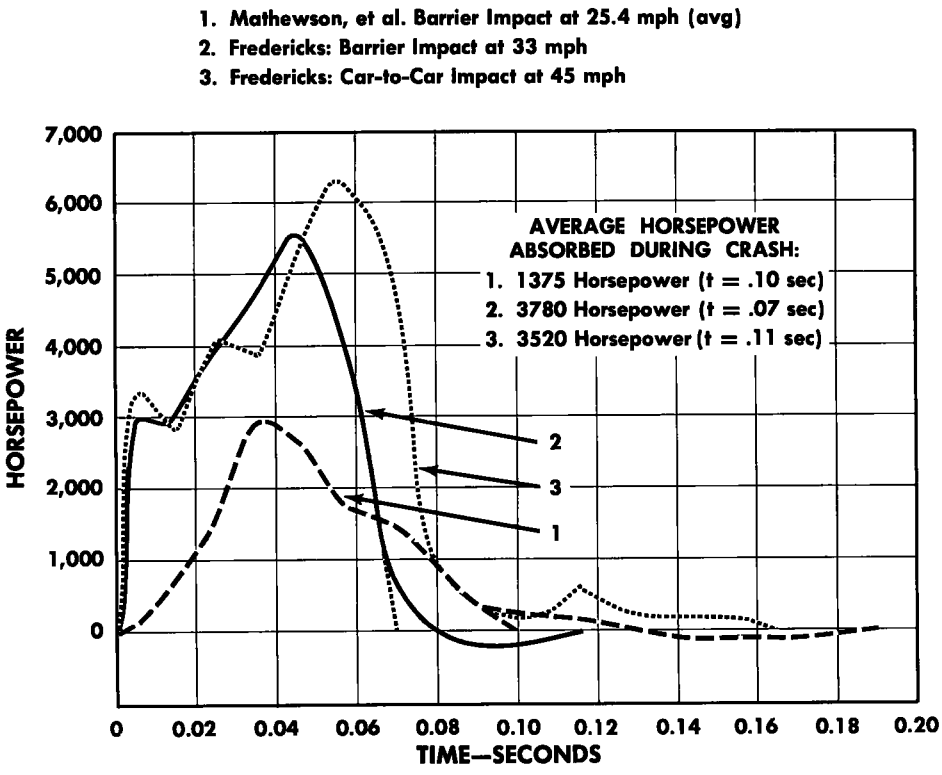

Figure 3. Comparative power absorption on impact tests.

power shown in the traces of the curves of Figure 3, after the collision is over, from -200 to 500. The third bar shows the peak power developed during a 70-mph panic brake stop, 550 horsepower. The fourth, fifth, sixth, and seventh bars are the peak powers developed during 25-mph and 33-mph barrier impacts, the 45-mph car-to-car crash, and the 64-mph tree impact, respectively.

Thus, a collision with a solid obstacle or another car is a dynamic event which can be characterized in engineering terms, and it can be prevented in most cases by application of well-known engineering technology.

HISTORICAL

Much of our existing network of roads and streets was laid out and in use before the automobile came into being. With appropriate regard for economy of time and distance, horse-drawn vehicles were operated in both directions with little or no hazard. When the first automobiles appeared, they were widely scattered and rare and of slow speed and light weight. Consequently they had low kinetic energy, and they, too, were operated in both directions on the same roads, with little hazard because of this type of operation. Conflicts with horse-drawn traffic occurred, no doubt, and there was the ever-present probability of mechanical

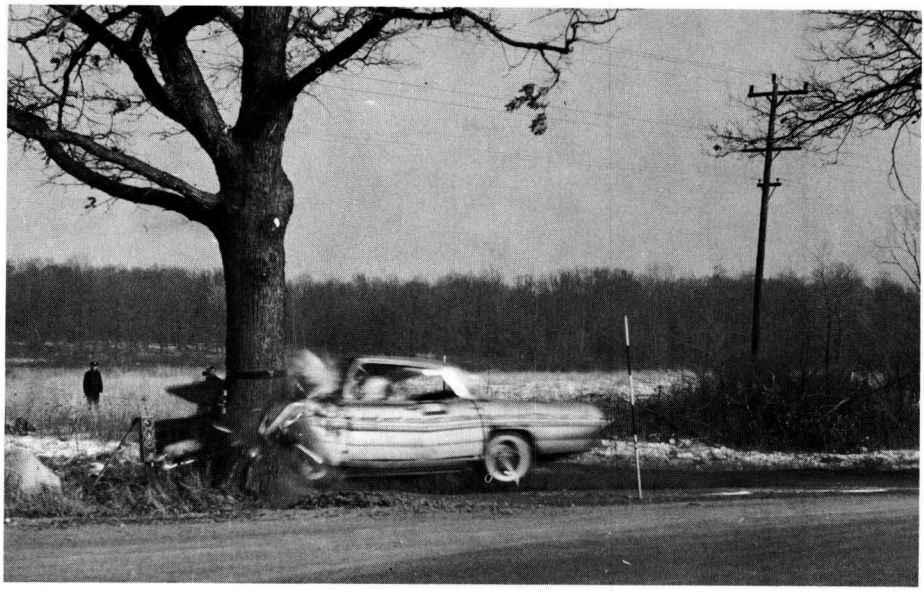

Figure 4. Car-tree impact—64 mph.

