U.S. DEPARTMENT OF AGRICULTURE

BUREAU OF PUBLIC ROADS

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NOT OILED—WHAT OIL DOES FOR EARTH ROADS—OILED

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U. S. DEPARTMENT OF AGRICULTURE

BUREAU OF PUBLIC ROADS

PUBLIC ROADS

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REINFORCED CONCRETE SLAB BRIDGE DESIGN BASED ON FULL SIZED TESTS

By A. T. GOLDBECK, Engineer of Tests, Bureau of Public Roads.

THE past winter has witnessed the failure of many types of road surfaces due to the extremely heavy truck loads they have had to carry. Such loads, except for the occasional traction engine and roller, were unheard of when these roads were built, and adequate provision for them was not made in their design. Highway bridges in general have fared somewhat better than the road surfacing, but when we see the inadequacy of the roads to carry heavy loads we should not be surprised at the very natural queries, "What about the bridges?" "How long will they continue to carry these increasingly heavy loads, and what is the greatest load they can safely carry in the future?" The present discussion will treat of a particular phase of these questions, that dealing with reinforced concrete slab bridges.

The ability of wide, thin slabs to support heavy concentrated loads, and the proper procedure in their design were matters of great uncertainty up to a few years ago, when several laboratories almost simultaneously investigated the subject. Now, however, sufficient tests on full size slabs are available to permit reliable calculations being made. Many tests have been carried on by the Bureau of Public Roads, by the University of Illinois, and the Ohio State University, to investigate how to design a slab subjected to concentrated loads. Some of these tests will be described briefly, and practical rules for applying results will be given.

AIM OF TESTS.

A thin, flat slab when loaded with a concentrated load differs from a narrow beam in that only part of the slab width is effective in carrying the load, whereas the entire width of a narrow beam is brought uniformly into play. The thin, wide slab with a load applied at its center is stressed most where the load is placed, and the stress decreases to each side and vanishes if the slab is very wide, in a curve as shown in figure 1. Narrow rectangular beam theory has been well established, and the data obtained in the tests of wide slabs was readily applied to this theory for the formulation of a suitable basis upon which to design wide slabs.

HOW THE SLABS WERE INVESTIGATED.

In all of the slab tests at the Bureau of Public Roads the method of procedure was to apply known concentrated loads on the slab specimens which rested on two supports. The deformation of the steel reinforcing and concrete, and also the deflection were measured. These deformations or changes in length in the slab were always taken at the "dangerous section," where they were greatest. In a few cases, deformations were also measured over the entire area of the slab. A strain gauge capable of measuring changes of 0.0002 of an inch was used in all of the tests, and in addition, the vertical deflections of the slab were obtained, generally by means of a micrometer head reading to 0.001 of an inch.

DATA ON SLAB TESTS.

Slab No.	Dimensions.		Depth.		Steel percentage.		Central load, effective width ÷ span.	Failure.	
	Span.	Breadth.	Total.	Effective.	Longitudinal.	Transverse.		Span.	Central load
	Feet.	*Feet.*	*Feet.*	*Feet.*					
679	11.5	6	7	6	0.77	.....	.....	11.5	21,500
705	6	7	5	4	.91	.....	0.9	.....	.....
706	3	7	5	4	.91	0.41	.....	3	42,800
730	5	7	6	5	.91	.....	1.1	6	24,700
	6	.....	.....	.....	.....	.....	.96	.....	.....
736	6	7	4	3	.60	.....	.....	6	7,560
737	5	7	7	6	.75	.33	1.2	6	34,200
	6	.....	.....	.....	.....	.....	1.2	.....	.....
835	16	32	12	10½	.75	.....	(1)	16	119,000
930	16	32	10	8½	.75	.....	(1)	16	80,000
934	16	32	7	6	.75	.....	(1)	16	40,000

[1] See next table.

EFFECTIVE WIDTHS UNDER CENTRAL LOADS.

Center load.	Slab 835: 10½ inches effective depth.	Slab 930: 8½ inches effective depth.	Slab 934: 6 inches effective depth.
15,000	.....	11′.4=71.6 per cent span.	12′.7=79.5 per cent span.
20,000	11′.6=72.3 per cent span.	13′.0=81.2 per cent span.	17′.5=109.3 per cent span.
25,000	11′.5=71.9 per cent span.	12′.9=81.1 per cent span.	.....
32,500	12′.1=75.7 per cent span.	.....	.....
35,000	.....	14′.5=90.7 per cent span.	.....
Failure	119,000 pounds.	80,000 pounds.	40,000 pounds.

THEORY USED FOR APPLYING RESULTS.

Consider first a wide slab supporting a single load concentrated at its center. Measurements of deformation show that the load deforms the central part of the slab as shown in the curve in figure 1. The maximum deformation occurs under the load, and as the sides of the slab are approached the deformation becomes smaller.

This curve of deformation is the same in shape for both the steel and concrete. A little thought will show that the resisting moment of any slab is directly proportional to the area of the curve of unit deformation. Two similar slabs stressed to have the same area of unit deformation, even though their unit deformation curves are dissimilar in shape, exert equal resisting moments. Suppose one slab is

stressed as in curve JHF, and the other as in rectangle BIGD, and both have the same area and the same maximum ordinate CH. A slab of width BD stressed constantly throughout its width is then equal in strength to a similar slab stressed as in the curve by a single load at its center. The width BD is commonly called the "effective width" of the slab and this is the width of the slab which may be considered as carrying the entire concentrated load. When the value for this width as determined by test is substituted in the common formulas for narrow rectangular beams, these formulas may be directly applied to the design of wide slabs.

A number of slabs have been tested as outlined above, and their effective widths have been obtained from the deformation curves, first, by getting the areas included between these curves and their base lines, then dividing these areas by their maximum ordinates. When the load is placed in the centers of the slab and the width of the slab is more than about twice the span length, the effective width may be considered as equal to seven-tenths of the span length of the slab.

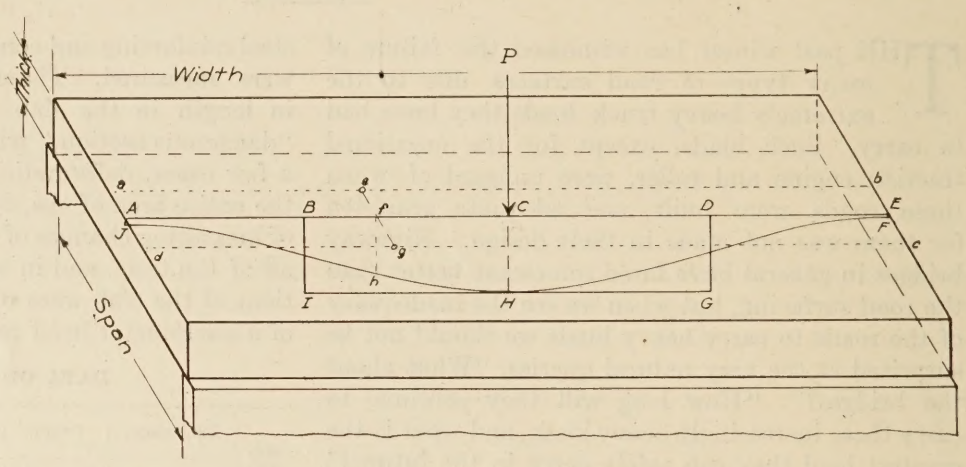


FIG. 1.

Typical deformation curves in the concrete at the center line midway between the supports are shown in figure 2. In this particular slab the total width was 32 feet and the span was 16 feet, or the width was equal to twice the span. The features to be noticed about these curves are (*a*) the large ordinate under the load; (*b*) the gradual decrease in deformation to practically zero at the sides. A number of slabs have been tested with a central load and having widths equal to twice their span lengths, and the table on page 3 gives data on the slabs tested at the Bureau of Public Roads during the past five years.

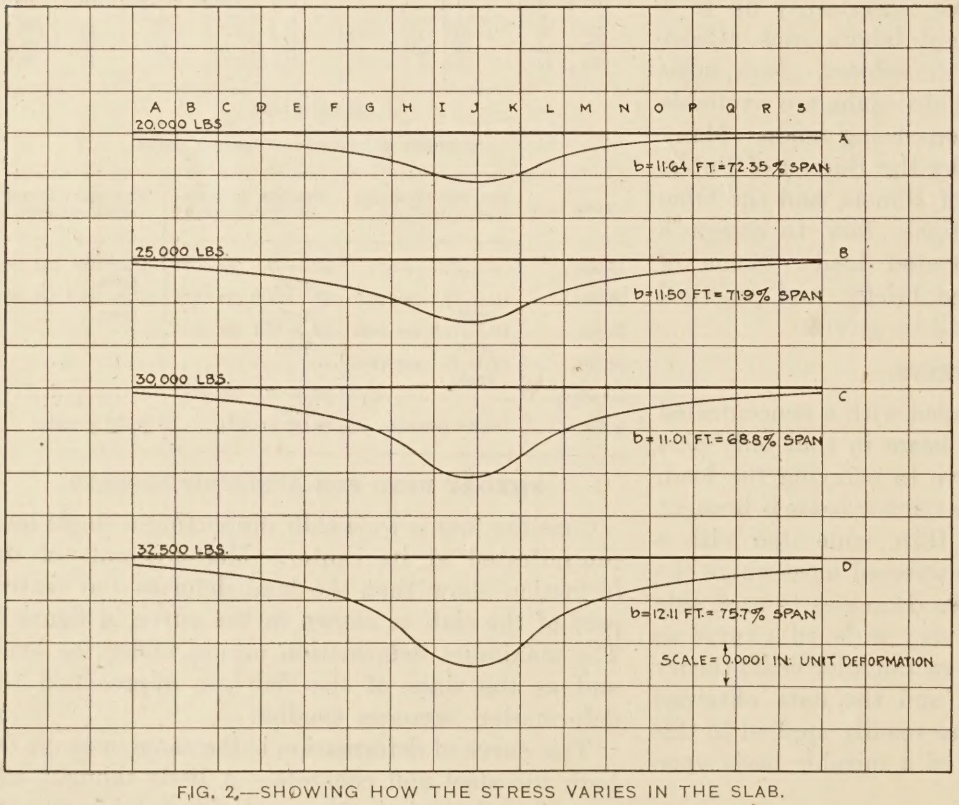
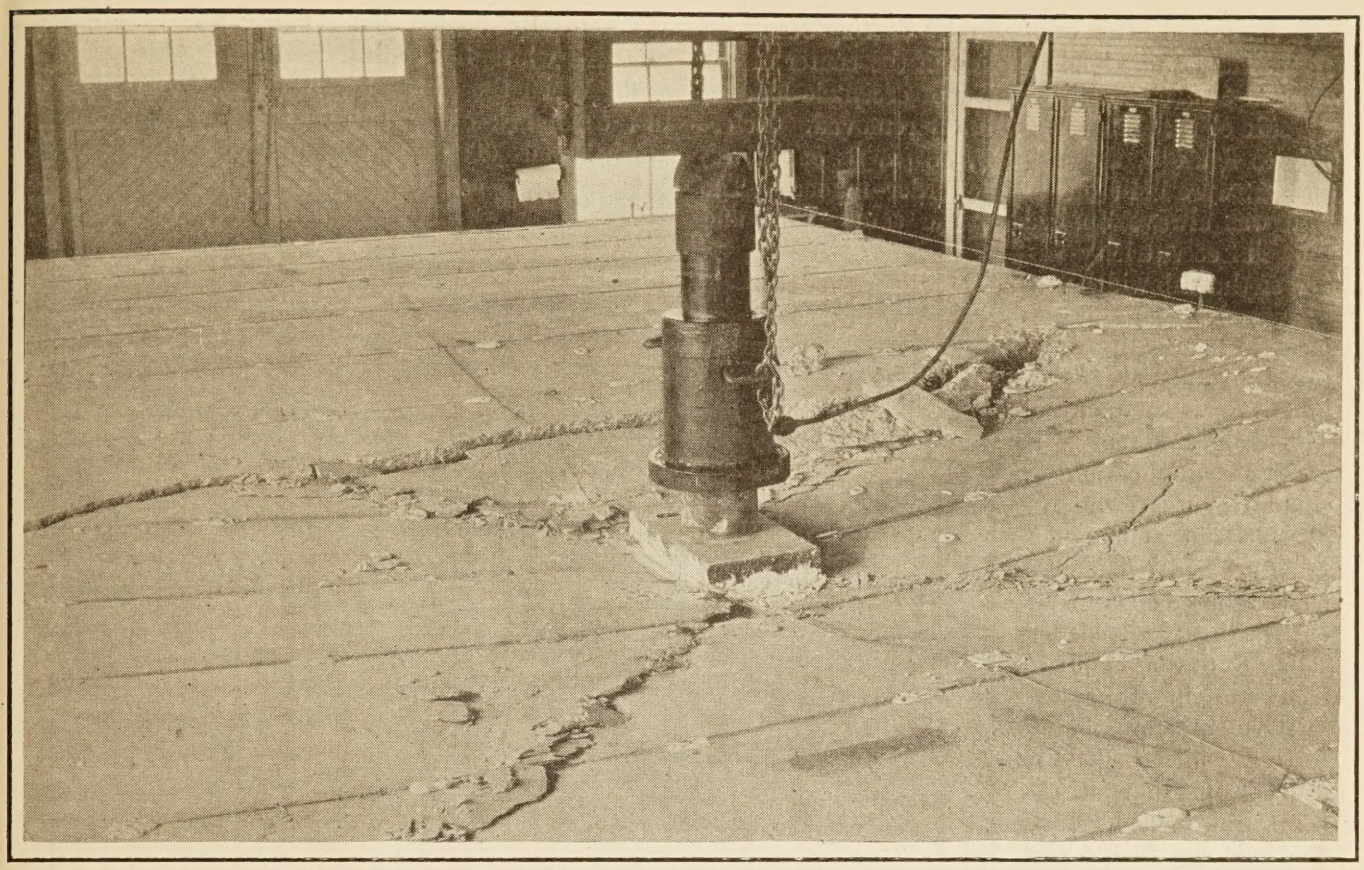


FIG. 2.—SHOWING HOW THE STRESS VARIES IN THE SLAB.

