(January 17th, 1938)

City Traffic Planning

By MAXWELL HALSEY.

His Honor Lieutenant-Governor Mathews was present at the guest table.

CHAIRMAN T. D'ARCY LEONARD: — Your Honor, Gentlemen, before introducing our guest speaker I desire to refer to the fact that for the first time since his appointment we have with us today the Lieut.-Governor of Ontario. Your Honor, on behalf of the Canadian Club I desire to express the pleasure we have all felt in your appointment, and to extend to you our heartiest congratulations and good wishes.

Our guest speaker today is one of the leading experts on traffic matters in the United States. At Harvard he occupies the position of assistant director of the Bureau of Traffic Research. As you know our traffic problem in Toronto is a very serious one, and one which seems to increase from day to day. We consider ourselves very fortunate in having Mr. Halsey with us today. He is an internationally known expert on traffic problems and has been consulted very widely by cities and organizations. I am sure his advice and assistance will be of great benefit to us in Toronto.

MR. HALSEY:—Your Honor, Mr. President and gentlemen: May I say at the outset how happy I am to be here today and how pleasant have been my previous visits to your city.

Physically there is little difference between the traffic problems of Canada and the United States. In both countries the free wheel transportation system has out-grown its swaddling clothes and, while it still evinces many growing pains, the time is ripe for a critical analysis of the system as a whole. Clear thinking at this stage of development

should produce a recognition of the basic facts and bring about an orderly procedure which should make possible progress far beyond that permitted by the far too common "Growed-like-Topsy" principle.

It must be recognized that there is much more involved in transportation than accidents, which are primarily a symbol of inefficiency, and that the real problem goes right down to the roots of organized society and government.

The following fundamentals of the situation, which are frequently obscured by the mass of detailed complaints, are believed to be particularly significant.

(1) Mobility is a function of organized society: No person can escape moving about, either as a motorist or a pedestrian, in the existence of a normal life. Walking and riding are essential to business or recreation. The inexorableness of this fact makes movement basic to civilization and thus subject to the same separate and distinct fundamental treatment as public health, water supply, sewage disposal, or fire protection.

(2) Recognizing mobility as a function of organized society, society has delegated the responsibility of this to certain units of government: This is the accepted manner in which society acts in an organized way to protect itself and make progress; as, for example, the delegation of responsibility for fire protection and the subsequent establishment of fire departments, or the delegation of responsibility for protection of life and property against crime and the necessary establishment of police departments. In like fashion, society must delegate Traffic Authority to government and similarly establish a special unit to carry out the essential activities. This usually takes such forms as the Federal Bureau of Public Roads, the Motor Carrier Division of the Interstate Commerce Division, State Highway Departments, Highway Patrols, State Traffic Engineering Offices, Motor Vehicle Departments, City Traffic Engineers, Traffic Divisions of Police Departments, or Traffic Commissions.

(3 Having accepted the responsibility of providing a "facility" (for mobility), an inherent part of the responsibility is to provide a facility which is acceptable: Thus, for example, having accepted the responsibility of water supply, government has accepted, as an inherent part of this, the responsibility of providing water which is acceptable; in other words, water which is clean and pure and suitable for drinking purposes. Similarly, government, having accepted the responsibility for providing a traffic facility, must provide one which is acceptable and permits safe and expeditious travel.

(4) The facility (for mobility) is a whole composed of three integral parts—the personnel (the drivers). The rolling stock (the vehicles) and the roadbed (the street and highway): The facility must include the selection, training and control of the personnel, the provision of adequate rolling stock, and the provision of a suitable roadbed. Thus, reduced to its elements the free wheel transportation system has much in common with the rail transportation system, many of the operating principles of which are directly applicable. It is essential that there be a recognition of the fact that any facility for mobility or transportation must be considered as a whole and that each part must be considered in relation to the other parts. Thus, for example, the roadway must be considered in the light of the operators who are going to drive upon it and the vehicles which they will use.