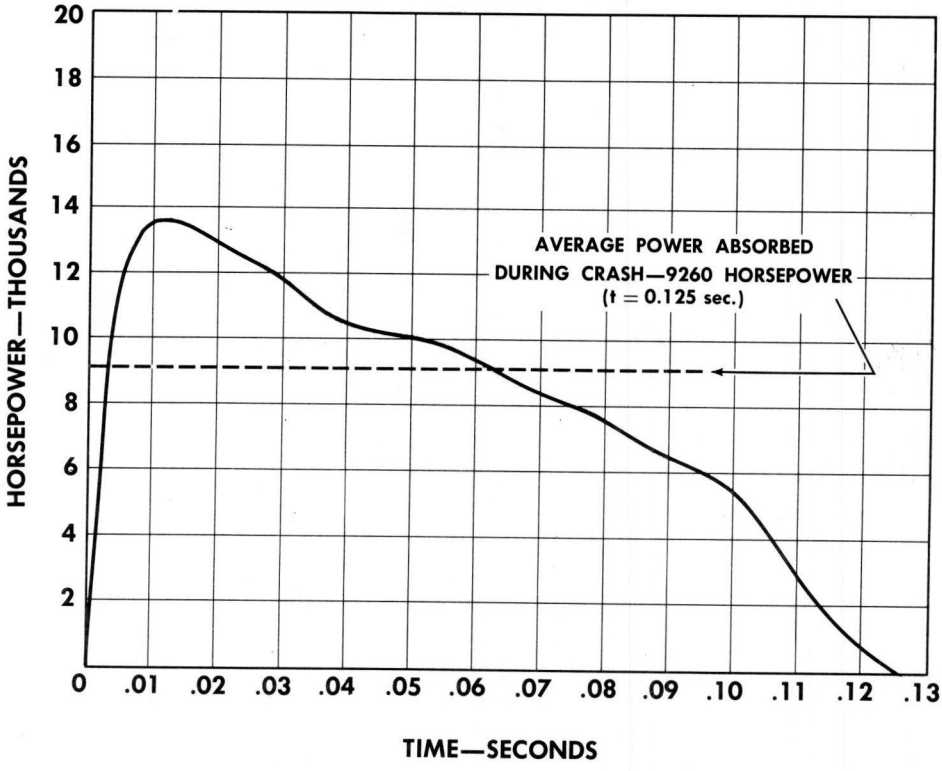

Figure 5. Power absorption vs. time, car-tree test—64 mph.

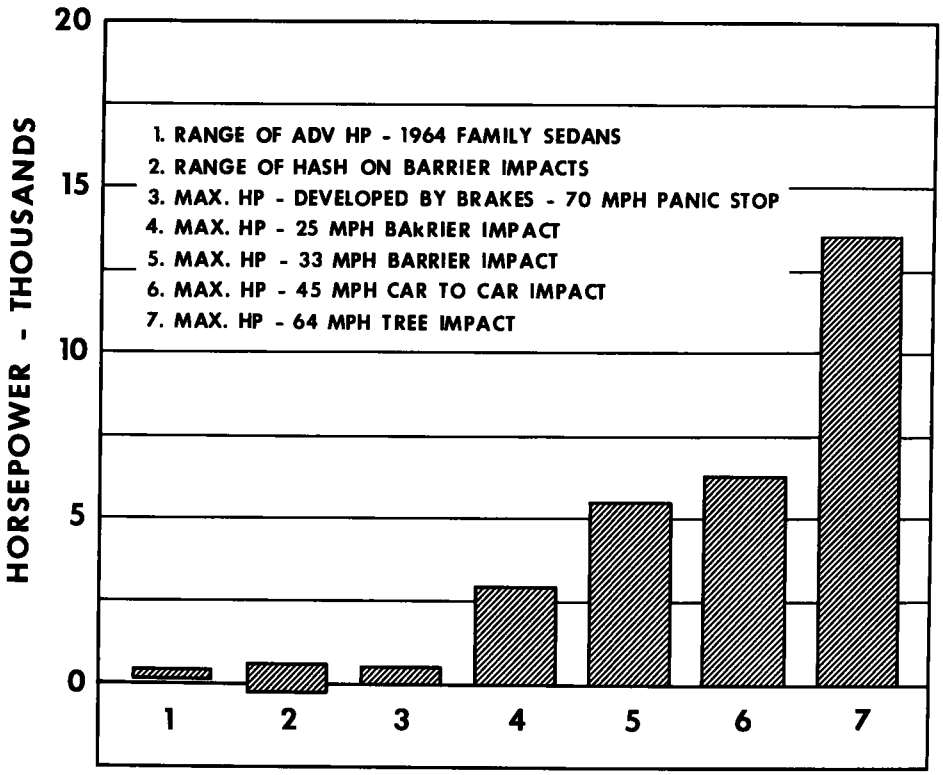

Figure 6. Relative and relevant horsepower.

failure and consequent roadside accident, but head-on collisions of two automobiles were no real problem for many years.

As the number of automobiles increased and as their reliability improved, the probability of head-on and intersection collisions increased. As the speeds and weights increased, the severity and relative importance of such accidents increased. Rules of the road were established at a relatively early date, we suppose, and regulations were imposed to restrict the speed of the early cars to that of the other traffic, in recognition of the relative hazard of differential speeds in the traffic stream. Additional regulations have been imposed from time to time to define proper conduct more precisely, both to guide the driver and provide the courts with clearer definitions in collisions where personal injury or property damage occurred. Parenthetically, it must be noted that this discussion of historical treatment is offered without benefit of counsel.

As the number of cars increased more and more, it appeared necessary to tax them and register them for identification purposes to establish proof of ownership, etc. Later it became evident that some drivers were not well qualified, and the practice of requiring driver licenses began. We aren't sure whether this was primarily to assure that only qualified drivers were on the road or to identify drivers who might have transgressed some regulation.

And so we have progressed as more cars have appeared, attempting to define the proper path and action and conduct of every driver along every foot of the road every minute of the day and night, so that no drivers who follow these definitions, or regulations, faithfully should ever be involved in an accident.

CONCLUSIONS

I think this has worked surprisingly well. Serious accidents are extremely rare and only a very small minority of drivers disregard the conventional definitions and make up their own. These people tax our enforcement people and clog court calendars. However, the number of accidents of all types is in almost direct ratio to the number of cars registered in, and the population of, the community. With our present system of complete definition of traffic practice, we still have people who are slightly unreliable. I do not believe that we can legislate human reliability.