SLABS HAVING WIDTHS LESS THAN TWICE THEIR SPAN.

The foregoing discussion treats of slabs having widths equal to twice the span length, in which case the sides of the slabs are not stressed appreciably. When the width is less than this, however, stress does reach the sides, and the narrower the slab, the more are the sides put under stress as seen in figure 3. It will be recognized that the width of the slab plays an important part in influencing the effective width. The amount of this influence has been quite fully investigated by a number of slab tests, in which the width of the specimen has been decreased after each load application, the sides of the slab having been split off by means of plugs and feathers. It has been possible to obtain the follow-



A 16′ × 32′ SLAB SPECIMEN AFTER FAILURE.

ing values for effective width from these investigations.

Table I (plotted in figure 4).

TOTAL WIDTH÷SPAN.	EFFECTIVE WIDTH÷SPAN.
0.1	0.1
0.2	0.2
0.3	0.28
0.4	0.37
0.5	0.44
0.6	0.50
0.7	0.55
0.8	0.58
0.9	0.62
1.0	0.65
1.1	0.67
1.2	0.68
1.3	0.70
1.4	0.71
1.5	0.72
1.6	0.72
1.7	0.72
1.8	0.72
1.9	0.72
2.0	0.72

The above values may be used for spans up to 16 feet at least, and probably for longer spans.

TWO LOADS ON THE SLAB (*Fig. 5*).

When the span is such that a single axle load will control the maximum bending moment, the slab is subjected to two wheel concentrations, and the most dangerous condition exists when these wheels are midway between the supports. In order to investigate this condition, tests were made on slabs with two loads spaced 5 feet apart on the center line of the slab. Note the fact that directly under the load the deformations are greatest, and are even slightly greater than the deformation at the center of the slab. This stress distribution does not hold, however, for every thickness of slab, for a few of the tests show the deformation to be greatest at the center. The effective widths of slabs loaded in this way may, in general, be assumed as equal to the effective width due to a single load plus 4 feet.

ECCENTRIC LOADS.

When a heavy load traverses a slab bridge it may not remain at the center line but may travel over the bridge near one side. Again there are often occasions when a heavy traction engine will stop at the side of a bridge spanning a stream, in order to replenish its supply of water. On such occasions heavy load concentrations are supported on the side of the bridge as eccentric loads, and this is a much more severe condition than that of the centrally applied load.

For the investigation of this case a slab specimen 16 feet in span, 32 feet in width and 13 inches effective depth was made up. The original width

was decreased after each test by cutting strips off of one side. The loads applied in the center of the original 32-foot width became an eccentric load as the side of the slab was gradually removed. Referring to figure 6, the strips *ij, hi, gh, fg, ab, bc, cd,* and *de,* were split off in the order named. The load was always applied to the same spot, and thus its eccentricity varied as the slab width was decreased. Without going into the details of the test, the results are shown in the curve in figure 6. The dash line curve is merely a duplication of that in figure 4, and applies to wide slabs under a central load. The solid curve is based on the tests of the eccentrically loaded slab. Note that about 10 feet were spilt off the sides of the slab before the effective width began to differ from that of the centrally loaded slab. The load was then 6 feet from the side of the slab, and when its distance to the side became less than this, the effective width became much less than that of the same slab centrally loaded. This is shown by the deviation of the solid line from the dash line. The dotted line is plotted to represent the effective width of an eccentrically loaded slab with values for this effective width assumed to be equal to $\frac{b_c}{2}+D$

Where

b_c = the effective width of the slab under central load. D = distance of load to nearest side of slab.

This curve follows the curve of test results very closely and it may be quite safely stated as a general proposition that when a slab is eccentrically loaded, the effective width to be used in design may be calculated in the following manner:

(1) When the distance of the load from the nearest side is more than half of the effective width of the centrally loaded slab (Table No. 1) use the effective width for central loads.

(2) When the distance of the load from the side of the slab is less than half the effective width under central loads (Table 1) the effective width is to be taken equal to $\frac{b_c}{2}+D$. In order to make a slab bridge eccentrically loaded equal in strength to one centrally loaded, it will be necessary to supply extra strength at the sides by means of a parapet wall, and the following procedure for the design will give safe results.

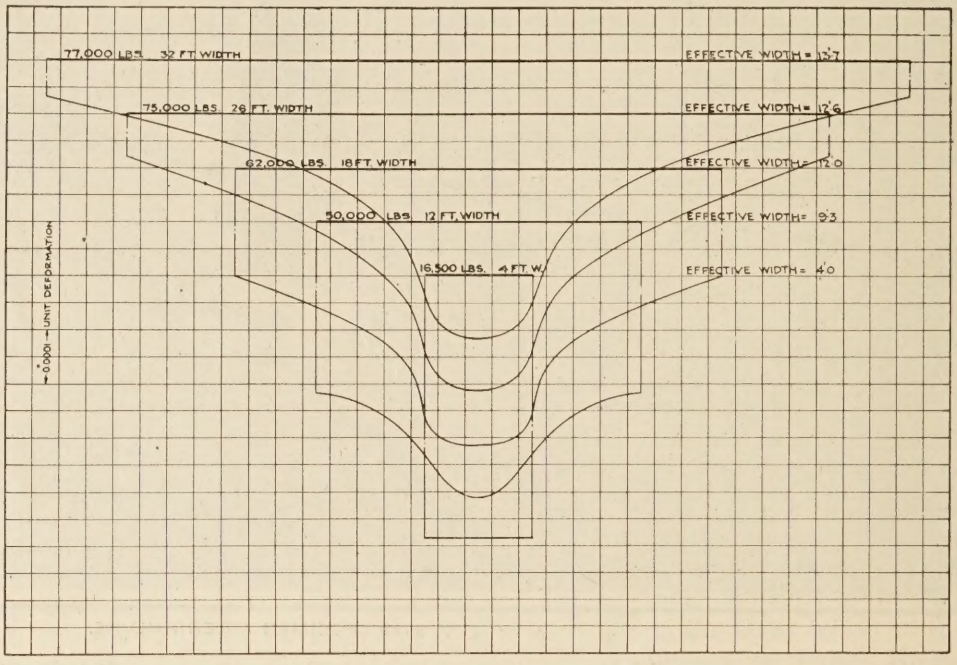


FIG. 3.—HOW THE WIDTH OF SLAB AFFECTS THE STRESS DISTRIBUTION.

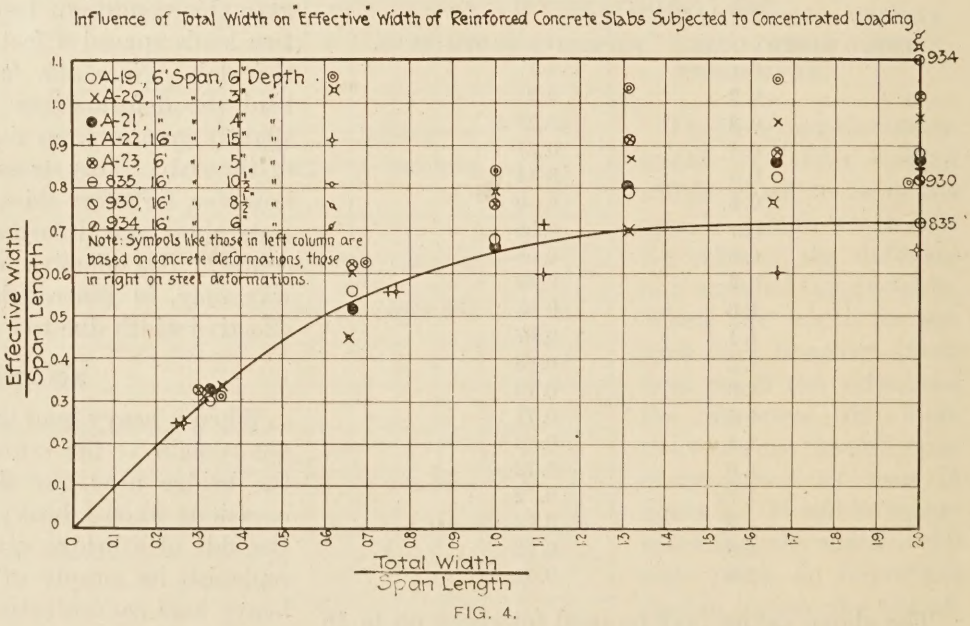


FIG. 4.

(1) Use the formulas for narrow rectangular beams substituting for the breadth b the value obtained from Table 1, (2) determine the loss in effective width due to the assumed eccentricity of the load, (3) supply the deficiency by designing the curb of the parapet to provide a resisting moment equal to that of the slab width lost due to eccentricity. Allowance will have to be made, however, for the stiffness of the section under the parapet. An unfinished test thus far indicates that this method of design is safe at least.

To illustrate the above method. Assume the slab 16 feet in span length and 20 feet in width, designed to carry a concentrated load to be applied 3 feet from one edge, then the

$$\frac{\text{Total width}}{\text{span}} = \frac{20}{16} = 1.25.$$

From the table for central concentrated loading (Table 1), the effective width $= 0.69 \times 16' = 11.04$ feet $= b_c$. Consider the load to be carried by a width of 11.04 feet, use the ordinary formulas for rectangular beam design, and determine the effective depth of the slab and the area of the steel required. Next determine, by the relation indicated above, the effective width with the load placed 3 feet from the side.

$b_e = \frac{11.04}{2} + 3$ feet $= 8.52$ feet = effective width for eccentric load.

The difference between the values of b_c and b_e is $11.04 - 8.52 = 2.52$ feet. The curb of the parapet should, therefore, be designed so that it will have a resisting moment equal to that of a slab of width 2.52 feet.

Although there are several other conditions which may arise in the investigation of bridge slabs, the few above considered are most important, as they generally control the design.

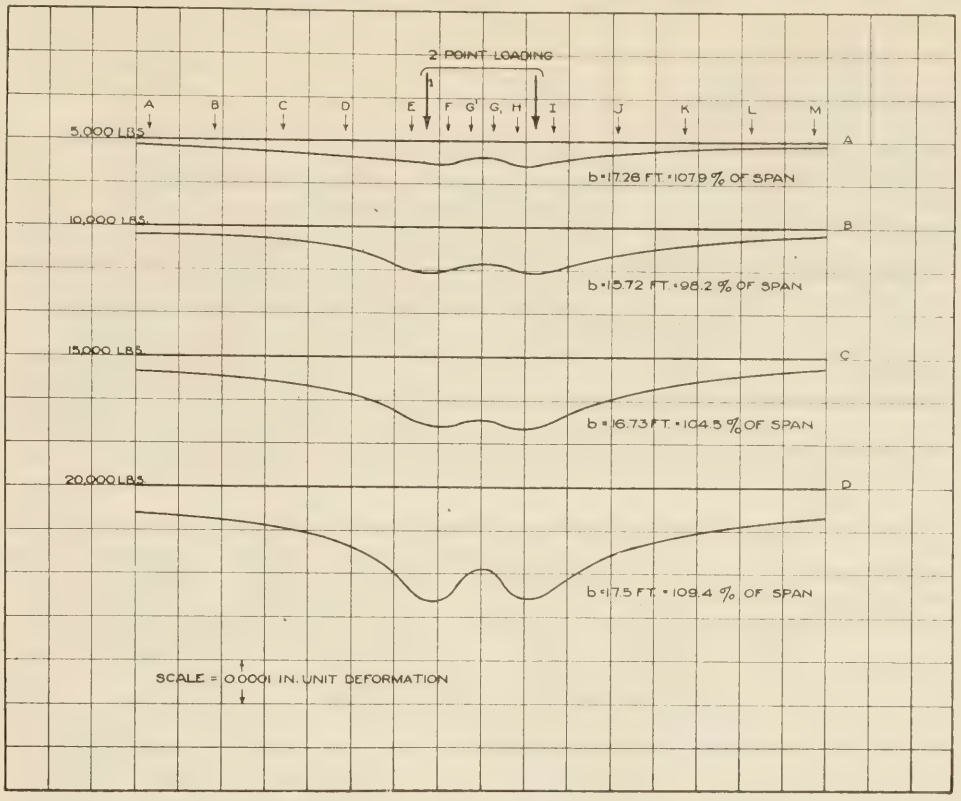
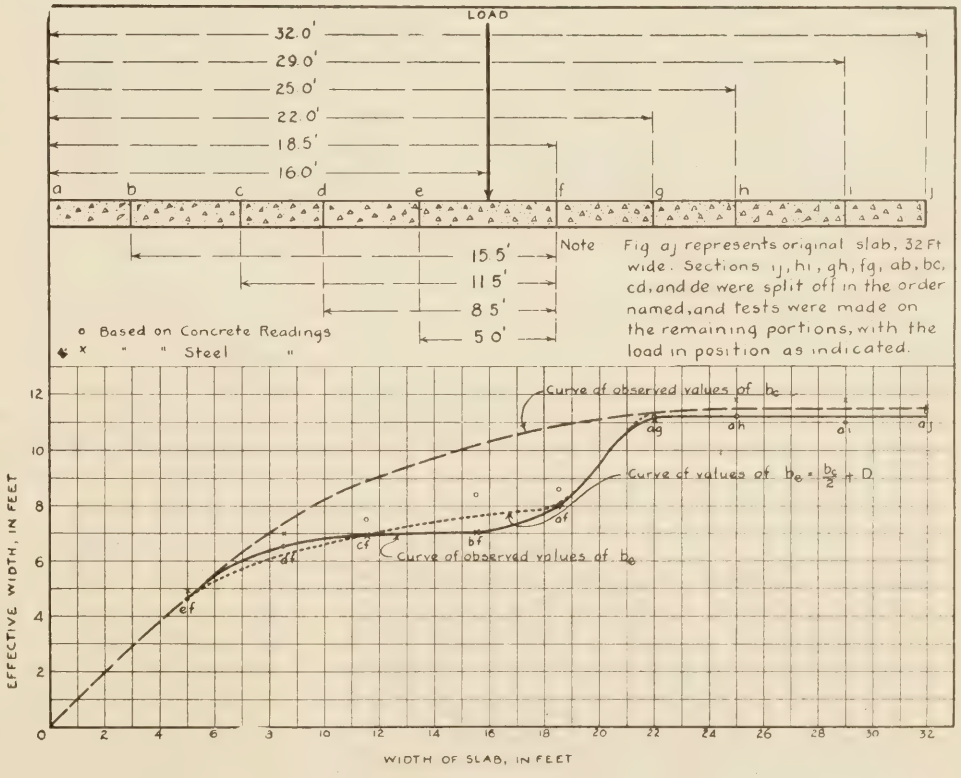


FIG. 5.—STRESS DISTRIBUTION UNDER TWO POINT LOADING.