(5) The present facility indicates a severe maladjustment between the three factors or elements, particularly an inability of the roadbed to absorb the potentials of the rolling stock and to compensate for the inherent weaknesses of the personnel. Any maladjustment in factors of mobility makes accidents and congestion or "Traffic Inefficiency" inevitable. Eighty mile cars cannot be operated upon fifteen mile streets and forty mile highways by human beings endowed with a strong desire for mobility without the strain of restraint being too much for human nature to stand. Even in the face of enforcement, which may bring temporary forced adjustment, or educational efforts, which must move slowly and which may never be able to overcome certain basic human desires for mobility, it is believed that human drivers will out-drive the facilities provided for their use, unless these facilities are designed properly for them and their

vehicles, and provide a degree of mobility in keeping with their potentials.

(6) The major portion of the accident situation is not caused by incompetency or malice upon the part of the personnel, but results from the inability of the personnel to make safe adjustments under existing maladjustments. All of the problems of congestion arise from these maladjustments. The desire for mobility cannot be permanently suppressed by law enforcement, nor can people be educated out of their desire, as long as a strong maladjustment or differential exists between the factors. Temporary gains may be made, but, in the long run, human nature and its inherent desires will win out, and accidents and congestion will continue until the system has been properly balanced. While education and enforcement, the free-wheel counterpart of training and control, are essential, permanent improvement and progress can only come from a deeper consideration of the transportation system as a whole and a balancing of the factors. Attention is now directed to the element of the roadbed.

(7) The true function of the roadbed is to carry traffic safely and efficiently and a failure to do this falls short of performing an acceptable service: To blame the natural inherent errors of the personnel for traffic inefficiency, is to have a wrong perspective. The facility is built for the operator with his money and must be of such character as to give him safe and expeditious movement. Even a highly trained railroad engineer would have just as many accidents as the average car operator if the transportation were to provide him with grade crossings every 250 feet, a free choice of numerous lanes (one of which would make possible a head-on collision, and constant interference from both sides). It has been adequately demonstrated that roadbeds, in keeping with the requirements and potentials of the personnel and the rolling stock, can be built. What is needed is merely to extend the principles which have already proven effective.

(8) Operating performance of the roadway is not in the sub-surface structure, but in the super-surface structure. Hardness and width are merely a foundation upon which

to build an operating structure: In the earlier stages of the movement of the free wheel transportation system, the engineers made invaluable contributions through the development of hard surfaces, which literally took the automobile out of the mud. This first battle has been won and the engineer must now turn his attention to the second and equally important problem of, how to mould and design the roadbed from the surface up, so that it will deal with velocity and inherent human weaknesses.

(9) The requirements of this facility must be of such character as to minimize the four basic traffic frictions. These four frictions, in which are involved all of the basic causes of both accidents and congestion, serve to clarify the situation and to provide clues upon which to base a sound engineering approach.

First: Medical Friction — Which takes place between cars moving in opposite directions. This results in head-on collisions and sideswipes, and rear-end collisions, produced by drivers trying to turn back into line, the last minute, in order to avoid a head-on collision.

Second. Marginal Friction—Which occurs along the moving edge of a moving traffic stream. This results in accidents from parked cars and vehicles and pedestrians attempting to get into and out of the moving stream.

Third. Intersectional Friction—Which takes place between cars moving in cross directions. This results in the typical intersection accident.

Fourth. Internal-stream Friction — Which occurs between vehicles moving in the same direction, but at different speeds. This results in accidents due to attempts to pass and rear-end collisions due to those who find it impossible to pass and at the last minute are forced back into the slower line.

