Outline of talk before a group of Reserve Officers engaged in research work in various fields. The Pentagon, Arlington, Virginia. Sept. 12, 1950.

HIGHWAY TRANSPORT

If the two words trip off the tongue as one it is because of their long association.

As long as there has been a modern highway improvement program, that long and longer has there been a more or less organized program of study of the means to make highways better and highway transport more serviceable.

Indeed, the devising of better ways of road building goes back much farther than the modern period; and the names of the earlier road builders that are now remembered are those of the few who, unwilling to follow accustomed ways reasoned out what they believed to be better methods.

The Frenchman - Pierre Marie Tresaguet (1716-179(first to proclaim the need of constant maintenance and first to build a crowned foundation - the developer of the methods which Napoleon put into effect to build and preserve the French road system.

The Englishman - Thomas Telford (1757-1834) introduced into England methods similar to those of Tresaguet in France, relying on the firmness of a large stone foundation carefully laid and keyed with smaller stones (foundation stones 10 x 6 x 4 inches) to support the broken stone surface layer (Approx. 10 inches).

The Scotchman John Louden MacAdam (1756-1836). First to state the principle that the earth subgrade must support the traffic load, he abandoned the paved foundation and relied on a compact layer broken stone to waterproof the earth support and take the wear of traffic.

His name survives in our word macadam which we use to describe a type of road essentially different from those which MacAdam built.

MacAdam's theory failed to take account of an important force - the force of capillarity.

The Romans knew how to build roads that would outlast the ages.

They built them of 4 massive courses from 3-1/2 to 5 feet thick overall.

The Appian Way remains today a Monument of Antiqu which no modern road builder can use as a pattern because of its great costliness. Only the fiat and power of a modern Caesar could set aside the laws of economics that make the Roman methods impractical in our day.

Hitler might have done it. Stalin doesn't seem to understand the need for roads.

All efforts of modern roadbuilders, beginning with Tresaguet have been directed to the finding of means to obtain Roman stability at a cost consistent with the economic system of the modern world.

Eli Whitney Blake (1795-1886) inventor of the Stone Crusher (1858). First used in Central Park to crush stone for concrete. First used to produce road metal by Hartford, Conn. (1859.)

Steam Road Roller - invented by Louis Lemoine of France (1859) and first used in Bois de Boulogne (1860). First English patent to Clark and Bathe (1863). First used in U. S. in the U.S.Arsenal grounds, Philadelphia (1869).

These two machines - the product of individual inventors like most of the advances since made in the provision of mechanical means of road construction.

Modern production studies suggest the needs of invention.

The great driving force of the modern road movement - New Vehicles - bicycle, automobile, truck.

Bicycle which started it, bringing about practically simultaneous creation of first State Highway Department (New Jersey, 1891) and first Federal Agency (Office of Road Inquiry, 1893). Both in their origin essentially research and promotional agencies.

The latter the forerunner of Bureau of Public Roads which was only 17 years old when I entered its service of research and education.

Small wonder that to me the words Highway and research have always seemed inseparable - like the little Southern girl who didn't know until she grew up and went up North to college that Damyankee was two words.

Those were days when most thought and study was devoted to the development of ways of making better road surfaces.

In the South - how to overcome the wheel-miring proclivities of southern red clay. The sand-clay road first extensively built by S. H. Owens, Superintendent of Road Construction, Richland County, S. C. Developed by Spoon and others of Public Roads.

Burnt clay roads in Louisiana.

In the North - how to lay dust raised from the waterbound macadam surfaces by automobiles.

Molasses road in Dept. of Agriculture ground. Waste sulphide liquor from pulp mills. Typical of other proposals for use of surplus and waste products they come to nothing - Vide cotton reinforcement in bituminous surfaces; will rubber in asphalt be another?

Other early research.

Determination of the road building qualities of various rocks - devising of methods of testing Page Impact Machine, by Logan Waller Page, Director of OPR - student of Shaler.

Bituminous materials and methods of testing - Prevost Hubbard.

Cement and Concrete - A. T. Goldbeck, F. H. Jackson (now President Amer. Conc. Inst.)

Surface wear; expansion and contraction of Concrete

Experimental Roads - Connecticut Avenue. Learned some lessons we didn't need - such as joints in Concrete

Two highly productive lines of research the result of damage to roads by trucks in World War I

Soils - begun by BPR in 1919 - Developments,

Classification.

Correction - Terzaghi - Hogentogler

Effects of Trucks - Bates Road - Arlington (where Pentagon now stands)

Bates Road Tests in detail - Fatigue

Arlington Impact Tests - Effects on tire industry.

Public Roads strain measurements (stress). Conjunction of load and warping stresses found critical.

These tests the basis of concrete road design, which carried loads without serious damage until the second War.

18,000 pound loads less than 8 per thousand prior to 1930 - in 1949, 86 per thousand. Traffic volume increased 3 times, hence 30-time increase in excessive loads, a cause of much of the damage now evident.

Pumping

Necessary to redemonstrate - Maryland Road Test.

Maryland Road Test as example of cooperation.

Highway Research Board coordination - Board organized in 1920. Functions.

Industry cooperation in Maryland test follows previous instances in impact, hill-climbing and brake tests.

Effects of wheel loads and group axle loads on roads and bridges - tandem axles.

Necessity for length - Public resistance and its faulty reasons.

Same relation between length of vehicles and curvature of several classes of vehicles.

Effect of length on passing

Gross load limits illogical.

Economic Study (cooperation again) Describe.

Is truck now driving force to change of road design?

Genesis of traffic research - Personal experience -
Taft. Early counts as incident of physical study.
But taught more - idea of systems.

Origin of State systems - Federal Aid System.
Personal connection - Trials of size of system - 7%
Latter an early instance of way in which research
has influenced Federal legislation.

State traffic surveys developed principle of traffic
distribution and growth - during period of 1920's
Also period of most rapid growth of improved
roads in restricted systems.

Hayden-Cartwright Act - 1934 - 1½ % funds - origin and need.

Highway Planning Surveys - Character.

Early use in Toll Roads and Free Roads - another instance of effect on legislation.

300 vehicles per day transcontinental.

Highway Capacity Studies in aid of Planning Survey -

indicative of design significance of traffic volum

Passing - Transverse distribution - Speed

Effect of Sight Distance

Lateral obstructions - Effect on lane width

Lane width - effect on Capacity

Studies of hill-climbing ability and Braking - Cooperat

Interregional Highways - First use of all studies in legislation.

Suggestions regarding cities - bypassing vs. throu routes.

Bypassing city center.

Expressways - Uses of capacity studies - Capacity

compared with street 8 to 1 Mixing lanes, Ramps, etc.

Parking - Where - How - Turrage

Opposite Tendencies now evident

Concentration on major highway vs. Extensive improvement of local roads - Another use of research data in Local Road Report.

Re-emergence of toll highways - Cause antipathy to be

Major problems now main economic, financial, administrative.

Local withdrawal with increase of aids.

Planning surveys teach road system must be dealt with as balanced whole - This idea conflicts with idea of "my road first".

Further highway program depends on answers to those policy questions.

Highway Needs Studies - Synthesis of planning surveys

45% of system wearing out in 10 years.

Continuing Program over 4 Billion a year.