CURVE SHOWING
EFFECTIVE WIDTH vs. WIDTH OF SLAB
FIG. 6.

UTILIZING LOCAL STONE

By GEORGE E. LADD, Bureau of Public Roads

ONE of the results of war-time activities during the current year has been the great interest in the utilization of local stone in road work. In some parts of the country rail transportation of broken stone in any considerable quantity is very slow and granted so reluctantly by the Railroad Administration that officials responsible for the maintenance and reconstruction of highways can not rely any longer on former sources of supply. Consequently there is a quite general return to the use of small crushing plants for producing road material locally.

From the viewpoint of a quarryman engaged in producing crushed stone there are two distinct types of crusher installations. One of these is for large-scale production and is operated continuously, if practicable, in order to keep the unit cost of the product as low as possible. The other is a small type, producing rock for local purposes and often the rock for but one stretch of highway. The methods of conducting the blasting and conveying the material in large quarries usually differ from those in the plants which it is best to employ in small operations. The failure to understand the essential differences between large-scale and small-scale operations is responsible for much of the unnecessary high cost of utilizing local materials with portable plants. Furthermore the conditions favorable for the production of crushed stone exclusively may be unfavorable for turning out dimension stone. For example, a multiplicity of joint planes is an advantage in producing rock for crushers and may render the ledge of little or no value for other purposes.

There are two general classes of quarries used in small-scale work. The first is the temporary quarry which will probably be abandoned after it furnishes the material for which it is opened, and the second class is the small quarry which may be operated intermittently to meet later demands for crushed stone. In the latter class more preliminary work is warranted than in the former. It may be desirable in such cases to avoid a thick overburden on the rock, to spend more money for drainage, and to install a more expensive plant than where there is no probability that stone will be taken from the quarry after the original working of it. For a single operation it may even be desirable to employ stiff uphill haulage, which is undesirable if the quarry is to furnish stone from time to time in future operations.

In studying local stone, where any question concerning its availability for road work arises, samples should be sent to the State highway commission or to the Bureau of Public Roads at Washington. During the period of the war it will be necessary in some sections to use stone which is not of the most desirable quality, but great care should be exercised to develop those quarries which will supply the best material it is practicable to obtain without railroad transportation. Fortunately in a number of States a large amount of information has been collected regarding the location and quality of stone which can be employed for highway construction, but the development of the commercial crushed stone industry has tended to diminish the value of such information during ordinary times, and the existence of it may not be generally known. Most cities have one or more well-informed amateur geological enthusiasts whose assistance in preparing a list of the available local sources of supply will prove useful, even though they have no knowledge of the qualities which a stone must possess to be fitted for road work.

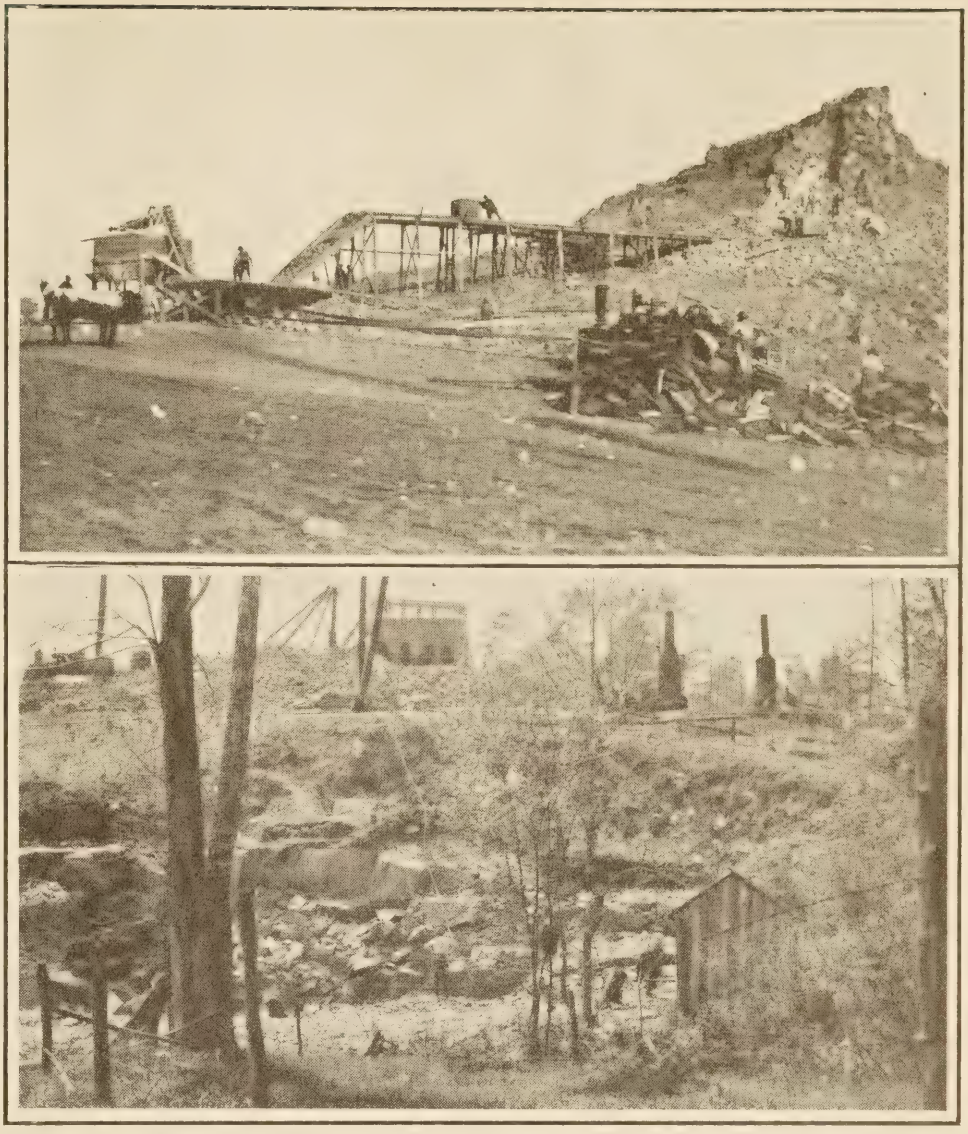
THE QUARRY SITE.

The selection of the quarry site, even for small operations, may involve the weighing of a number of factors. It is of course desirable to reduce the amount of overburden which must be stripped, but this factor, upon which much stress is frequently laid by authors discussing large-scale quarrying, may actually be of relative unimportance in temporary work in connection with roadbuilding. It is desirable to obtain rock which is undecomposed, and the extent of the fissures and the filling of fissures by clay and detritus may be determining factors in selecting the ledge. The length of haul and the grades over which the hauling must be done, the possible location of the crushing plant, the delivery of the quarry rock to the crusher platform, and the delivery of the crushed stone to the wagons or trucks must all be considered. Drainage is often an important factor. The quarry floor, the mechanical plant and the roadways must be kept dry.

If sedimentary rock is to be used and the beds are not horizontal, the site should be selected as a rule so that the bedding planes will dip either to the right or to the left as they appear in the face of the quarry. In order to attain this end it is necessary to determine the strike and dip of the bedding planes. The strike is the line made by the inter-

section of the plane of a dipping bed with a horizontal plane, and is recorded by giving its angular direction with respect to a north and south line. The dip is the angle which the dipping plane makes with a horizontal plane intersecting it and is measured at right angles to the strike. The dip and strike can not be ascertained from a single cross section of the strata. At least enough of the surfaces of the bedding planes must be seen to show the average position of the beds in the rock to be quarried.

In ledges of granite and metamorphic rock, structural planes resembling bedding planes may occur. The quarry face should be opened in such cases so that these planes dip to the right or to the left in the face. This reduces the amount of work to be done against gravity. If a face can not be opened in this way, it is better to open the quarry with the main structural planes dipping into the face rather than away from it. Where bedded rocks have a gentle dip, and the quarry face is opened so that operations proceed toward this dip, there is danger of following a bedding plane down with the dip and producing a floor sloping toward the face, which will form a pocket for the accumulation water and make it necessary to haul stone upgrade to the crusher.



TOP: ECONOMICAL ARRANGEMENT OF CRUSHER PLANT. STONE RUNS TO CRUSHER BY GRAVITY. BOTTOM: EXPENSIVE WAY OF GETTING ROCK TO CRUSHER.

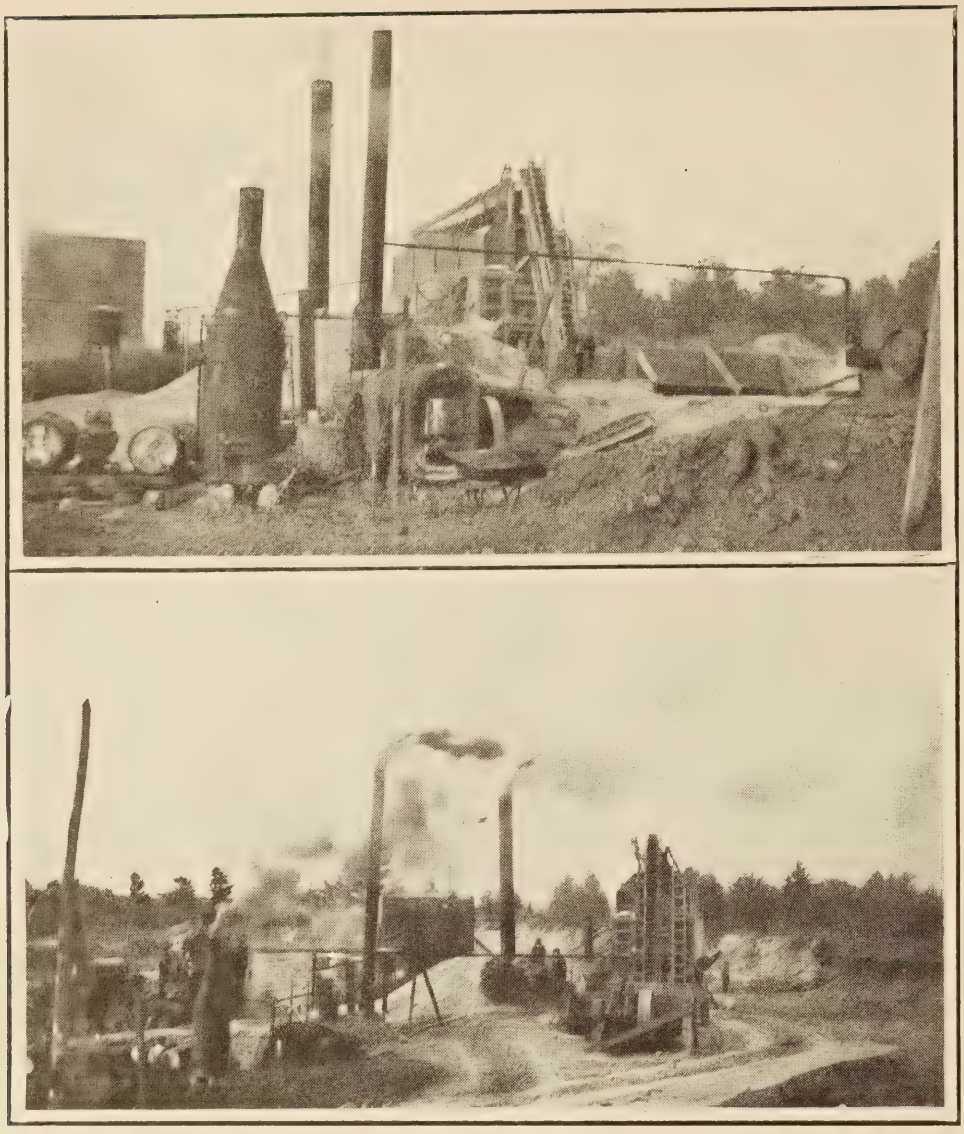
Stripping the quarry is usually done from time to time as the quarrying proceeds, in the case of small work.

QUARRY EQUIPMENT.

For small quarrying operations, the steam or air drill mounted on a tripod is required for the deeper holes for blasting down the face, and a hand hammer drill for putting holes in bowlders or for shallow work in opening the quarry. The hand drill can be used in the softer rocks for the blasting of the face if it is benched to 12-foot faces, but it is unwise to depend upon it for such work if a tripod drill can be obtained. Many plants have excess boiler capacity which enables the drill to be operated without a special boiler plant, but if the crushing equipment is some distance from the quarry face it may be advisable to install a boiler for the drills exclusively.

Light railways for handling stone from the quarry to the crusher have not often been used in temporary plants, but where labor and horses are scarce, and light railway equipment can be obtained at a reasonable expense, it may prove economical. Conveyors are occasionally employed in gravel pits. As a rule the stone is handled in dump carts.