(10) The design of the highway should eliminate the necessity for the driver to make critical decisions, or insofar as such elimination cannot take place, should make it impossible for the driver to make an erroneous decision. Furthermore, insofar as this is impossible, the design should provide physical protection to reduce the severity of the consequences of an erroneous decision, or to compensate for

any failure of personnel or rolling stock. Human errors of judgment and analysis cause many accidents and much congestion. The more automatic the highway is and the less judgments are required, the more efficient the facility will be. For example, good design at a crossing should provide a left turn without a conflict; in other words, a right turn at a "Cloverleaf". If it is not possible to provide a grade separation, a wrong decision, such as cutting the corner, should be made impossible through the provision of left turn islands.

A wrong decision of a driver might bring him into contact with a centre post or support under an underpass. This should be eliminated, so that the wrong decision of the operator would not produce the accident. If the center post cannot be eliminated, then it should be provided with a guard-rail so that it is impossible to hit it head-on, and a wrong decision of the operator in getting in the middle of the road would not result in a direct crash, but merely in a slithering off the obstruction back into the correct part of the highway. The typical guard-rail on the outside of curves now provides a like function so that when the operator makes a wrong decision, such as going into the curve too fast, instead of going off the road into a deep ditch and having a serious accident, the results of his wrong decision are reduced by the guard-rail along which he slides until his vehicle is brought under control and is back on the correct part of the highway again.

(11) To accomplish in full the true functions of a completely acceptable facility, a "limited way" is required: A true "limited way" eliminates the four traffic frictions. It is a way on which there is no cross traffic at any point, no direct access to abutting property, a physical division of opposing lanes of traffic, and accelerating and decelerating lanes for entering and leaving. Its design is frequently, but not necessarily, elevated.

(12) Important traffic flow should be concentrated upon "quality roadways" and not dispersed over large numbers of "quantity roadways". When traffic accidents and congestion have increased, there has been a tendency in some localities to reduce the volume by spreading it out and building more roadways or widening existing streets. Such a procedure ignores velocity, and the permanent bottle-neck of the intersection at grade, which can only pass about one-third of the traffic which is brought to it. The creation of more roadways, with the same traffic disease, is not a cure for the traffic problem. The better principle is to concentrate traffic on quality roadways, which have been designed to carry it safely and expeditiously. The actual cost of such a procedure is much less, in terms of the total number of vehicles which can be carried.

Having established a fundamental basis for understanding the traffic problem and its relationship to organized society and to government, attention is now directed to the application of traffic techniques to existing problems. These techniques cannot be applied without careful consideration of the human beings, for whom they are designed.

One of the most fundamental factors in the traffic problem, which has not received sufficient consideration in the past, has to do with the human characteristics of the average motorist and the average pedestrian. In too many instances the traffic administrator is apt to make the quite human mistake of thinking that he is a good "guinea pig", and that any design or system which he understands will be successful when utilized by the average drivers. Generally speaking, traffic plans for the future must be more simple than they are today, if the average motorist or pedestrian is to be expected to utilize them effectively. Most students of the traffic problem have not recognized the fact that the fundamentals of human behavior are far-reaching and produce reactions to every step, which is taken toward improved traffic control. Thus, every remedial measure must be carefully evaluated in the light of these factors, in order that some measure of its final effect and success may be calculated. The following human elements are believed to be the more important among these which have a rather specific relationship to methods affecting the safe and expeditious movement of traffic.

Every human being has a fundamental desire to move rapidly from point "A" to point "B". In fact it is this desire which stimulates him to purchase an automobile. If he were not interested in speed, he could accomplish a certain

amount of mobility through walking, or through the use of the horse-drawn vehicle. This same desire causes the individual driver to regard any form of traffic restriction which reduces his mobility as something which is in the way and which is to be avoided, if it is at all possible. Thus, any restriction on the driver in the interests of safety, which materially reduces his mobility and thus from his point of view inconveniences him, is fighting against a very fundamental desire on his part. Such measures cannot hope for success, as they are too adverse to the basic demand for freedom of movement. This means that any safety measure must also provide facility of movement.