Proving Ground drivers leave the road once every 240,000 miles because of human failure, and those of us in the public highway traffic stream must fail more frequently. These failures are not deliberate except in a small minority of cases, and in many cases they are probably unconscious. I think we are covered adequately by general definitions of proper conduct and specific instructions in locations where our traffic engineering friends deem them necessary, and I do not think we can reduce our rates significantly by additional regulations or improved enforcement or court procedures.

Reductions can be made only by recognizing that our highway network does not leave room enough for the occasional unreliability of us drivers. The missile track isn't quite wide enough, and we need a little more room to recover from our infrequent lapses. Just as on the Proving Ground, some of us leave the road or the traffic lane every once in a while, and what happens depends upon whether there is an obstacle in the way. The solution is to remove the obstacles, trees and rocks and sharp ditches and opposing traffic. Application of this technology requires reconstructing cross-section designs for a reasonable distance from the edge of the road, removing all solid obstacles or protecting them with well-designed guardrail installations, and converting the road network to one-way operation. The money to do it can be found in the $8 billion annual cost of accidents. Application of engineering technology will reduce the number and cost and severity of accidents, and work wonders on relieving the load on enforcement agencies, and clear up court dockets.

COMMENTARY

HARRY V. CHESHIRE, *General Counsel*
Automobile Club of Southern California

I would like to begin by making one or two comments about the general frame of reference within which I will approach this subject. I was told that the purpose of a discussant was to refine and elaborate along the lines of thought commenced by the opening paper. Also, I noted Mr. Morony's statement in the program regarding the purpose of the meeting.

Initially, the title suggested for this colloquy was "Research Frontiers in Motor Vehicle and Traffic Laws," but it seems to me that the scope of our discussion has been a little broader than that. So, perhaps it is more appropriate to use Mr. Morony's statement that our purpose should be to identify the contributions that research can make toward improving the law. This, it seems to me, opens up a much broader range of inquiry than is involved when we are concerned only with research in the legal field.

It is important, however, that the results of this inquiry be directed toward research in the *legal field,* particularly looking toward the future activity of this Committee on Motor Vehicle and Traffic Law. Probably one of the most beneficial results of this meeting will be to identify some of these areas for further legal research which the committee can undertake.

I was going to say that in the pursuit of these purposes I have had the advantage of reading and rereading Mr. Stonex's paper. But I'm not so sure it was an advantage, because in his oral remarks he deviated somewhat from his paper and left a few things out. I do think, however, that the paper was stimulating and interesting, both for what it did say and for what it did not say.

Turning first to refining and elaborating on what it did say, it seemed to me that one of the things it said was that in this instance maybe we do not need so much new research because a great deal can be done by the application of *known* engineering technology. His main theme appears to be that since we cannot overcome the fallability of human beings, and we know they are going to run off the road from time to time, the sensible solution would be to remove obstacles along the right-of-way so drivers would not crash into them. There would not

Third Session *(left to right): Robert Sornson, Chrysler Corporation; Dr. Leon Goldstein, U. S. Public Health Service; Carl Saal, U. S. Bureau of Public Roads; K. A. Stonex, General Motors Technical Center (representing Automobile Manufacturers Association); Edward Wetzel, Port of New York Authority; Harry Cheshire, Automobile Club of Southern California; Robert Montgomery, Jr., National Committee on Uniform Traffic Laws and Ordinances; and Arthur Freed, Westchester County, New York.*

be any barriers, poles, buildings, etc., with which to collide, and there would not be any severe ditches—they would be shallowed out.

Before commencing to search for *legal questions* which might be raised by this proposal, there are a number of preliminary questions. I would like more information about what will be necessary to work out the type of solution suggested. For example, how much land would be required if we were to remove these obstacles? Does the amount of land we need depend on the speed of the traffic? That is, if we permit faster speeds on the highway, are we going to have to acquire more land so that we can clear the land of the obstacles?

And speaking of speeds, what about the urban areas? If permissible speed does have a bearing on the amount of cleared land required, what special problems do we face in built-up urban areas? Of course, we know that along the New York State Thruway and other expressways in *rural* areas we have a separation of the traffic streams. We have a fairly wide median strip and a very wide shoulder area, perhaps.

But what about the cost of this solution in urban areas? Wilshire Boulevard in Los Angeles comes to mind. It is a rather heavily traveled traffic artery. If we were to leave space for a vehicle to go off the road without hitting obstacles, it would mean clearing the adjacent property of some very expensive buildings. You might avoid taking the Ambassador Hotel, because it has a rather large front lawn. But when you come to any number of other buildings along Wilshire Boulevard, each costing a few million dollars, you are dealing with a total value that is staggering.

Therefore the urban areas, it seems to me, would present a serious challenge in working out the "engineering solutions" that are suggested. Would we go to one-way streets to eliminate friction from opposing traffic streams? Would we rebuild our cities with wide set-back lines for building? If we did not require removal of obstacles along the sides of streets and highways, but built this open space into the street design, then it would seem that we would have to require traffic to use only the middle lane of a street, regarding the outside lanes in the same way as cleared shoulder areas. And, if so, we are in the position of having to call for almost a doubling of the capacity of the streets. All in all, I think the solution offered raises some serious economic and social problems.

The economic problems are obvious. But social problems would also appear if we ever tried to take that much land out of private control.

Intersections are another problem, and I am not sure how you would solve it from a design standpoint.

So, with regard to these nonlegal questions, we do need further research—and to this we need to add accident research. What portion of the traffic-accident problem involves rear-end collisions, where it does not make any difference whether you have opposing streams of traffic? What portion involves intersection accidents, and how would you solve that? What portion involves vehicle against vehicle as distinguished from vehicle against fixed object?

As to the points involving the law, Mr. Stonex's suggestion suggested to me in turn some problems which might be clarified by legal research. Could we legally acquire this needed additional property by purchase? If we are talking about building a highway and clearing the adjacent land of all obstacles, how far out from the roadway can we go under the law in the expenditure of public funds to

purchase this property? At some point these purchases may be challenged as a gift of public funds, and so be invalid.