The crushing plant on these small temporary operations is generally rated as requiring about 15 to 30 horsepower, which is enough to furnish from 6 to 30 tons of hard, tough crushed stone per hour. Belt drives are desirable for crushing, screening and conveying machinery, for a belt will slip if a sudden overload occurs and the danger of breakage is materially reduced in this way. It is customary to estimate that at least 1 horsepower must be provided



TOP: PORTABLE CRUSHING, SCREENING, AND DRYING PLANT. TEAMS ARE DRIVEN ACROSS PLATFORM AND RETURN. BOTTOM: SHOWING ROAD TO AND FROM CRUSHER PLATFORM. THIS IS A MORE ECONOMICAL ARRANGEMENT THAN WHERE THEY HAVE TO TURN ON THE PLATFORM.

per ton of product per hour for a small crusher, and about one-half horsepower for elevating and screening, where jaw crushers are used, and 25 to 50 per cent more for a gyratory crusher. The boiler horsepower must be in excess of this. A 3½-inch tripod drill requires 8 to 10 boiler horsepower.

Elevators to raise the crushed stone from the crusher to the screen are generally necessary. The foremen should be instructed to keep the pit at the foot of the elevator cleaned out. In some cases a conveyor can be used to advantage to carry quarry rock to the crusher. The screens in small portable plants are generally placed on top of the bins, which hold from 12 to 50 tons of screened stone, and are equipped to discharge their contents by gravity. Where crushed gravel is produced, it is desirable to screen it so that only the oversize material goes to the crusher. For this purpose a screen is usually set up near the crusher in such a position that the oversize is delivered to the crusher as directly as possible, and the sized material is delivered either to a stock pile or to the bins receiving the crusher product, depending on the local requirements.

In war times it is specially desirable to reduce the amount of labor required about the quarrying and crushing plant. An able-bodied man should not be used if machinery to take his place can be obtained at reasonable expense. For example the crushing plant can sometimes be located so that the stone is fed to it from the quarry by gravity. It is desirable to place the crushing plant as near the quarry face as practicable, and yet avoid damage by the blasting operations. It is desirable to drive the rock carts across the crusher platform rather than to turn on it. A crusher having a large jaw reduces the number of bowlders which must be broken up. Good foundation should be provided wherever necessary, and all shafting must be kept aligned and lubricated. Machinery of this character receives such severe usage that it is advisable to give more than the usual attention to its care, in order to avoid shutdowns for repairs which proper maintenance would avoid. Such shutdowns often result in the idleness of a large part of the construction force, and where the work is already lagging behind the desired rate of progress this may be a serious matter.

QUARRY OPERATIONS.

The operations which are most likely to cause unnecessary expense in quarrying are: Drilling; the proper spacing and proper location of holes; blasting. Different classes of rock resist explosives so differently, and there is such a wide variety of working conditions at different quarry sites where the kind of rock is the same, that even experienced

quarrymen must experiment at every new quarry to determine the best blasting methods.

If the surface of the rock is practically horizontal, a sunken-type quarry must be opened. It will then be necessary to hoist the material out of the quarry or to build a sloping incline down into it to enable the material to be hauled out. In this case three or four drill holes about six feet deep are driven at an angle of 30 to 40 degrees inclosing a pyramidal mass of rock. After this has been blasted out, the pit is opened out until a face, usually curved in plan, has been obtained. Additional depth is obtained by repeating the whole process in each successive floor. While opening up the quarry in this way valuable information can be obtained concerning the best explosives to use and the proper spacing of the holes. As a rule it is best to try 40 per cent dynamite first, if the rock is limestone, and 75 per cent dynamite if it is a tough igneous rock. If the results are unsatisfactory a trial of some of each grade in each hole can be made, and the proportions of the two varied until the best results are obtained. Slow-acting explosives lift and throw rock more than quick-acting grades, which have a greater shattering effect.

TOP: TEMPORARY QUARRY WITH TWO PORTABLE CRUSHING AND SCREENING PLANTS. DOWN GRADE TO HIGHWAY JUST TO LEFT OF QUARRY. BOTTOM: DELIVERING ROCK FROM TEMPORARY QUARRY NEARBY TO PORTABLE CRUSHING AND SCREENING PLANT FOR ROAD IN BACKGROUND.

If an approximately vertical face can be obtained, at which to start the quarrying operations, it is customary to sink the first row of holes back from the face a distance equal to about three-fourths of their depth. The depth of the holes in the benches is commonly 10 to 12 feet, and in a complete quarry face it may be 18 to 20 feet. The work of development is carried on until the quarry face has a slope of about 45 degrees. The overburden is then stripped off and regular quarrying operations begun. The first holes are in a row 6 to 8 feet back from the face, 6 to 7 feet apart, and sunk nearly or quite to the floor. If there is a seam or bedding plane at the floor, the holes may be stopped 5 or 6 inches above it, for the blasting will break the rock to the seam. The next row of holes may be sunk at a distance back from the face equal to three-fourths of their depth.

The proper spacing of drill holes in the regular quarrying operations depends upon the hardness and toughness of the rock, the number and arrangement of the joint planes and seams, the depth of the drill holes, the kind and amount of explosive used, and its vertical distribution in the holes. Experiments must be made until an arrangement is found which will not only tear down the face but will break the rock most completely for the crusher.

The choice of explosives, unless an expert powderman can be consulted, should only be made after securing the advice of the powder company supplying the explosive. These companies also furnish complete instructions for using dynamite, which should be thoroughly taught to the man in charge of the quarrying operations.

Small quarrying and crushing operations are always expensive, per cubic yard of output, in comparison with large-scale operations. It is all the more desirable, therefore, to carry on the work so that these costs will be as low as possible, which can only be done by requiring the foreman to keep a detailed record of his expenses and the output of the plant. These records should show his progress in reducing the drilling and explosives needed to blast out the rock, the labor required in delivering it to the crusher, and the expenses of the crushing. Constant endeavor should be made to encourage foremen to seek methods of greater efficiency in the work under them.

MAINTAINING GOOD ROADS.

It is axiomatic with householders that "keeping up the house is the truest economy." And so most of us watch for signs of decay about our premises, and we putty and paint and repair, to guard against the heavy expenses that would be the certain penalty of serious neglect.

But when it comes to municipal housekeeping what is our practice? Usually long periods of positively wanton neglect. This is especially true of our roads, which are an important part of our municipal premises.

We build our macadam streets, bolster them up with a good foundation, surface them with the best material at hand, roll them, view the finished job with satisfaction and then, like a slovenly home owner, pay no further attention to them until they have fallen into such a disreputable state that the steam roller must come with its plows, tear them to pieces and begin a work of complete reconstruction.

Practically all of the nations of Europe have long ago learned the economy of road maintenance. As you travel over the beautiful, hard macadam roads of France you observe, at intervals, small piles of broken stone and gravel. And for every dozen miles of road there is a road patrol with his one-horse cart, who labors incessantly at filling up the little depressions, ruts and holes, with his ever ready supply of good material. Once filled, the damaged spot is wet down thoroughly and tamped, and the road becomes again an integral whole. The thrifty householders of France have thus carried into the housekeeping of their municipalities and provinces the economics which they practice about their own hearth stones.

—Dubuque, Ia., Times-Journal.

BUSINESS MEN WORK ROADS.

Twenty-five business men of Bluffton, Ohio, put in a day working on the roads leading out from that town, in order to get them in better shape. More than 25 miles in all were repaired.

CONSIDER IOWA'S ROADS.

At the summer conference of the commercial secretaries of Iowa, held in August, a full day was spent discussing Iowa's roads, how they could be improved, plans for future development and an educational campaign throughout the State in regard to them.

URGE ROAD WORK AS WAR MEASURE.

The Ohio State Automobile Association set under way a campaign for the dragging and scraping of dirt roads in that State this fall, with the idea that otherwise unimproved roads may be used as late as possible into the season of bad weather. It is urged that it is the duty of township and other road authorities to take steps for this work, that the big crops which have been raised may be moved to receiving centers and railroads and not lie on the farms. Drainage of these roads is especially emphasized.

BAD ROAD LOSES MAIL SERVICE.

Near Decatur, Ill., a part of one of the rural mail routes has been cut off and the service transferred because of the bad condition of the road, which was not repaired after 60 days' notice had been given. Several families thus lose their mail delivery.

FOR TENNESSEE HIGHWAYS.

The Tennessee State Highway Committee held a meeting in August at which State and Government funds were allotted for road construction in Anderson, Hawkins, Unicoi, Sullivan, Cocke, Campbell, Madison, and Maury Counties. About $10,000 were appropriated for each county. The Maury County road will be along the Jackson Highway. The route of the Bristol-Memphis Highway west from Nashville was decided in favor of the Charlotte Pike or Dogorock route.

TO PROMOTE MOTOR TRUCK EXPRESS.

The Highways Transport Committe of the New York State Council of Defense will carry on a campaign in every county in the State to promote motor express lines. In addition to establishing rural motor lines the chief endeavor will be to start return load bureaus and to secure the removal of snow from roads so as to permit truck transportation the year round.

Highway Commissioner Duffey told the committee at a recent meeting that State highways had stood the severe test of the movement of Government motor trucks with excellent results, save where the trucks were used last spring on the older sections before the frost was out of the ground.

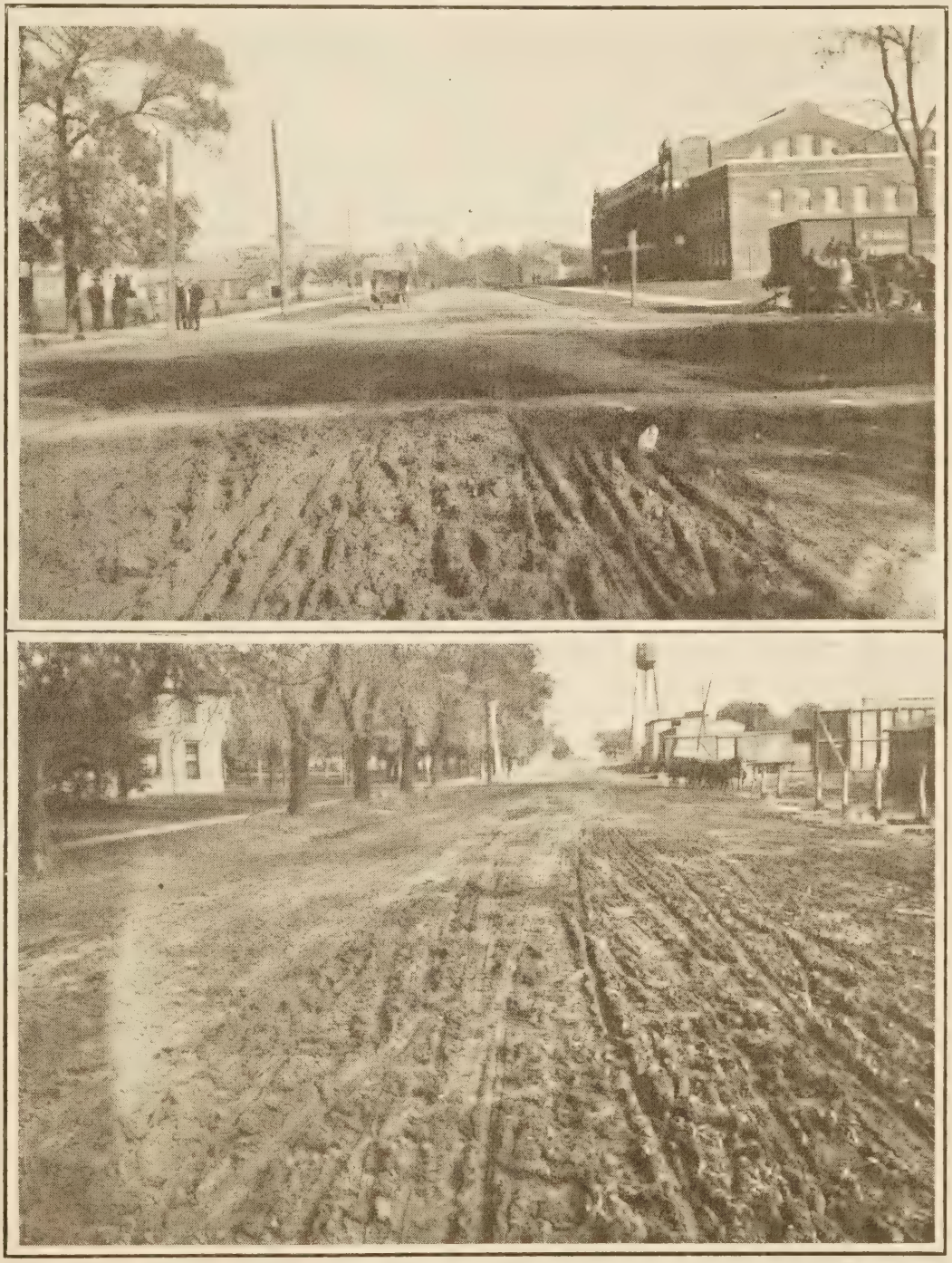
MAINTAINING EARTH ROADS WITH OIL.

By THOS. H. MACDONALD.

THE State of Iowa has learned by experience that the use of certain asphaltic road oils which produce a mat when applied to an earth road gives good service for a limited time under moderate traffic.

With the prices on all types of paving surfaces almost at the prohibitive point, with labor for new construction and for dragging and blade grader maintenance next to impossible to secure, and with a considerable mileage of important roads which have been maintained for several years past by oiling and which must continue to receive such treatment or go entirely to pieces, it would seem that oiling certain Iowa roads should receive attention as a war-time economy measure. On some limited sections of highway it would seem reasonable to class road oiling as a war-time necessity.