It is a clearly established fact that those in authority cannot restrain or alter human behavior beyond a certain point—usually at a level established, by selling the individual and society upon the necessity for such restraint. This means that the engineer and the enforcement official cannot merely upon the basis of facts and analyses come to a conclusion, that certain actions would reduce accidents, and therefore apply them. For example, a mere increase in the number of arrests for traffic violations may temporarily decrease the number of violations, and therefore the number of accidents. However, unless the individual and the public have been sold to the point, where they realize that this additional restraint is necessary, a strong public reaction will set in, which almost inevitably results in so much pressure being applied against public officials, that the net result is fewer arrests than previously. If the engineer produces a by-pass around a particularly dangerous spot, the necessity for this inconvenience must be established, if it is to remain and be effective. This means that it is vital for any program to be sold to the public.

Much may be learned from the known fact that the shortest distance between two points is a straight line. The motorist is entirely aware of this fact and will usually automatically select such a path in his movement. This produces a reluctance to turn from a straight line, and this principle must be kept clearly in mind in designing roadways and lateral control. For example, curves on roadways and large open squares or plazas, must be provided with distinct lines and channelizing islands, to prevent the motorist from selecting a straight path or short cut, in every individual case. Wide open squares or plazas which permit numerous choices of movement by the operator will inevitably result in a multitude of non-coordinated movements with each operator expressing his idea of the shortest distance between two points. This means that all changes from a straight line require very special design treatment.

Almost all motorists are lazy to a certain extent. This markedly affects their behavior on the highway, and it is almost impossible to get them to go against this feeling. For example, any road with a high crown will inevitably cause the individual motorist to drive upon top of it for the simple reason, that it is less comfortable and requires more effort in steering, for him to drive on the right hand side of the road. Likewise, a mere paint line will not result in the motorist making a circuit, which to him may seem to require a lot of unnecessary effort on his part. This means that "design" should make the right driving act the easiest.

It must be remembered that solutions deal with average judgments of average drivers. Far too frequently the traffic professional creates design or systems which appear simple enough to him from his point of view, because he is so familiar with them, but which are far too complex for the average driver to understand, under operating conditions. thus indicating a failure to understand human nature. All control methods must be designed that hazards, if any, are apparent and that the average driver with average judgment not only can, but will handle his vehicle safely. This means that the engineer should not use himself as a "guinea pig", but should study the average motorist.

The average motorist is reluctant to accelerate and decelerate any more frequently than is absolutely necessary. Any system which requires a large amount of slowing, stopping, and accelerating will not prove effective. Furthermore, with a constant highway speed of 40 or 50 miles per hour the human system becomes "velociated" and finds its reaction to slowing down "numbed". Thus, a reduction in speed from 50 miles per hour to 35 miles per hour gives the motorist an illusion of actually driving at 20 miles per hour. Hence, provision must be made for the transition from highway speeds to city street speeds. Records indicate that in

many cases speeds are more out of line in the transition area where highways enter residential districts. This means that the engineer should design for constant speeds or at least for "Zones" of constant speeds.

Motorists traveling at high speeds will not drive close to any vertical curve, abutment, wall, or other fixed objects, but will sheer away from it a distance of two or three feet. If there are fixed objects on both sides, the motorist indicates a marked tendency to reduce his speed because he feels shut in. This means that adequate optical clearance must be provided, if the direction of movement of the vehicle is not to be changed.

The motorist has a strong feeling of self-sufficiency, power, arrogance, and a belief that everyone should get out of his way the minute that he finds himself behind the wheel of a powerful fast car with great acceleration and deceleration. This is quite parallel to the same feeling which an individual has when he wears a badge, a uniform, or when he is given strong authority. This means that the motorist is very likely to express this feeling through higher speeds and through a desire to pass at the slightest possible excuse or opportunity. Thus, those in the traffic field should try whenever possible to avoid presenting the motorist with circumstances where too much restraint is required for safe operation.