Can we accomplish our objective by easements? Maybe we do not have to purchase the property, but can get along with some form of negative easement which would prevent the landowner from building anything on his property that would constitute a threat to the safety of travel on the highway. In this connection there is an interesting development now going on with regard to so-called "scenic easements." In general, the approach seems to be that, in rural areas particularly, the government might obtain a scenic easement over certain lands, under which a landowner could continue to use his land as he is now using it (which might be agricultural or grazing), but he could not build anything on it.

Condemnation, of course, raises other questions. Is acquisition of property for creation of open roadsides a "highway purpose" within the meaning of the condemnation authority of the state highway departments? Are we involved here with so-called "excess condemnation?" Can we justify the taking of this property as necessary for highways? I think, also, that the suggestion for clearing the area adjacent to the roadway—be this part of the public right-of-way or privately owned land—raises the question of whether existing laws are adequate or whether new laws must be enacted.

Of course, we do have laws relating to the freeway as a precedent, and we should see how far the existing laws relating to freeways can be utilized in the situations we may wish to visualize for this new type of roadside.

Earlier I asked whether the amount of cleared land we will need adjacent to the roadway will depend on the speed of travel permitted on the roadway. In this area I think there is a need for some coordination between those who are designing the vehicle, those who are designing the highway, and those who are designing the laws. The automobile manufacturers are developing vehicles designed to travel 100 mph or more, the highway engineers are designing highways for maximum design speed of perhaps 70 or 80 mph, and the people who design the laws are thinking in terms of 65 and 70 mph. There seems to be some inconsistency here for which we are paying a high price in efficiency and safety.

A similar inconsistency is hampering development of sensible laws regarding vehicle sizes and weights. Vehicles are being designed not only to go 100 mph, but to carry two or three times the amount of weight that is now permissible in any state. We need to examine this problem because we are designing highways for particular weight limits, and therefore, once again we need coordination between the designers of vehicles, highways, and the laws.

Going back to the suggestion about the removal of obstacles, it may be possible, both legally and practically, to work this out, but I do raise a question about our ability to pay the economic costs of such a program Perhaps we are going as far as we can when we build the kind of expressways we have today, with median strips and wide shoulders It may not be possible to accomplish on a nationwide scale what has been accomplished at the General Motors Proving Ground. It may be far too expensive if it means doubling our existing street and highway capacity.

I mentioned in the beginning that I thought the paper was interesting for what it did not say, as well as what it did say. It did not, for example, say anything about automotive design. This was a bit of a surprise to me. If we are going to

do as much as we can on highway design, maybe we ought to do as much in connection with vehicle design as well.

I think that a basis for approaching this aspect is provided by two statements in the paper. One was as follows: "If we are to approach this problem realistically we must accept the premise that the solution is to avoid these high energy impacts. In trench warfare, it is possible to provide structures which will provide security against 500,000 ft-lb artillery projectiles, but it is not possible in automobile traffic." The other statement had to do with the severity of a collision where a vehicle was driven into a tree. The paper includes a picture of such a collision, and states: "This picture makes it clear little can be done by vehicle design modifications to assure occupant security." I emphasize the choice of the word "assure." It is probably true that little can be done to raise the level of security to the point of certainty that the occupant will not suffer major injury in a collision of this sort. But I wonder if this relieves us of the obligation to keep trying to improve the situation of the occupant.

As to the legal aspects of this, I was interested to hear Dr. Schlesinger make a reference to the desirability of looking into the legal aspects of crash injury research. Recently I read an article in a law journal written primarily for attorneys representing plaintiffs in injury cases. The article expressed the idea that patent law was a prime source to secure safer auto design to reduce highway deaths. It is interesting that in this article the author says: "Robert A. Wolf, director of the Automotive Crash Injury Research program at the Cornell University Aeronautical Laboratory . . . finally felt impelled to tell a convention audience recently that there is no reason for any further delay in installing collapsible steering wheel mechanisms." The point is that this appeared in a magazine which, as I said, is directed toward plaintiffs' attorneys, and this man is telling plaintiffs' attorneys how to go about getting a judgment from automobile manufacturers as a result of defective design.

I think this is a significant legal aspect of the premises that we adopt regarding our automotive design. Since the manufacturers may be compelled to do more, by virtue of legal liability imposed on them, it is perhaps a good idea to explore what the law is in this area and what it may become. There is already some law on this subject, of course, and the article makes some further references in this connection, saying that judicial recourse against automobile designs is increasing. It specifically notes the Corvair, which it states, has a steering shaft which extends too far in front of the front wheels. The author then points out the sources of evidentiary material for making a good case against a manufacturer. All you have to do to find the proper evidence and get it into court, is to know where that evidence is and what questions to ask. He says, for example, it may be important to know that a technical paper delivered by a Ford Motor Company engineer early in 1963 touting the experimental model of the Mustang detailed several safety features which included (1) genuine bucket seats with lateral holding power, (2) strongly anchored seats, (3) bent steering shaft to ward against being driven back into the passenger compartment, (4) collapsible steering shaft to cushion any impact, (5) roll-bar structure strength, (6) fail-safe dual-brake system. All these features, this writer says, were deleted from the production model of the Mustang now on the highways. His point is that if you can show the court that some engineer said these were good safety measures,

you are on your way to getting a judgment when you say they were deleted and were not included in the vehicle.

Considerable public attention was given to the Corvair case in Santa Barbara County, California, which was settled for about $70,000. Here again there was an allegation of defective design. Another case in Texas involved the design of the ignition switch.

There are numerous problems which I think will arise in this general area, and the liability for defective manufacture, laid down in the old case of *McPherson v. Buick,* may very well be enlarged to the point where we will be talking about liability for defective design in even more precise terms than we are now. A review of the law on this subject might well be a valuable contribution from legal research.