The dirt road on which oil has formed a good mat will withstand much more traffic for a considerable time with very little maintenance and with more freedom from dust and mud nuisance than the unoiled earth road even with a considerable maintenance expense. While the traffic that these oiled dirt roads carry is heavy for Iowa, it is not heavy for more densely peopled sections of the country where heavy motor trucks are used. What we mean by heavy traffic in Iowa is a very large number of light automobiles and light trucks, and



STREETS IN SAME, IOWA. TOP: OILED INTERSECTION SHOWING UNOILED APPROACH. BOTTOM: JUNCTION OF OILED AND UNOILED SECTIONS.

for such traffic the mat produced by the suitable grade of road oil on a well-prepared dirt road affords a sufficiently good wearing surface, though we have found it an extremely expensive one to maintain.

While the application of good road oil to properly graded and drained earth roads maintains them in a serviceable condition, very poor results have been obtained with the use of some of the cheaper oils on gravel surfaces. In come cases the oil has acted apparently as a lubricant to the pebbles forming the gravel and has helped to destroy rather than to increase the road bond. During the period of the war paving is out of the question as a remedy for road conditions in Iowa, and will soon be stopped entirely. We will necessarily fall back upon those systems of maintenance which will retain our present roads in a serviceable condition as long as possible, even at an excessive cost. Hence, we feel that our experience with the use of asphaltic road oils justifies us in employing them in our maintenance work. We can not maintain our roads in the condition needed for the traffic they must carry in some places without such oil.

It is undoubtedly true that oil has been used on earth roads in many cases when it should not have been employed, and the same criticism can be made on every form of maintenance and road paving. However, our experience shows that in the allocation of road oil for street and highway purposes the distribution of the material should not be based solely on the character of the roads to which it is to be applied. Consideration should be given to the service the roads are called upon to render. There are surfaced roads in sections of Iowa which do not carry so much or so important traffic as the earth roads in other sections carry, and there are surfaced roads in other States which do not begin to render the important service to the community that earth roads are called upon to render in Iowa.

The situation that we are facing in Iowa at this time is an unusual one. We do not believe in the general extensive use of road oil on earth roads. We have always refused to approve of this practice on the ground that the results were not comparable with the expenditures, but under present conditions we find ourselves attempting to carry an ever-increasing amount of traffic over roads which must be used without more surfacing. It is not so much a matter of cost as of the actual impossibility of securing contractors willing to take the work under any conditions. We must maintain our principal roads with the absolute minimum of labor, even though the cost of doing so is excessive, and the use of oil of good quality assists in attaining this end. Therefore, it seems logical that road oil which is available for country highways should be desirable on the basis of the service to be rendered by the roads which it is proposed to oil rather than by the actual character of the roads surfaced now.

TOLL ROAD PURCHASED BY STATE.

Arrangements have been made for the purchase of the Lancaster, Pa.-Columbia Pike from the Lancaster and Susquehanna Turnpike Company, for $80,000, which will give to the stockholders about $400 a share for their stock. The road will soon be a free public highway.

LOUISIANA ROAD PROJECTS.

At a meeting of the police juries of Terrebonne, Lafourche, and St. Mary Parishes, La., in August, it was decided to build three roads in these Parishes which affect all mutually, and also to build the link in the Southern National Highway stretching across Assumption Parish, 3½ miles long, which will shorten the road between New Orleans and Morgan City by 10 miles. A portion of the funds for this link was raised by private subscription.

FOR $50,000,000 ROAD FUND.

An amendment to the Pennsylvania constitution will be voted on at the November election this year to authorize the creation of a State debt of $50,000,000 for the building and improvement of highways. Five years ago a similar proposition was defeated. It is believed that now the voters of the State see the question in a different light. Advocates of the proposition hold that the great importance motor truck transportation has developed has made clearer the necessity for better roads in Pennsylvania.

MISLEADING MILE POSTS.

A movement has been started in Hamilton County, Tenn., to abolish the system of advertising mile posts which exists along the public roads in that county. A very complete case has been made out against the system. It is shown that these posts are not reliable, that in the same locality will be found signs differing much as to distances, and that much confusion and misunderstanding is brought about by them.

The mile posts are erected on the county's right of way, and it is believed that jurisdiction over them is with the highway commission. Some legislation may be necessary to effect desired results. It is proposed to have every highway properly measured by the county engineer and mile posts erected by the commission at the public expense.

TESTS OF AUTOMOBILE NUMBER TAGS

By JAS. P. NASH, Testing Engineer, Texas State Highway Department.

TEXAS, being one of the four States of the Union using the permanent number tag for motor vehicles, the State highway commission considered it good business to have sample plates from the various bidders tested before awarding the contract for additional numbers. The tags are permanent in the sense that they do not change every year, but remain with the car as long as the latter is used on the public highways. The law provides that the motor vehicle shall be provided with a seal, which alone is changed each year. So that purchasing the tags it was desired to procure a number plate that would look well and at the same time outlast the average life of an automobile, which was considered at between three and five years.

Three destructive influences were considered, first the drying action of the sun on the enamel, second, the action of salt air or water on the tags, and last the impact of sand and stones and the wearing action of loose parts tending to wear the enamel off. The test of the properties resisting the first destructive influences was by placing the tags in an oven for 8 hours at 100° C. These tags, which included the poorest as well as the best, were put through an abrasion test. In order to determine the relative value of this heating test, duplicate tags were run in the abrasion test without previous heating, but no difference in appearance could be detected, so it was concluded to abandon the heating test. Furthermore, it was decided that any paint that was hard and tenacious to resist the abrasion test to which the tags were put, would leave little doubt regarding its qualities resisting weathering. Upon examining a number of plates which had been in use for a year, it was noted that practically the only defects were that the paint had been scratched or worn away by some hard agent such as a keen knife used in removing mud.

The abrasion test was made by revolving the plates, bent so as to form a cylinder, with an abrasive agent of iron hexagon nuts. The plates were fastened, face inward, on two circular wooden rings 28 inches outside diameter. A short metal strip formed the joint between two plates. This formed a hollow cylinder, the tags lengthwise forming the circumference, while the width of the number, which was 4 inches, determined the height. This cylinder was placed in the brick rattler as a convenient means of revolving it, only three staves being used, however, in order to lighten the load on the pulleys. Crushed quartz sand was first tried as an abrasive agent, but this had little effect on the enamel, so one-sixteenth inch steel ball bearings were then tried, but the results were not considered decisive enough, so finally 400 grams (13 in number) of one-half inch hexagon nuts were used and the cylinder was given 1,000 revolutions in either direction.

The results of this abrasion test were very satisfactory as it showed very clearly the hardness of the paint and the tenacity with which it adhered to the metal. With some of the number plates the paint was almost completely clipped off, exposing as much as 90 per cent of the metal. The paint on even the best plates was badly scratched, but no metal was exposed except at the edge of the raised letters. There were varying degrees of wear between these two extremes. It is worthy of note that

Reports of tests of auto number plates.

Maker.	Number on plate.	Thickness of metal.	Loss in weight in 2,000 revolutions.	Rating.	Condition of plate after run.
		Inch.	*Grams.*		
No. 1	174,005	0.033	.....	70	Blue background badly scratched, but metal not exposed except at corners. White letters about 50 per cent worn.
No. 2	[1] 381,079	.025	0.8	65	Blue background in fair condition; metal exposed at edge of letters, but letters in good condition. Metal exposed in pin-point areas in background.
No. 2	381,079	.028	1.0	[2](60)65	Blue background badly scratched and chipped off in pin-point areas. White letters in fair condition except at edges where metal is fully exposed; about 30 per cent worn.
No. 3	734,508	.028	.6	57	Blue background chipped off wherever exposed to considerable wear. White letters in fair condition.
No. 3	734,508	.028	1.7	[2](50)55	Blue background badly worn, exposing metal over large areas. White letters in fair condition; about 30 per cent worn.
No. 2	[3] 381,079	.020	3.0	55	Blue background worn between letters where abrasive agent had free contact. About 85 per cent of black worn off letters.
No. 4	LA 23,600	.028	1.1	40	Green background almost completely worn away. White letters worn away at edges and had appearance of salt and pepper.
No. 5	K D 5438 A N	.024	.....	35	Both background and letters worn so that about 75 per cent of metal is exposed; poor condition.
No. 5	K D 5438 A N	.025	1.8	30	Background and letters worn so that about 85 per cent of metal is exposed.
No. 6	140,491 I11	.042	2.1	30	Paint badly worn; about 95 per cent of paint is worn off letters and 10 per cent off background.
No. 6	140,492 I11	.385	3.0	[2](25)30	100 per cent paint worn off letters and 70 per cent off background.

[1] No. 2 extra finish.

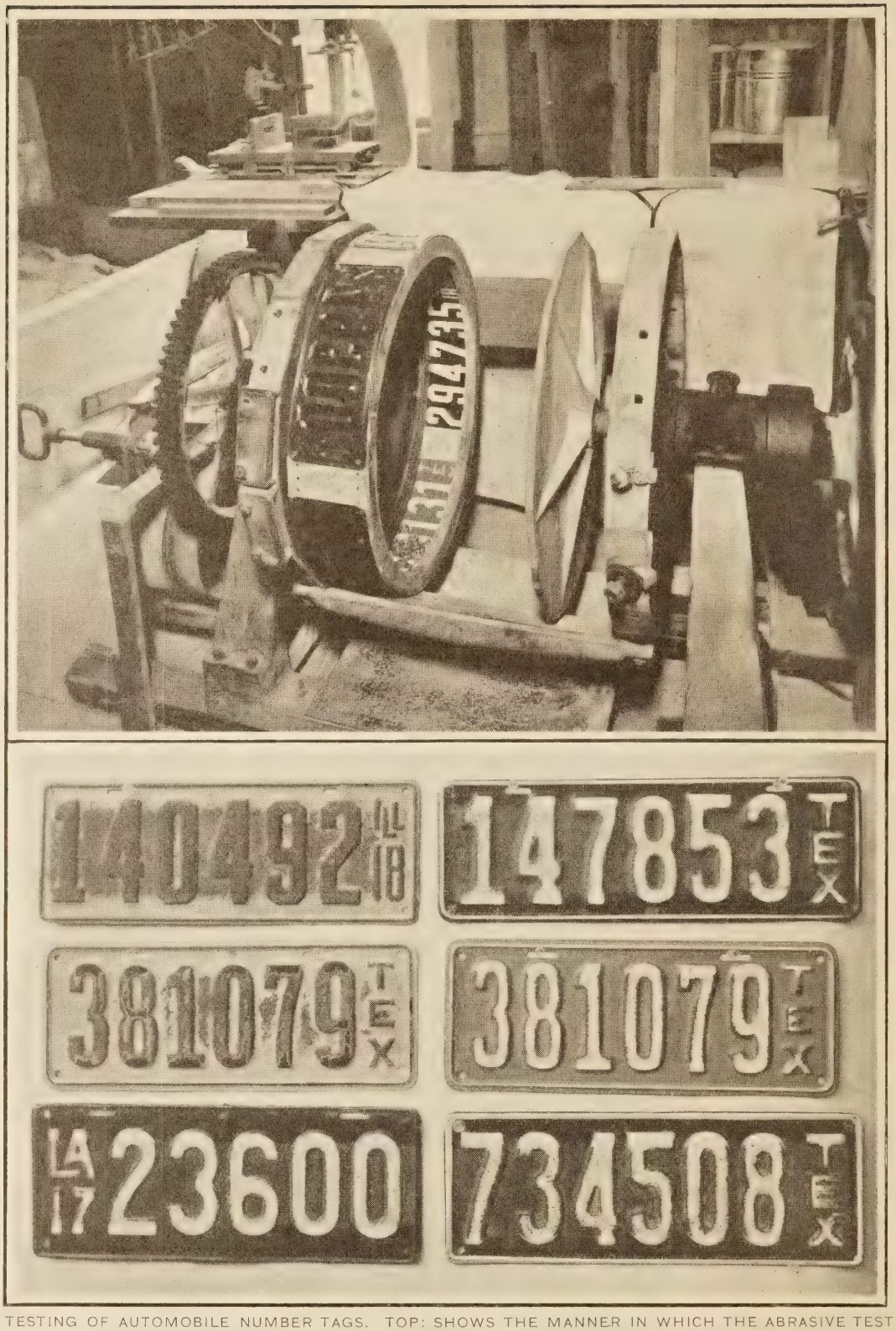
[2] Denotes plates were subjected to temperature of 100° C. for 8 hours and tested with sand, and ball bearings before final test with hexagon nuts. Rating arbitrarily raised 5 per cent to allow for this.

[3] No. 3.–26 gauge.

the two highest prices bid included the best and poorest plates as shown by this test.

In order that the difference in wear could be presented to the highway commission in a forceful manner, and in a measure duplicate the weathering action of our coast country, the number plates, after the abrasion test, were subjected to a 10 per cent solution of common salt. First the tags were embedded in sand saturated with the salt water, but it was found that grains of sand rusted to the exposed metal.

To avoid this, they were removed from the sand and sprinkled with the salt water, then allowed to dry in air. A further effect, besides the rusting of the metal, was noted, and that was the paint on the backs of many of the plates became soft in spots and could be rubbed off by a slight pressure with the thumb.



TESTING OF AUTOMOBILE NUMBER TAGS. TOP: SHOWS THE MANNER IN WHICH THE ABRASIVE TEST WAS MADE. BOTTOM: APPEARANCE OF TAGS AFTER THE TESTS.

The rating given the tags was a matter of judgment, arrived at by considering the plate before the run as 100 per cent perfect, and estimating the area of metal exposed by the tests, not considering the edge of the raised letters. While the actual numeric figures may be slightly in error, the relative worth of each plate is clearly brought out and the numerical rating is merely a means to an end.