The average motorist has too many other things upon his mind besides driving to warrant making it safe to present him with complicated traffic situations. There is a very strong demand, therefore, for increased simplicity of design and control so that the motorist is not called upon to solve innumerable problems as he drives along the highway. Non-standard signs, markedly different operating requirements, and different problems at each intersection of a complex nature will prove too much for the average individual. It must be recognized that there is a considerable difference between what the individual is capable of doing, if everything else is taken off his mind and he is doing a specific task, and what he may be expected to do under normal operating conditions. Thus, if we are to obtain success in control measures to any considerable extent, the burden of causing changes in movement, must be placed upon design

and mechanical control, and not too much upon the ability of the human mind along the line of Sherlock Holmes, in being required to ferret out the answer to complex traffic situations.

The limitation on reaction time, eye-hand coordination must be recognized. Design must take these into consideration and must provide roadways and vehicles within the reach of limited physical powers. Thus, for example, the approach to an intersection must be provided with adequate signs, markings, and signals which will register upon the human mind a sufficient distance in advance to make it possible for the average driver to decide upon changes in operating movements which are required for safety at each particular point.

A lateral movement of any motorist upon the highway is affected by the line of curbing, edge of pavement, painted lines, guard rails, or any physical structure. This tendency of the motorist to direct his path in accordance with optical lines is exceedingly important. Unfortunately, there have been many cases where the motorist has been led into trouble through the inadvertent appearance of the elements described above in such a way as to cause the motorist to select the wrong direction. This is especially true at night and under conditions of fog, rain, and snow when visibility is reduced. This means that all optical lines within the right-of way must be carefully studied.

With numerous things upon the driver's mind we should not anticipate his applying his full intelligence to mechanical control or to reading speedometers. The speedometer is in the same position as the sign and must be of such a nature as to "Talk" to the operator, instead of having to be read, if it is to be effective. This means that special emphasis must be placed upon simplicity and clarity.

The average person resents complications. He is unable to understand his insurance policy, his income tax blank and finds the traffic regulations just as complicated. And of all regulations the one which seems to him the most nebulous is the "Prima Facie Speed Law". Faced by a barrage of "Reasonable and Proper". "Having Due Regard for the Safety of Others", "At All Times Having his Car under Control", and upon the application of which his opinion

would probably differ from that of any other "individual", he draws his own conclusions, and is surprised when the officer does not agree with him. He goes out on the street or highway and sees a few signs—and then he is further confused because they do not seem to fit conditions. Thus it is not much help for the officer to inquire of the so-called violator whether or not he knows the law, or for the engineer to rely upon the statutes in working out his design.

Until the laws are simplified and each sign installed after an engineering study and actually notify the motorist of the safe speed and that above which he will be arrested, officers of the law will have a difficult time. Until then the only process which will be effective will be a carefully worked out administrative and interpretative policy on the part of enforcement agencies.

Human beings are creatures of habit and this is reflected in their driving. Most people drive from point "A" to point "B" in the straightest way possible or follow a route shown them by some friend, even though this may not be the quickest or safest way to go. This means that if any change is made which requires a different route, (such as making a street one-way), special notice is required to break this habit. Similarly, if a new roadway is created or a new one constructed which would permit better routing this fact must be advertised to the motoring public or the old habits will prevail and the new facility will not prove to be a maximum utility.

This will be especially true of commercial drivers who have deliveries to make. Naturally they are surprised and will resent anything which changes their habits. Incidentally, their job does require them to park and take merchandise into stores and if they do not they will get fired and this means that if they cannot park at the curb they will double park, and thus the answer to commercial double parking is not its prohibition but the enforcement of "Loading Zones" to provide a place for such industrial activity, and the provision of off-street parking facilities for passenger cars and loading facilities within buildings.