Another area for needed legal research concerns the statutory requirements relating to automotive equipment. Is regulation of equipment going to increase? What will be the relationship between the statutory requirements and the administrative regulations in the area of equipment? What about interstate compacts? These compacts are opening up a whole new field of motor-vehicle law. Recently attention has been focused on the interstate motor-vehicle safety equipment compact, but this brings us face to face with the question of what other types of subjects are suitable for being handled in this same way in the future. (Unfortunately, I think we are sometimes inclined to assume that a new device such as this provides the answer for everything that needs to be done; but I believe we would make a mistake to place too much reliance on compacts, and forget the Uniform Vehicle Code and the possibilities of building on it.)

With respect to the matter of liability for accident losses, we may not need a compensation system such as was previously discussed. If we continue to extend the theory of manufacturer's liability for defective design, this may be a form of recourse which will become increasingly available to the accident victim. I am not advocating this, but we cannot fully assess the possibility without more research.

By way of summary, therefore, I see needs for study in the following areas of legal research:

1. Questions raised by the use of condemnation and purchase to acquire the land, easements, or other interests in real property which would be involved if we were to undertake a program of clearing our roadways, roadsides, and adjacent areas of all obstacles contributing to the severity of vehicle-fixed object collisions.

2. Questions bearing on manufacturers' legal liability for defective design of vehicles.

3. Identification of some of the specific areas where the engineers feel there are limitations on their technological efforts because of the law. I am not referring solely to automotive engineering, but to highway engineering and traffic engineering. I would like to know where the engineers feel that because of the law they cannot now do some things they believe are sound from an engineering standpoint. Let us take a look at what can be done about the law in this regard.

4. I feel keenly that laws of the future should be looked at in terms of the engineering design of the future. Here I am thinking of speed, sizes and weights, and electronic controls of both the vehicle and the highway.

DISCUSSION

DR. ROBERT MONTGOMERY, JR., *Executive Director*
National Committee on Uniform Traffic Laws and Ordinances

The thread of the Uniform Vehicle Code has run through our previous discussions, and I consider it part of my responsibility to the colloquy to inform you briefly on what this is.

Professor McFarland mentioned the need for legal standards in this field, although his comments went somewhat beyond the legal standards. There is now a standard, and there has been a standard since 1926 for motor-vehicle and traffic law. This is in the form of the Uniform Vehicle Code. It has been kept timely over the years since it first appeared, so that now it stands as a guide for states to follow in the evolution of reasonably uniform motor-vehicle laws.

The need for this, of course, grows out of our governmental problem in the United States where 50 states present the possibility of going in fifty different directions. This standard, if you want to call it that, is maintained by the National Committee on Uniform Traffic Laws and Ordinances. The National Committee is a group of approximately 100 people whose interests and viewpoints cover the entire spectrum of transportation in this country. Inevitably the Code is a product of compromise, and in its working-out process it tries to take into consideration all of these various interests.

As to the paper of Mr Stonex—and letting some of my personal feelings into the discussion—I found the paper very reassuring and I did not find much in it with which I could join issue.

As far as law is concerned, I cannot argue much with his description of the evolution of the law. It has had a rather wild and haphazard growth in some of its parts.

I was interested in Mr. Stonex's use of ballistics to illustrate the characteristics and problems of highway traffic. Perhaps it was because of this that a point of comparison occurred to me in the proposed gun laws that are receiving so much notoriety at the present time. Recently the *Washington Post* suggested a parallel between traffic and ballistics, saying we regulate our automobile drivers very rigorously, but we do not regulate gun owners and users to anywhere near the same extent. Certainly we do have a multiplicity of laws, which, as Professor McFarland has noted, is not strange because they follow the complexities of the human mind.

It seems obvious to me that we can expect increasing complexity in our laws as society and technology become more complex. One point worthy of examination here is whether the law is trying to do too much. What is the role of law in the growth of our transportation systems?

Although it is true that we have our hands full now with problems of highway transportation and traffic safety, the real problem lies in the future. One reason that the National Committee on Uniform Traffic Laws and Ordinances and the Uniform Vehicle Code are so important is that they furnish machinery for the guidance of states in the assimilation of new ideas, legal and technological, into state legal and governmental structures.

The combination of research on existing state laws as measured against the Uniform Vehicle Code and subcommittee deliberations of the National Com-

mittee—and this will involve the compact conceptions, "delegations of authority, and governmental relationships" already mentioned—will be, we think, a valuable contribution to new thinking. It will also serve to translate research findings and new ideas into a better legal fabric for our transportation systems.

ARTHUR FREED, *Traffic Engineer*
Westchester County, New York

I would like to go over some of my thoughts on a few of the aspects of what we have been discussing. It might be of some solace to note that while we are taking up some new concepts, there are others which are not so new.

I harken back to the experience of Lycurgus, the law giver of ancient Sparta, who historians say was the first public official to recognize the problems of women driving chariots. He promulgated rules for the operation of chariots by women in the city streets But the first woman apprehended for violating these rules was Mrs. Lycurgus, and the rules disappeared overnight. So we do not appear to have progressed very far in the business of enforcing unpopular regulations once they are enacted.

I think, however, that we should start off with Mr. Stonex's concern with roadside obstacles and—as one who has had Joyce Kilmer's "Trees" quoted to him for every limb that we have tried to remove to enhance the safety of our parkways and highways—I believe that his proposal is a good one but in some cases a theoretical one, and not entirely practicable in all instances. I think we should go back a little bit further in our study of law, to look at some of the consequences of loose zoning, and the absence of official or master plans that serve to protect areas where we desire to build highways sometime in the future. If we had considered these aspects when our urban areas were being developed, we could have avoided getting into some of the after-the-fact type of action that involves such drastic steps as condemnation by having areas set aside. Nothing has such perpetuity as space.