The contract for 75,000 additional pairs of plates was awarded at 34 cents a pair to the concern that held the previous contract for the identical plates at 39 cents, so it was considered that a saving of at least 5 cents per pair was made by having the plates tested, besides being assured that a good quality plate was obtained.

STANDARD SIZES OF CRUSHED STONE

From the Standpoint of the Producer

By R. W. SCHERER, Secretary, Wisconsin Crushed Stone Association

THE movement to standardize commercial crushed stone sizes, inaugurated by engineers of the Bureau of Public Roads, should be and will be heartily welcomed by crusher operators. The demands as suggested by Messrs. F. H. Jackson, jr., and C. W. Mitman in their article in the June number of "Public Roads" far from being stringent are rather too lenient. Economic plant operation is not the producers' only interest in the matter. They should be and generally are equally interested in the results from the type of construction involved and will be found willing to sacrifice economic operating to a considerable degree to gain better results.

It is difficult to see what a further survey of the screening practice and study of the nomenclature will do to clear up the situation. One could not expect to arrive at a typical set of screens by counting noses, nor by finding a majority of installations that are alike to which the minority would conform. It is also to be regretted that the investigators found it "impossible to record the rate of feeding the stone into the screen." That the nomenclature was in a condition of "confusion worse confounded" needed no demonstration.

HOW PRODUCT VARIES.

To define a grade of stone all are agreed that size of screen openings through and over which the material passes must be stated. When these are stated the product may still vary from several causes.

First. There is an appreciable difference in the product of round and square perforations. A hole described as 2 inches square will pass a larger stone than a round one 2 inches in diameter. Square perforations are still used, though to a very small extent except in fine screens. It would be safe to confine the question to circular holes; where square perforations are retained they must be made the equivalents of circular openings.

Second. It makes a noticeable difference in the product whether screens are stationary or revolving. On a stationary screen the stone particles slide over the surface; they are held on their longest dimension. In a revolving screen the stones roll and can and do go through holes no larger than their smallest dimension. The difference in size of product is so great that the stationary screen will retain 20 to 40 per cent of material that has been passed through a revolving screen of the same size perforations. This means that the specification still retained by some engineers—naming the largest dimension as the determining one is not practicable, since stationary screens are almost unknown in the industry. If engineers knew this, they might discontinue the practice. They could guard against "slivers" by other means.

Third: It makes a difference, of course, whether a screen of any type is overloaded or not. More often it is the large plant that has inadequate facilities for separating the sizes. Fines are carried over to the next section having larger openings. Thorough screening should be understood in designating sizes and how thorough it should be will be discussed in another paragraph.

NOMENCLATURE.

Now then, to get clearness in the matter of describing sizes. Let us describe a given product at least technically by the size of perforation which it passed through and the size of perforation that held it and let us understand thoroughly that the figures are for a round perforation, for a revolving screen, and for a screen of sufficient capacity for the plant.

And if we can best describe a given product by maximum and minimum smallest dimension, for technical purposes, why not for all purposes? Why should there be the conflicting nomenclature of numbers and more or less descriptive names. In fact, dimensions are the one description that now are universally intelligible, and it would seem that for all practical purposes, ordering stone, specifying, invoicing, and all, it is just as easy to refer to 2–1 inch stone as it is to write or talk about 23 or medium fine stone.

Probably the best established and most universal system of nomenclature is that of the granite crushers both East and West where No. 1 stone is always very nearly $2\frac{1}{4}$, $1\frac{1}{2}$, and one-quarter inch and finer called No. 4. It would be very difficult to accustom the granite trade to another system of numbers, while they could be led to adopt the figures limiting the sizes.

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LIMITING THE NUMBER OF GRADES.

Once we have means of describing grades of crushed stone and it would seem that with the above understanding—2–1 inch stone or any other size would mean the same thing everywhere—a further understanding could be arrived at between the producers on the one hand and road builders, engineers, and architects on the other hand as to grades that should be offered by the former and demanded by the latter.

The advantages to the crusher operators, if the number of grades can be reasonably limited, are manifest. There can be no question that there has been on the part of engineers—less of road engineers than of the specialists in structural concrete—considerable academic dogmatism about sizes for certain purposes—they have been just "finnicky." But—and this is from the quarryman's standpoint as well as the engineer's—results must be considered. It is to the quarryman's interest—and some of them can see it—to furnish just the size that will give the best results. It is incumbent on all parties interested to ascertain how much of this fastidiousness is justified and in how far the results in road or concrete are affected by a slight variation from the size demanded by some engineer whom the quarryman thinks pedantic.

THE DEMANDS OF ENGINEERING PRACTICE.

Here are some thoughts from the standpoint of the quarry operator who is interested in results, which it is hoped may illuminate the subject. On the one hand, some paving engineers, using stone in a special process of asphaltic concrete paving, have insisted on a product passed through a screen one-eighth inch larger or one-eighth inch smaller than was commercially produced. This seems to be pedantry that passes for scientific aggregating. In stone above 1 inch, one-eighth inch more or less can make no possible difference; even a quarter-inch variation seems unreasonable in 1-inch and larger stone. The demand for such variations can be eliminated.

On the other hand, quarrymen are at fault when they fail to recognize the imperative necessity for good screening. And here is where they should consider results. Stone for macadam must be distinguished from stone for concrete, and differently prepared. It makes no difference what the hardship on the quarrymen may be, results to a certain extent justify the sacrifice.

The distinction can be simply stated in this way: In macadam stone there must be a large percentage of voids, while in concrete stone the percentage must be as low as possible. To elucidate, no road builder can bind a crusher-run stone. Fines, when present in coarse stone, close the interstices and prevent the entrance of the binder even when that binder is hot tar. How much more must these fines prevent the entrance of stone screenings in water-bound macadam. In penetration macadam, road builders have had to discontinue the practice of dumping loads of the top course stone on the base, because as the load is spread with shovels the "fines" remain on the spot. The stone "mats;" the binder, instead of covering each stone, spatters on the mat; the binder does not anchor in the body of the course, and a bald spot results. A large percentage of failures of "poured macadam" is due to poor screening. Fines should not be tolerated at all. The engineers of the Bureau of Public Roads suggest a maximum of 15 per cent, but 10 per cent should be the limit; 0 per cent should be aimed at.

There is no "finnickyness" about demanding good screening for macadam. Not only should the fines be removed but the range of sizes in any one grade should be restricted as much as possible for macadam stone and as wide as possible for concrete work. Thus, for macadam top course, 2–1½-inch stone is better than 2–1-inch. The former being more even sized has more voids, and voids are what is wanted.

SCREENING CONCRETE AGGREGATES.

On the other hand, concrete aggregates must have a minimum of voids; the greater the range of sizes the better the results. Stone ranging in size from 2 to 1½ inches has 50 per cent of voids. To make a dense concrete, one-half of the concrete must be mortar, or a mixture of cement and fine aggregates. Well-graded stone ranging in size from 2 to one-fourth inch, when intimately mixed, has 35 per cent of voids or less, leaving just that percentage to be filled with mortar. The efficiency of the cement in the latter case is increased from 35 to 50, which means over 40 per cent.

The proofs for this are abundant. Whenever and wherever coarse aggregates have been tested for the compressive strength of the resultant concrete the well-graded samples have stood the highest tests. In fact, from the vast number of experimental tests of fine aggregates, in which investigators all over the world have used three sizes designated as fine, medium, and coarse, plotting their results on what is known as the Feret triangle, it is evident that 70 per cent of the largest size permissible, 20 per cent of the medium, and 10 per cent of fine results in the best concrete. Why should not engineers insist that not less than 25 per cent nor more than 50 per cent of, say a 2–¼-inch concrete aggregate shall pass a 1-inch ring and why should not quarrymen be prepared to furnish it?

Again this is not pedantry. Why? A concrete made of all 2-inch stone and an ungraded sand is an absolute failure, it is full of voids and can be worked only with a detrimental excess of water. A great deal of similar concrete has gone into bases

of pavements and it is to be wondered at that there are not more failures. This specification would be no hardship on any crushing plant. It is not necessary that the two or three sizes required be mixed in a bin; they can be loaded on the cars or trucks, one over the other and would be mixed in unloading, at least in the case of cars unloaded by shoveling. Mixing in bins is undesirable for another reason; a bin full of mixed sizes does not stay mixed. There is the well known separation by gravity, the large pieces always rolling to the outside of the pile. If the bin is large enough a rather close separation can be obtained by gravity.

MUST TAKE CONCESSIONS.

These, then, are concessions which quarrymen must take for the sake of results, thorough screening in macadam stone and thorough mixing in concrete stone, both within reasonable limits. That State testing engineers and chemists are willing to concede the ridiculous fractional sizes is apparent from their preliminary report. (Department of Agriculture Bulletin No. 55.) They recommend the following screen perforations: 3, 2, 1, ½, and ¼ inch. The nomenclature proposed consists of the numbers 3, 2, 1, ½, and 0, corresponding to the largest size contained in the grade. Thus No. 3 stone is 3–2 inches. Combinations of the numbers are proposed; thus No. 1, 2, 3 means a mixture of ½, 1, 2, and 3 inches. From the fact that this system of designating grades is the very contrary of the only system that has been at all firmly established in any branch of the industry, that of the granite quarries, it does not seem likely that its adoption universally could be successfully urged.

The logical system of describing grades seems the only one which we could hope to see adopted, that of specifying the limiting sizes. In this system stone for macadam base course would become 3–2 inches instead of No. 3 as is proposed, or instead of "ballast," "macadam," "2-inch stone," or "3-inch stone," as is now the confusing practice in different localities. Stone for cement concrete wearing surface would be simply 2–¼ inch instead of No. 12, as is proposed. One-half inch screenings would become "½ inch and finer." There can be no doubt that the nomenclature would be universally intelligible and, with the restrictions mentioned above, would be accurate.

The First Conference of State Testing Engineers and Chemists evidently considered only road work; the requirements of structural concrete must be considered and this will probably add another screen and grade—1½ inch round perforations. This will not be seriously objected to by crusher operators, 2–1½ inch stone for second course macadam will give very much better results than 2–1 inch. For concrete 1½–¼ inch material is vastly better, is as easily worked and will be more acceptable even for reenforced work than 1–½ inch.

STANDARDIZATION DESIRABLE.

The adoption of standard sizes is possible. The action of the Bureau of Public Roads in inaugurating a movement to bring this about is to be highly commended. Their engineers have shown a disposition to meet the producer more than halfway. If, in addition, other interests are considered, possibly the American Society for Testing Materials, the quarryman who has conformed his screening plant to the standards prescribed, would have the highest engineering authority to protect him from the whim or caprice of pedantic road builders and engineers, and other engineers on their part, would be assured of getting what they specify. To recapitulate:

I. The establishment of standard sizes of crushed stone adopted throughout the States is possible and highly desirable.

II. To accurately define a grade of stone, screen perforations, through and over which it passed should be given. It should be universally understood that (first) circular perforations are meant, (second) that the screen is a revolving one, and (third) that the screening plant is adequate so that any one grade shall contain not more than 10 per cent of fines (possibly 5 per cent) and not over 5 per cent oversize by laboratory tests and that (fourth) a mixture of various grades such as 2–¼ inch shall contain not less than 25 per cent nor more than 50 per cent of "fines" passing through a 1-inch screen, that is, through perforations having one-half of the diameter of the maximum sizes permitted in the mixture.

III. The following screen sections are proposed: 3, 2, 1½, 1, ½, ¼ inch.

IV. The nomencalture should be the logical one, simply stating maximum and minimum sizes.

[As pointed out by Mr. Scherer, any movement to standardize sizes and nomenclature of crushed stone products should be and probably will be heartily indorsed by the industry. In fact the survey of present practice so far completed by the Bureau of Public Roads would have been practically impossible without the cooperation of the operators concerned. Although Mr. Scherer can see no reason for any further survey of present conditions, the Bureau of Public Roads feels that such a survey is not only desirable but necessary before final recommendations can be made which will be generally acceptable. EDITOR.]

DECISION PREVENTS BUILDING.

Judge Paul Little, of the circuit court in western Arkansas, has sustained 65 appeals against assessments levied in the Scott County Road Improvement District No. 1, which was created two years ago to build 42 miles of road from Waldron west to the Oklahoma State line and from Waldron to Manfield, on the Sebastian County line. The decision nullifies the district. The highway was to be a link in the Albert Pike Highway, from Colorado Springs to Hot Springs, and in the Bankhead Highway.

FEDERAL AID PROJECTS IN JULY

Federal aid projects approved in July were fewer than in any other month so far this year. The total number was only 46, the total mileage 394.061, while the estimated cost of all the projects approved or for which agreements were signed during the month is $3,530,511.66. The Federal aid allowance is $1,171,107.08.

South Carolina had the largest number of projects approved. These were six projects, with a total mileage of 57.8 miles, to cost $182,485.70, including the Federal aid allowance of $69,645.31. One of the projects is a concrete bridge to cost $22,545.82. Georgia followed South Carolina in the number of projects approved and in the total mileage. Her projects are five in number, with a mileage of 52.1 miles, to cost $188,435.12 and an allowance of $85,318.41.

Ohio leads in the total cost of roads approved and receives the largest aggregate allowance. Four projects, with a mileage of 24.89 miles, including bridges and culverts on one, and for concrete or bituminous surface and bituminous macadam roads, will cost $587,260.30, for which a Federal aid allowance of $131,500 is made.

The largest single project for the month is 11 miles of brick road in Ford County, Kans., estimated to cost $386,848.66, or $35,168.06 a mile. The allowance for this road is $58,027.30. The single project in Rhode Island is a bituminous macadam road, 2.04 miles long, to cost $93,747.50, or $45,954.70 a mile, the highest average cost per mile.

The greatest allowance for a single project is $111,839.79 for a concrete road in Oklahoma, 14.64 miles long, to cost $223,679.59.

The table gives in detail the projects approved and those for which the final agreement was executed.