Most drivers are apt to determine the speed at which they will operate by how much noise the car makes and how rough the ride is—instead of looking at their speedometer

and keeping their speed within that range, safe under each set of traffic and roadway conditions. This is a carry-over from the days of the model "T" Ford when at high speed the engine vibrated, the car rattled, the wind whistled, and every small bump jarred the operator. Thus, whenever a roadway surface is made smoother, high speeds must be anticipated; the officer must increase his enforcement until speed is under control, and the engineer must increase his caution signs, traffic signals and improve his "safety design" to match the change which will take place quite naturally.

Human reactions to changes in design and control. Every time a change is contemplated, considerable thought should be given to what the reactions of the motorist will be. The following examples will serve to explain this point.

(1) Smoother pavements will encourage higher speeds. Thus, when a rough pavement is made smooth, control provision must be made for high speeds which should be anticipated and which did not obtain before.

(2) The installation of a traffic signal at one corner may result in the motorists electing to detour a block to the right or left in order to avoid the signal. In this case care must be taken to see that the alternate routes are protected for a new fast movement which may result. This means that when any change is made, all of the possible changes in vehicle operation must be carefully studied.

From this very brief analysis it should be quite clear that all traffic control measures must be worked out in terms of their effect upon human nature as it exists today. Attention may now be directed toward a development of remedial measures.

Any consideration of the subject of designing of safety and facility had best begin by a discussion of the attitude or philosophy of the engineer. Having provided smooth, flat surfaces with more gradual curves and hills, many engineers quite naturally felt that they had provided the motorist with an opportunity to fully utilize the potential of his motor vehicle. The primary effect, however, was to encourage higher speeds without the same degree of safety which was obtained before. The mere provision of nice concrete slabs on which the motorist was invited to do his

worst was obviously not the solution of the problem. Quite a few engineers were inclined to view the speed question as simply a matter of enforcement. They could hardly be blamed at that time for not seeing that the law represents what the people want, and the motorist wants faster cars and better roadways and will always be very reluctant to be legislated or enforced out of them.

Thus, a point has been reached where one of our greatest difficulties is the vast difference between the potential safe speed of the rolling stock, (the automobile), and the road bed, (the highway). Common sense dictates that with modern cars capable of safe sustained speeds of 60 miles per hour trying to operate over city streets with average safe speeds of 15 to 20 miles per hour or over highways with average safe speeds of 35 to 40 miles per hour, accident increases were inevitable. It is thus obvious that the engineer must take the stand that it is the duty of design to provide a safe operating roadbed with potential safe speeds in keeping with those that can be obtained by the modern automobile. In this approach, the engineer may take a leaf from the experience in industry. The industrial engineer soon found in factories, that if a moving belt created an opportunity for a laborer to get his sleeve caught, the only sure answer was not through cautioning him, but through placing guards around the moving belt and making such accident impossible. Briefly, the main functions of safe and fluid design are as follows:

(1) To make possible safe operating speeds in keeping with current demands.

(2) To encourage the motorist through design to operate his car in a safe manner.

(3) To make impossible certain improper driving practices.

(4) To channelize traffic movement through physical barriers. It is quite apparent that modern design is rapidly moving toward physical channelization and that, in a certain sense, the intersection of the future will have some of the characteristics of the slot machine, in that the automobile will be forced to move in the correct direction. The roadway

of the future will be so designed, that it will take an idiot or a genius to have an accident.

At this point Mr. Halsey showed a number of lantern slides, illustrating methods of control which have been adopted in the United States and added:

In conclusion I would like to take just one more minute to tell you that, before we can arrive at a final solution of the traffic problem, we must have extensive research, by trained men. We have therefore set up at Harvard a training progarm for men in the field of traffic engineering. There are fifteen fellowships, and last year we picked one man from Canada, and the year before one man from England. We have our difficulties in making a choice. We had over a thousand applications and, if you want a job, just try, as we did, to pick fifteen men from that number.