I think, too, that we should not let ourselves get too far away from one point Mr. Stonex left out of his paper—vehicular design. In legislative halls throughout the nation we now are beginning to hear legislators talk about disc brakes and dual master cylinders with the same enthusiasm that they discuss taxes and appropriations It seems to me that unless somebody begins to set some norms for vehicular design, we are going to have legislation dictating some vehicle design features that are good and some that are totally impossible. There is no question that much can be said on both sides of the matter.

Here, too, we run into an impasse between the effort to design highways, for which we are investing hundreds of millions of dollars, and the effort to design the vehicles that will travel these highways. To illustrate this problem I would call attention to the provision in highway design predicated upon maintaining a certain minimum sight distance for the vehicle operator

Yet in recent years the automobile designers have seemed intent upon making the silhouette of the car lower and lower, and driver eye height lower and lower. In New York State we found in 1958 that the median eye height was dropped from 54 to 44 inches. Mathematically you can figure out what this does to the sight distance of the highway system. One obvious consequence is to make all the existing markings for "No Passing Zones" obsolete. Another, which is be-

ginning to stand out as having some connection to the change in design, is the predominant incidence of compact car accidents in which the compact is on the wrong side of the road, indicating that the compact car drivers feel they have adequate sight distance, when in fact they do not, because they are so much lower to the road.

Many subtleties enter the problem of the highway. If the embryo highway is not built and taken care of properly, it grows up to be a juvenile delinquent and has to be rebuilt at some future date. These subtleties vary from the gasoline station owner who shovels his snow out onto the roadway, and effectively closes one travel lane, to the homeowner who does not clear his walk at all, and so requires pedestrians to walk in the roadway.

I think we have to consider that we must take care of highways just as they begin to grow up. Enforcement is subjective to the motorist who is speeding and to the individual who has jurisdiction for maintaining a highway. Our need in the law, therefore, starts not only with the treed forest that provides the room for the future highway. It also starts with the ingot of steel that becomes today's automobile. It is the law as well that regulates yesterday's drivers to try to conform to today's needs so that perhaps we all might survive until tomorrow

DR. LEON G. GOLDSTEIN, *Chief*
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I find it is a little difficult to organize my thoughts around the themes and concepts that have been discussed here. Like all the rest of you, however, I suppose it is best if one starts from where he is, from his discipline and his experience I think of an experience I had several years ago at a psychiatric institute in a discussion of the mind and the motorist Someone got up and presented a point of view which started with the law and went on to describe a considered, thought-through program for traffic safety. After it was over I asked him why he started with the law. He answered that it was the natural starting point, since law was the basis of society. Now, to me this was a new point of view since I always thought that people were. This was the way I felt because I was a psychologist. This is my bias; this is the way I look at the world

In the past few years I have had occasion to talk with and listen to people from almost every conceivable discipline, including my own, and the thing that stands out in my mind is the degree to which people in various disciplines live in different worlds. So, if you ask them to define any problem for you they will do so in terms of their own discipline and the things with which they are familiar. I think this is characteristic of anybody, including me. So, if we are to address ourselves to important social problems, such as the reduction of traffic accidents, I think it will require a joint effort of many disciplines, and I am delighted that this kind of colloquy is taking place. I do not think we will understand each other fully at the end of the colloquy, but I think we will have made a good beginning.

I would like to come to grips with a couple of specific matters. Mr. Stonex in his paper used a sentence which is the kind of statement that always brings my attention to a point: "It may be more effective to see that the problem is in its fundamental terms " In this connection I return to the point of view that was raised with me several years ago when I was working with the Department of the

Army, and our problem was the selection and training of electronic maintenance people. In that context we had occasion to talk with engineers who design and operate the air defense system. It so happened that during that period I met socially one of the engineers from the Signal Corps who had recently been talking to one of our people about the potential of human engineering to the problems in the air defense system. He made what I think was a characteristic remark: "What's this jazz about human engineering? We all know that engineers are human."

I replied, "That's true. Engineers are indeed human. So tell me, how many targets can a radar operator in an air defense system track simultaneously?"

He said, "I don't know."

"Of course you don't know," I said to him, "and I don't know either. But the difference is that I know how to find out "

Perhaps this sounds like an arrogant statement, but I firmly believe that this is the core of what behavioral science has to contribute. It is a relatively new area. Law, in our society, is as old as the Mosaic Code, and in the Chinese and Indian societies it is much older. Engineering goes back at least to the Pyramids. These are very old and mature disciplines and have had great achievements. I think perhaps the behavioral sciences need to make more noise in order to be recognized and heard and listened to occasionally.

This is a point of view we encounter time and time again. Every human being feels he is a psychologist I'm a parent; I've brought up children; so I know all about how they act and why. Of course, it just isn't so.

The feasibility of the particular proposal that Mr. Stonex has made has already been discussed, but I will comment on it to this extent· He picked up one problem area in the totality of this matter—that is, the problem of off-highway accidents —and indicated where engineering solutions can be applied This is excellent when you can do it. But there are obviously many other problems involved in working out his approach. I would also point out quickly that this is certainly not the only problem, even on freeways. About 40 percent of the accidents on the Pennsylvania Turnpike are rear-end collisions at night. I think it is a fairly safe deduction that you have some human unreliability or limitation involved here that is fairly subtle, and the remedy is not at all obvious. This is where research is needed, to find out just what are the human limits that precipitate this kind of accident. You can say "Be careful!" all you want, but unless you have the information and take into account these limits you can't stop them.

A comment about the figures for freeways and their safety: I am sure that the advent of the freeway has improved transportation and has improved the accident picture. I would remind us, however, that it is not a cure-all The figures tabulated for fatal accidents per 100 million vehicle-miles are not directly comparable to those of other roads for a number of reasons You almost never get a pedestrian on a freeway. The saloons and roadhouses are not located on the freeway, so that alcohol is more difficult to obtain

In most freeway, or expressway, driving the people are on longer trips than when driving on local roads, so generally people think a little more about having their cars in good shape.