FEDERAL AID PROJECTS APPROVED DURING THE MONTH OF JULY, 1918.

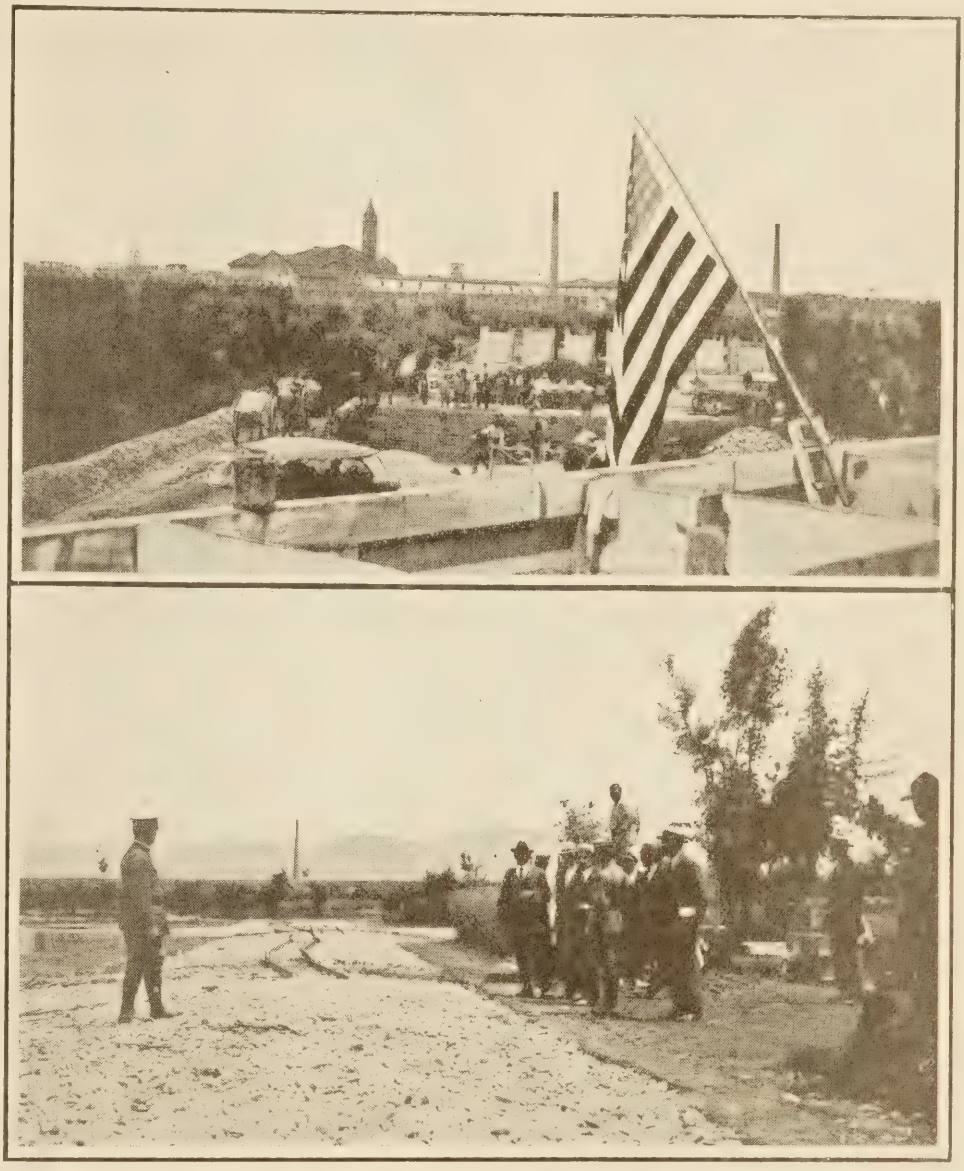
State.	Project No.	County.	Length in miles.	Type of construction.	Project statement approved.	Project agreement executed.	Estimated cost.	Federal aid.
Alabama	30	Geneva	10.85	Sand-clay	July 3		$23,285.69	$11,642.84
Arizona	2	Maricopa	3.78	Concrete		July 12	91,779.93	38,600.00
Connecticut	3	New London	7.80	Bituminous macadam	July 18		204,953.65	78,000.00
Florida	5	Desoto	2.50	Brick or asphaltic concrete	July 9		44,173.91	20,000.00
Georgia	21	Heard	8.00	Topsoil or sand-clay	do		27,658.62	12,000.00
	24	Cherokee	13.60	Gravel and topsoil	July 7		60,247.00	25,000.00
	28	Paulding	10.00	Sand-clay or gravel	July 17		30,767.00	15,000.00
	31	Dade	10.80	Topsoil and gravel	July 20		50,682.50	24,318.41
	32	Columbia	9.70	Topsoil or gravel	July 15		19,078.40	9,000.00
Illinois	3	Will	5.20	Brick	July 31		132,917.50	37,216.90
Iowa	20	Monroe	9.00	Earth	July 29		33,438.90	16,719.45
Kansas	14	Ford	11.00	Brick	July 3		386,848.66	58,027.30
Kentucky	7	Hart	10.00	Macadam surface treated	July 5		60,755.20	30,377.60
Michigan	8	Allegan	7.00	Bituminous macadam		July 12	158,399.13	70,000.00
	19	St. Joseph	3.97	Stone bottom with gravel top		do	49,011.38	24,505.00
Montana	9	Madison	10.00	Graded and drained	July 15		22,880.00	11,440.00
New Hampshire	18	Hillsborough	.90	Gravel	July 29		9,020.66	4,510.33
New Mexico	16	Lea	5.25	Macadam	July 13		25,450.70	12,725.35
	17	Eddy	5.00	do	July 9		18,385.40	9,192.70
New York	10	Rockland	2.47	Bituminous macadam or concrete	July 11		49,399.35	24,699.67
	11	Orange	2.59	do	do		51,726.40	25,863.20
North Dakota	5	Traill	25.15	Earth	July 18		23,519.10	11,759.55
	27	Benson	24.20	Graded earth	July 19		27,804.13	13,902.06
	29	Steele	12.15	Earth	July 5		21,627.10	10,813.55
	31	Lamoure	4.50	do	July 13		7,532.80	3,766.40
Ohio	15	Madison	12.80	Concrete or bituminous surface	July 15		331,136.52	70,000.00
	16	Clark	4.93	do	do		133,347.54	34,600.00
	17	do	4.47	Bituminous macadam	July 11		122,076.24	14,400.00
	22	Guernsey	2.69	Grading, bridges, and culverts	July 9		27,700.00	12,500.00
Oklahoma	5	Bryan	14.64	Concrete	July 15		223,679.59	111,839.79
Rhode Island	2	Washington	2.04	Bituminous macadam	July 19		93,747.50	20,400.00
South Carolina	2	Spartanburg	14.90	Concrete or brick, topsoil		July 27	121,716.58	48,577.87
	8	Bamberg	12.17	Sand-clay	July 24		26,122.36	10,771.14
	9	Newberry	5.63	Topsoil	July 19		16,178.58	8,089.29
	10	Lancaster	22.34	Gravel or macadam	July 24		49,296.50	17,000.00
	11	Chester	9.46	Sand-clay	do		53,769.42	18,784.88
	14	McCormick	8.25	Topsoil	July 31		14,573.02	6,000.00
	15	do	.15	Concrete bridge	do		22,545.82	9,000.00
Texas	22	Dallas	2.35			July 31	20,792.20	10,200.00
Virginia	13	Stafford and King George.	6.932	Gravel	July 24		59,263.28	29,631.64
Washington	13	Okanogan	1.077	Gravel with two bridges	July 31		33,195.80	13,789.67
	14	do	2.41	Gravel	do		16,556.70	8,278.35
	15	do	4.14	do	do		22,985.56	11,447.98
West Virginia	6	Mineral	.78	Concrete		July 15	14,530.84	6,381.00
	18	Tyler	1.00	do	July 5		25,650.00	6,650.00
	19	Ohio	.572	do	July 3	July 14	11,435.25	5,680.00
	20	Dodridge	.568	do	July 5		19,104.36	5,415.00
Wisconsin	10	Walworth	1.82	do		July 5	33,745.36	11,248.45
	11	Milwaukee	2.23	do		July 16	52,903.51	17,634.50
	18	Oneida	2.00	do		do	18,455.36	2,818.45
	32	Winnebago	3.52	do		July 31	74,721.20	24,907.07
	33	Fond du Lac	3.70	do	July 7		74,990.30	24,956.33
	48	Monroe	11.05	Earth	July 24		42,500.30	14,316.66
	49	Waupaca	10.10	Earth, surfaced in part	do		31,861.25	10,620.41
	50	Ozaukee	1.92	Bituminous macadam	do		17,556.88	5,852.29
Wyoming	20	Sheridan	8.02	Concrete or asphaltic gravel	July 2		169,380.45	80,200.00
Total			394.069				3,530,511.66	1,171,107.08

AMERICAN RED CROSS A BUILDER OF ROADS AND TOWNS IN ITALY

THE American Red Cross in its wonderful work for the victims of war has developed activities in a hundred different directions. It is not only caring for the wounded and sick and feeding the hungry, but is working most effectually to house the homeless refugees from the battle devastated lands.

The Red Cross forces have now been in Italy for several months. They preceded the arrival of American troops on the Italian front, and gave to Italy the first demonstration of American participation in the struggle that country is making. Early reports which came from Italy showed the enthusiasm with which the first contingents were welcomed, and later ones coming from time to time emphasize the various activities the workers are engaged in.

The work in caring for the refugees from the war zone in northern Italy has attracted much attention. There have been great numbers of these refugees, and homes have had to be found for them. The Red Cross representatives have undertaken and carried out this task. In doing this the Red Cross has built houses, even complete villages, with streets, stores and schoolhouses.



TOP: VIEW OF CONSTRUCTION WORK OF MODEL VILLAGE IN THE OUTSKIRTS OF PISA, ITALY. BY THE AMERICAN RED CROSS, LOOKING TOWARD THE CITY. BOTTOM: ROAD CONSTRUCTION IN THE MODEL VILLAGE.

Just outside of Pisa there has been constructed a model village. It was built in cooperation with Italian architects, the work being done by Italian laborers. On April 1 the site was an apple orchard, by August 1 the village was complete, housing 2,000 people. The town contains houses, stores, shops, and workrooms, a church and school, all of cement and concrete. Great attention was paid to the water supply, sewage disposal and sanitation. The reports are that this Italian village will rival in sanitation all leading suburbs. The roads were constructed of native material, were well built, and it is hoped they will be a model to other small communities.

SOME STATE HIGHWAY BUILDERS

ON THE opposite page are the portraits of State highway officials who are bringing their States to the front in the building of better roads. The list includes men active from New England and the South Atlantic coast to the Pacific Northwest. Other portraits and sketches will follow in future issues.

The highway work of Nebraska is looked after by the State engineer. The present occupant of the position is George E. Johnson. Mr. Johnson was born at Beatrice, Nebr., in 1881. He received degrees in civil, electrical and mechanical engineering at the Armour Institute, Chicago, in 1902. For 18 months he was employed on the St. Louis & Iron Mountain Railway in Arkansas. For the next two years he was superintendent of electrical construction for the Swift Packing Co. Following this he opened an office as consulting engineer at St. Joseph, Mo., remaining there until 1907, and afterwards maintained offices at Holton and Sabetha, Kans., and Falls City, Nebr. In 1915 he was appointed State engineer of Nebraska.

Thomas Harris McDonald, chief engineer of the Iowa State Highway Commission, was born in 1881 at Leadville, Colo. He attended the public schools of Poweshiek County, Iowa, and, for one year, Iowa State Teachers' College at Cedar Falls. In 1890 he graduated from Iowa State College in the civil engineering course. He was with the Chicago Great Western Railroad for a time on track work. In 1904 he became assistant professor of civil engineering at Iowa State College and placed in charge of road investigation work. In 1906 he was appointed highway engineer with the first State highway commission and held this position until 1913, when he was made chief engineer of the present reorganized State highway commission. He is also supervisor of State roads, a position which places him in charge of all highways and streets adjoining or upon State farms, State institutions, and the State capitol at Des Moines. Mr. McDonald is a member of the executive committee of the American Association of State Highway Officials.

The State road commissioner of Florida is William F. Cocke, born in Powhatan County, Va., February 7, 1875. Mr. Cocke started work as a rodman on a railroad survey. He was employed until 1907 on railroad location and construction work, and for a short time with the engineering department of Richmond, Va. In 1908 he took a position with the Virginia State highway commission, and advanced through various grades to division and maintenance engineer. In May, 1916, he was appointed State road commissioner of Florida. In this position he is the chief engineer of the State road department and its executive officer.

The legislature of 1917 greatly enlarged the powers and authority of the department and provided for the expenditure of 85 per cent of the State registration tax on motor vehicles for maintenance of State and State-aid roads in each of the 54 counties of Florida, all expenditures to be under the supervision of the State commissioner.

Charles Joseph Bennett was born in Frome, England, February 9, 1878, and was brought to this country when 2 years old. He graduated from the high school at Amsterdam, N. Y., in 1897 and from Union College in 1901, with the degree of bachelor of engineering. After his graduation Mr. Bennett was employed by the city engineer of Amsterdam. The following year he went to the Metropolitan Street Railway Co., New York City; in 1903 to the New York Central Railroad, and in 1905 to Hartford, Conn., with the New York, New Haven & Hartford Railway Co. In 1909 he entered the service of the State, working on the Saybrook Bridge. In 1910 he was made superintendent of streets of Hartford, and in 1913 was appointed by Gov. Baldwin State highway commissioner, and has remained in office through reappointments.