I was very much amazed when I used to travel to work on the Washington-Baltimore Parkway at the number of disabled cars along the side of the road. Apparently a great many of the people who drove this road are traveling to and

from work, and they do not pay particular attention to whether they have enough gasoline. When they run out on the turnpike they are just stuck there. And, the same was true of other normal routine maintenance needs. So I think that these factors need to be taken into account in adjusting the comparability of the fatality figures applying to the turnpikes and the figures from other roads.

Another issue has been raised recently There is a good possibility and at least a little evidence to support the notion that freeway driving may actually so alter the psychology of the driver that when he comes off the freeway, he needs a certain period of time to adjust to the type of driving he is called upon to do on the regular streets and roads. This increases the accident rates on roads adjacent to the freeways. The data now available are not compelling, but they are suggestive, and there is reason that this might be the case

Coming back to the problem of running off the highway, I think this is the type of accident that warrants a great deal of intensive study. There have been perhaps only two studies that come to my mind that really tried to find out why such accidents happened. This is unusually difficult because the people who might be able to tell you are often killed in the event. This is not always so, however, and one study by the Air Force found, for example, that among drivers who went off the road there was a much higher percentage of a high level of alcohol in the blood. This should be taken into account. Why do people drink? Why do they overdrive from their home base on leave? These are all human behavioral problems.

Recently a lawyer said to me that he was against speed limits because he was convinced they caused accidents. This was a new notion to me. I asked him how he came to this conclusion, and he said they tend to make cars bunch up on the highway. Now, again, there is a little bit of evidence to support this notion that the platooning of cars increases the probability of accidents. On a straightforward mathematical basis, if cars do not come close to each other, they cannot collide. So, again, this is something that needs reconsideration to determine whether the law, and the human behavioral sciences, and other disciplines need to join together in some additional research to find out just what this problem involves.

We presume all the time that speed limits are a good thing. I don't pretend to know whether they are or not, but I think a very interesting question has been raised here, even though it challenges one of our basic assumptions.

I would hope that out of this colloquy will come the notion that the design of a car, the design of the highway, and the development of law are all intended to serve people. I agree with an earlier observation that it is exactly the cynicism in regard to the human being and the shortcomings of human nature that initiated the law in the first place. This is something that we need to bear in mind. We should not assume that all the information we need to legislate, or regulate, or administer is readily available. It is not available, but I do believe that the techniques for finding out are largely at hand.

CARL C. SAAL, *Deputy Director for Research*
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Bureau of Public Roads

I will begin my remarks with vehicle design because I feel closer to this subject than to any other. I am disturbed by the manner in which this subject is often

discussed in connection with the Uniform Vehicle Code, the standards for Motor Vehicle Inspection, the regulations of the Interstate Commerce Commission, and practically everywhere else where vehicle design or vehicle components are mentioned.

Regulations have too often centered about detailed components: the chassis and body, electrical system, steering controls, packaging, safety accessories, etc. An important point to make here is that we are in a very "gray area" when we ask how far we can go into the regulation of vehicle design. It appears to me that there has been too little adherence to the principle that performance is the sound basis for regulation of the physical characteristics of the motor vehicle.

Many regulations of individual components, such as the braking system, attempt to specify the design of the system in great detail, without attention to what the system is expected to do. The consequence of this, it seems to me, is often to stifle progress Standardization sometimes works against progress Each time we standardize, we should be careful not to keep something better from coming along in the future. In this day and age of great technological advances, we have to think more and more of performance requirements and to include such requirements into the regulations, rather than trying to write specifications.

I do not know how to attack this as a legal research problem. It would seem, however, that the first thing needed is an inventory of the state of the art. For example, where has a regulation resulted in slowing down innovations that industry would like to have, and where has a requirement been so minimum that it did not stimulate improvements in performance? I noticed this, particularly in the hearings on the interstate compacts regarding tires, where the rubber industry's recommendation for a requirement was rather minimum. The fact apparently is that we are not prepared to write a good performance standard in this field. We need research to provide a performance standard which the regulatory agencies can use.

A problem similar to tires may exist in certain areas of braking problem; for example, the case of split systems

I would hope that we might get away from using the term "design standards," and use some term like "vehicle performance standards." Then if we specify what is wanted, the automobile manufacturers can design these performance standards into the vehicle, provided, of course, that the public is willing to pay for them.

This leads to another thought which has for years kept the problem a difficult one. It is summed up in the question: "What is the role of the Federal Government with respect to the states?" There has been a good deal of talk about this problem, but no one has really done very much about it. As a result, there is confusion at present as to who should take the lead in overhauling automotive equipment standards.

From its very beginning, the policy of the U.S. Bureau of Public Roads has been that the states should be responsible for many of the decisions relating to control of vehicle operation and performance. The birth of interstate compacts is a good example of how the states can function. The Federal Government had, at one time, no interest in regulating, but now has a very keen interest as evidenced by recent legislative action. I believe that someone, not the Federal Government, or the states, or AASHO, needs to take an objective look at this Federal-state relationship in motor-vehicle laws to determine what is the proper

and sensible division of effort. Certainly the Uniform Vehicle Code provides a mechanism for effective coordination of the states' efforts where uniformity is needed. But from what I have seen, the promotion for adopting the Uniform Vehicle Code will have to be reoriented to the growing need of using interstate compacts.

If the National Committee is going to be the group that takes the lead in guiding state legislation, it is going to have to assume positive leadership. I say this in the sincere hope that the National Committee will do so, because it is the group which was originally intended to provide the necessary leadership. And, in providing this leadership, the National Committee would benefit greatly by having the whole question of Federal-state relations clarified by an impartial group such as the Highway Research Board.

Another problem which I have noted, concerns maintaining the operational efficiency of our Interstate System. The Achilles heel of this system is the interchange There are varying laws and practices regarding marking and signing these points of conflict, and there are varying rules controlling the movement of traffic on and off the system. Perhaps the ultimate solution of these operational problems will depend upon the development of electronic controls and methods of communication with drivers. But these developments are too far in the future to help now, and we need to study these variations in the traffic and signing rules, and the legal implications that they involve.

Still another problem which I would like to emphasize is vehicle speed. This is a difficult area in which to define research needs, but more research is needed to determine the criteria to be used for governing speed, particularly if we are going to get any uniformity in their application. Local and geographic conditions present problems for uniformity, but their effects are less now than they were 20 years ago.

In the Wisconsin Avenue study a few years ago, and in several similar studies since that time in other states, an attempt was made to examine the legal problems involved in reducing congestion on urban arterial streets. It was found that one of the big problems was mid-block friction, not intersection capacity, as most of us had previously thought. In fact, the study revealed only one intersection which was loaded as we had expected it would be Mid-block friction was the important problem, and the things we recommended in the way of elimination of driveways and control of access, could not be done in the District of Columbia under existing law The District would have had to resort to condemnation or purchase of expensive property to eliminate or even reduce the causes of friction. This experience, I think, reinforces the point Mr. Cheshire made in his comments.

In the laws regulating vehicle sizes and weights, one of the big problems we have and do not really know about, is the practice with respect to special permits for oversize or overweight vehicles. The practices here are extremely irregular. People have made some inventories of the variations that exist in the various states, and these show wide variations from state to state and exceptions within a state. What rule, for example, should apply to the military when it is necessary to move a large missile over the highway? This is an extremely knotty aspect of the size and weight problem

I also want to emphasize the study of future concepts. Being Chairman of the Future Concepts Committee of the Highway Research Board's Department of Urban Transportation Planning, I know that one of the items that will plague

the committee is the legal problem. I think there is a chapter on the legal problem in the Arden House Report, but it is rather negative. It is indicated that one of the reasons we could not have automatic controls or electronic devices in highways was because of the legal problems. This is an area on which the Committee on Future Concepts is going to ask other committees of the Highway Research Board to cooperate with us as we get further along. I cannot give you anything concrete yet, because we have not had time to make evaluations of all the future concepts that have been suggested. This makes it rather difficult for even the engineer or the lawyer, or anybody else to think about specific aspects. But it is something that we will be working on because it deserves considerable attention from many viewpoints if we are ever going to harness modern technology for highway transportation.

I know, as you do, that we have a great many problems confronting us, but it seems to me that it is with respect to these future problems that the Highway Research Board, and this committee, can do a great deal.

ROBERT O. SORNSON, *Manager*
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A number of the items have already been mentioned. Perhaps I can comment on one or two of these from a different standpoint. Part of my job at Chrysler involves working with legislation and regulation pertaining to the automobile.

Generally, our objective in dealing with such regulations is to try to get them started in the terms Mr. Saal referred to a while ago, namely in performance standards, rather than telling the automotive engineers what materials, shapes, and sizes they must use. I think that only when there is freedom for the engineers to design in terms of objectives are we going to achieve the ultimate objective of making better and safer cars. So I would like to emphasize the need for avoiding regulation which limits design and desirability for establishing objective performance standards where regulations are needed.

One of the areas lacking research which I frequently encountered in this field involves studies to prove the necessity for legislation. For example, currently there is a rash in tire legislation being introduced both at the state and the Federal level Up to this time there has been very little research to prove exactly what the problem is in the tire field We do not know whether it is used or worn-out tires that are causing the problem, how big the problem is, or what there may be about new tires that may be causing a problem. The intent of the proposed legislation seems to be to regulate the entire field of tires, without relating or limiting it to any real problem that may be involved. So I think that when motor-vehicle legislation is proposed, there should be a great deal more research to define what the law should accomplish rather than an attempt to sweep all related facets of the problem into a broad statute intended to be a complete cure-all.

Some thoughts have been expressed here about more regulation of the design and construction of the automobile itself. It appears that this might be inevitable since a great many people think they know as much about designing automobiles as the engineers themselves do. I think part of the reason for this is that, politically, the easier way out is to try to place the problem on someone else rather

than to increase taxes for better highways and to enact proper driver controls or court sanctions against errant drivers. It is easier to say that the automobile manufacturer ought to take care of the problem for us by building more nearly crash-proof cars. Unfortunately, it is not quite that easy for the manufacturer. While I'm sure we can anticipate further automotive design improvements, especially in the area of injury-reducing features, it appears obvious that we must also do a better job to improve driver performance and highways, and that all areas should progress simultaneously in a balanced program.

Mention was made of the interstate compacts. As I view the compacts, they are not inconsistent with the Uniform Vehicle Code. Rather, I think, they are an adjunct to the Uniform Vehicle Code, providing a uniform basis for regulation in areas where broad authority is delegated to an administrator. If the compacts are successfully used as intended, they could achieve greater uniformity of administrative regulation than currently exists. This is essentially similar to what the Uniform Vehicle Code is trying to do at the statutory level. Whether it will work out this way or not, I do not know, but I think it is an experiment that is worth trying.

Also, I would like to say a word about the need for more research regarding accidents, and in particular the causes of accidents. In the last few years a great deal of work has been done at Cornell University and elsewhere on the injury-producing factors of accidents. Much of this research has been sponsored by the auto industry and the facts obtained from these studies are being used by manufacturers to improve their products

In the area of accident causation, we do not have a similar level of research at the present time. If we are to develop proper legal controls, it seems to me that we will need a great deal more research to find out what the proper controls are, what alternative remedies are, and whether some of the controls we now have are in fact working to aggravate the problem. I think it is clear that our present laws produce inconsistencies which create the reaction which Dr. Schlesinger described yesterday. For example, on one freeway you may find that the state speed limit is 60 mph and in the next state it is 75 mph. Yet these two freeways are built to basically the same design standards. Why should there be this difference in speed limits? It appears to me that, unless there is a rational basis for such laws and consistency in their application, they tend to produce non-compliance and disregard for the law rather than compliance and respect that traffic laws ought to engender.