Commissioner Bennett has written a handbook, "Highway Engineering," has contributed to technical periodicals, lectured at Columbia College and the Sheffield Scientific School at Yale, and has delivered addresses throughout Connecticut and in other States on road questions and engineering topics. He is a member of the American Society of Civil Engineers, the International Permanent Congress de la Rute, a director of the Massachusetts Highway Association, and a member of the American Highway Association, American Road Association, National Highway Association, National Society of Civil Engineers, Connecticut Society of Civil Engineers, Rotary Club, and the University Club.

The State highway commissioner of Georgia, Warren Rabun Neel, was born near Atlanta, that State, in 1882. He was educated at the Georgia Military Institute, founded by his father, and the Georgia School of Technology. In 1901 he went to Mexico to work on the National Railroad of that country. For 12 years he maintained an engineering office in Mexico City and Tampico, being employed in various engineering enterprises. At one time he was superintendent of construction of the street railways of Mexico City. He abandoned that

(Continued on page 48.)

1. GEO. E. JOHNSON, NEB.
2. THOS. H. McDONALD, IA.
3. WM. F. COCKE, FLA.
4. CHAS. J. BENNETT, CONN.
5. W. R. NEEL, GA.
6. JAMES ALLEN, WASH.

STATE HIGHWAY MANAGEMENT, CONTROL, AND PROCEDURE

By M. O. ELDRIDGE, Assistant in Road Economics, G. G. CLARK and A. L. LUEDKE, Engineer Economist of the Bureau of Public Roads.

IN the August number appeared the first chapters on State highway management, control, and procedure. In this number are presented the chapters on ten additional States. Each one takes up the development and results of State participation and control of road work and the relation of State to local control; organization, personnel, duties and powers of State and local road officials; classification of State and local roads with particular reference to control and basis of payment, including methods of selection, powers of State highway departments in granting aid, procedure in making surveys, letting contracts, and the control exercised by the State and local officials over road construction and maintenance; sources of State and local funds, basis of allotment and apportionment of State funds, and the relation of State to local funds, and the amount available for road purposes during the latest calendar or fiscal year.

COLORADO

DEVELOPMENT.

State participation in road improvement in Colorado is of State-wide scope and consists of money aid, technical advice, and supervision, and was first evidenced in 1908 by the employment of State convicts on the improvement of certain roads designated by the legislature.

A highway commission was created in 1909 with advisory powers over all roads of the State and had at its disposal a fund for State-aid to the various counties.

The laws relating to State-aid and State highway officials have been modified and strengthened from time to time until at present the highway department of Colorado is well organized, has funds at its disposal for State participation in road work throughout the State, and exercises to a limited extent supervisory and advisory powers over local work executed by county officials.

A system of State roads comprising about 18 per cent of the total road mileage of the State composed of roads chosen by the various county boards with the approval of the State highway department has been designated as State routes from which a system of State highways will be selected for improvement with State and local funds by the State highway department.

The State legislature from time to time has provided special appropriations for the construction of bridges in various counties of the State.

At the close of 1916, about 1,800 miles, or 4½ per cent of the total mileage of public roads had been improved by hard surfacing. In 1916, $607,728 of State funds and $662,829 of local funds were expended by or under the supervision of the State highway department. The total expenditures by State and local forces reached $2,313,208 in the same year. In 1917 they totaled $2,570,000.

State participation in road work was delayed by lack of funds during the period 1911 to 1913, due to the fact that the law providing State funds for construction purposes was declared unconstitutional.

ORGANIZATION.

The organization of the road forces of the State and the relation existing between them is shown by chart on page 25.

State.—The State highway department, composed of the State highway commission, State highway commissioner, his assistants and employees, is in charge of all road improvements for which the State provides funds wholly or in part.

The commission is composed of five members appointed by the governor for terms of five years, one being appointed each year from one of the five districts into which the State is divided by law. The commission has general charge over the establishment, revision, construction, and maintenance of the proposed State highway system; the financial affairs of the State highway department, and the preparation of a yearly budget of proposed operations of the department. The affirmative vote of all members is required for any action proposed. In case they fail to agree, decision is made by the governor.

The State highway commissioner may be removed from office by the vote of all members of the commission. If they fail to agree, the governor, acting with the majority of the commission, decides the matter. In case of removal the successor to the commissioner is appointed by the commission to serve the remainder of the term for which the removed official was appointed. The State highway commissioner is appointed by the governor for a term of four

years and is required to designate an employee of the department to act as deputy in case of absence or incapacity of the commissioner.

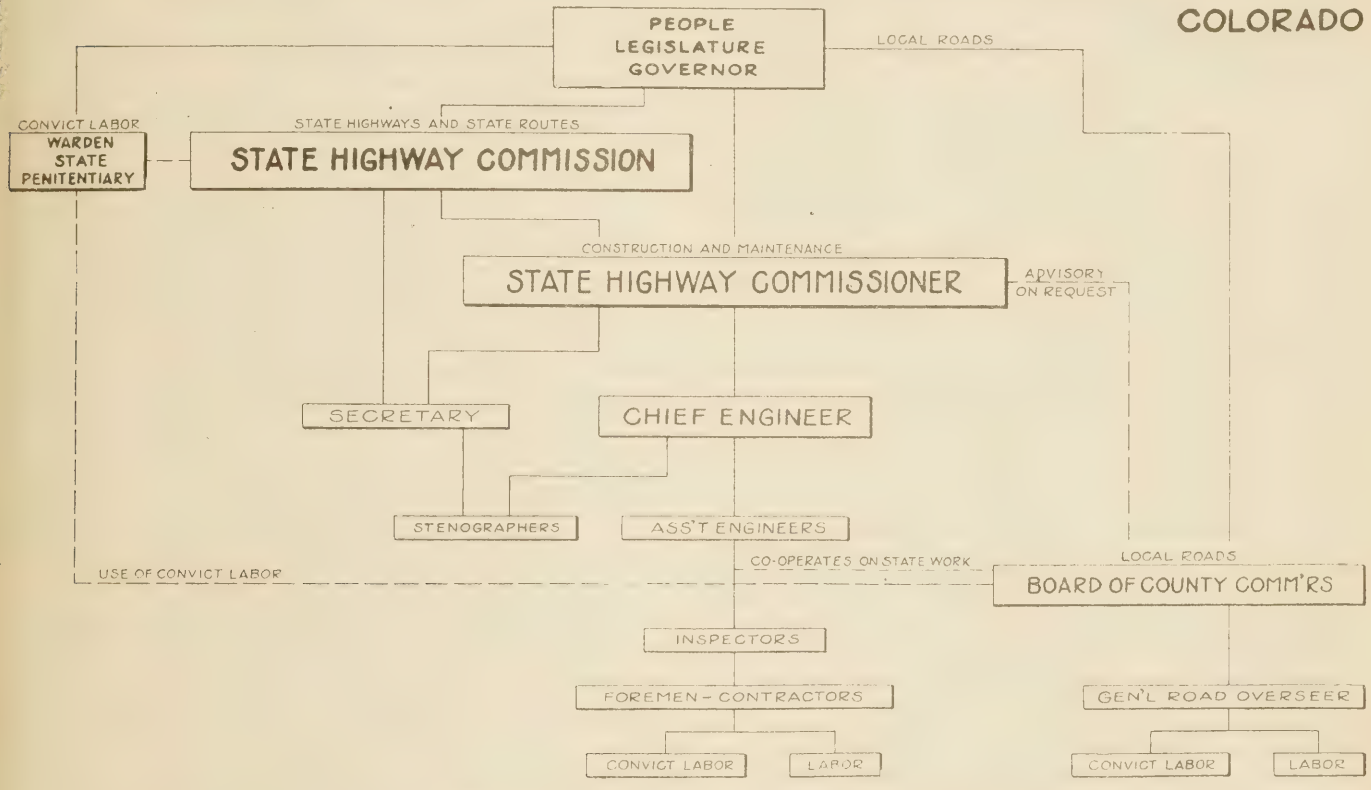
The commissioner is the executive official of the department and, subject to the orders of the commission, is in charge of all matters pertaining to road improvement financed wholly or in part by State funds. He appoints from lists of eligibles furnished by the commission such assistant employees as may bebneeded. The State civil-service. regulations do not extend to these employees. All payments made out of funds at the disposal of the department must bear the approval of the commissioner.

County.—County supervision over road affairs is vested in a board of commissioners, consisting of three members elected for a term of four years. The county clerk and county treasurer, elective officials, are clerk and fiscal agent, respectively, of the board. In all counties of the State, except Denver and those counties in which the road funds are less than $12,000 annually, the county board may elect a county road supervisor who is skilled in road building and who acts as the executive official of the board in all matters pertaining to roads and bridges under their control, and who has power to form road districts for the purpose of road dragging and other minor repairs. The board may divide the county into districts and appoint a general road overseer who, with the consent of the board, appoints deputy overseers for each district. The board has the power to levy and raise taxes and to enter into contracts for road and bridge improvement.

CLASSIFICATION, CONTROL, AND PROCEDURE.

The 39,739 miles of public road in Colorado are divided by statute for the purpose of fixing responsibility for construction, control, and maintenance into two groups, State highways and county highways.

State highways.—These comprise the roads chosen by the State highway commission from the system of 7,083 miles of State routes. They are improved under the immediate control of the State highway commissioner with State and local funds and maintained by State forces at the joint expense of the State and county.



The State route system comprises all roads designated prior to 1917 as State highways and such other roads as in the opinion of the commission should be added thereto. It is the intent of the State law that the State highways shall not be set apart from the State route system unless they have been improved or until funds are avaliable for their improvement. State routes may be improved and maintained as State routes by means of a joint fund supplied by the State and county in such proportion as may be mutually agreed to by the State and local officials. Federal funds, with the approval of the Secretary of Agriculture, may be used for the construction of either State highways or State routes. Construction of either the State highways or State routes is done under the supervision of the State highway commissioner either by force account, convict labor, with the approval of the warden of the State penitentiary, or may be let by contract. When executed by con-

tract, let by the State or by the State and county, payments are made on order of the State highway commissioner.

County highways.—These comprise all public roads of the State not specifically designated by the State highway commission as State highways or State routes. They are constructed and maintained by county forces with county funds. Convicts from the State penitentiary, on application of the county board and with the approval of the warden of the penitentiary, may be employed on county roads. All excess expense in connection with such employment is borne by the county. State routes are included in this system until withdrawn by action of the State highway commission.

REVENUES.

The State highway fund for the year ending November 30, 1917, was composed of receipts obtained from the following sources:

1. From the proceeds of a ½ mill State-wide tax levied on all taxable property in the State, $592,615.
2. By appropriation by the State legislature.
3. Receipts of the internal-improvement permanent fund and the internal-improvement income fund, $153,110.
4. From 50 per cent of the fees levied on motor vehicles and chauffeurs for license purposes and from 50 per cent of the fines and penalties accruing from violation of the motor-vehicle laws, $141,966.
5. From all public contributions, including those made by the United States Government or a department thereof. Such funds are to be expended in strict accordance with the terms of the contributions.

Local.—From 50 per cent of the fees levied on motor vehicles and chauffeurs as license fees, and from 50 per cent of the fines and penalties accruing from violation of the motor-vehicle laws. This fund is added to the proceeds of a tax levied by the county board at a rate which may not exceed $1 on each $100 of valuation. The combined fund is known as the county road and bridge fund.

Bonds.—Bonds may be issued for road and bridge purposes by the county boards when authorized by a majority vote of the tax-paying qualified electors of a county. Bond issues are limited as follows: Counties having a valuation between one and five millions may issue bonds to the amount of $12 for each $1,000 of valuation. When the valuation of a county exceeds $5,000,000, the limit is $6 for each $1,000 of valuation.

NEW YORK COST OF ROAD LABOR.

In the Ogdensburg region in Northern New York the labor of a man and team on the State road is now costing $7 a day.

CONNECTICUT.

DEVELOPMENT.

By its early start, its well founded policies, its liberal appropriations, and its gradual development from local to centralized control, Connecticut has, by State participation, accomplished a fairly comprehensive and connected system of improved roads. The State now controls approximately 11.5 per cent of the road mileage and contributes about 74 per cent annually of all road expenditures.

The State highway department was organized in 1895 with three commissioners in charge and a State-aid appropriation to counties and towns of $150,000 for the biennial period. The State was divided into three districts and one commissioner had charge of the work in each district. The law provided that the State, county, and towns each pay one-third of the cost of State-aid roads.

In 1897 State control was still further centralized by placing one commissioner in charge of all State-aid work. The organization has not been changed since that time and the administrative head of the department has been changed only once. The 1897 law limited State aid to towns only, and the State and towns were to share equally in the cost. The law of 1899 increased the State's share to two-thirds in the richer towns and three-fourths in the poorer towns. In 1907 this was increased to three-fourths and seven-eighths, respectively.

A connected system of trunk-line roads, over which the State exercises complete control and pays the entire cost of construction and maintenance, was provided in 1907. This system includes 1,500 miles, of which 950 miles have been improved. There are about 520 miles of road which have been surfaced, and 195 miles reconstructed through the aid of the State.

State funds available for trunk-line and State-aid work for the biennial period October 1, 1917, to September 30, 1919, will amount to approximately $7,224,000, including estimated receipts from automobile registration fees, while the total State funds expended for road work from 1895 to September 30, 1917, amount to $20,923,752. The trunk-line and State-aid roads are systematically maintained by the State under the patrol and gang systems. Out of a total of 14,061 miles of public roads, 3,100 miles, or about 22 per cent, had been surfaced up to January 1, 1917, thus showing that the State has been responsible for about one-half of the total improvement.

In 1916 the State expended $1,950,948 for construction, maintenance, and engineering, of which $85,000 was contributed from local funds. In addition to this, the local authorities expended for the same period approximately $1,250,000, making in all $3,285,948. In 1917 the total expenditures from all sources were $4,004,225.

ORGANIZATION.

The highway organization of the State and the relation existing between the local and State forces is shown in the diagram on this page.

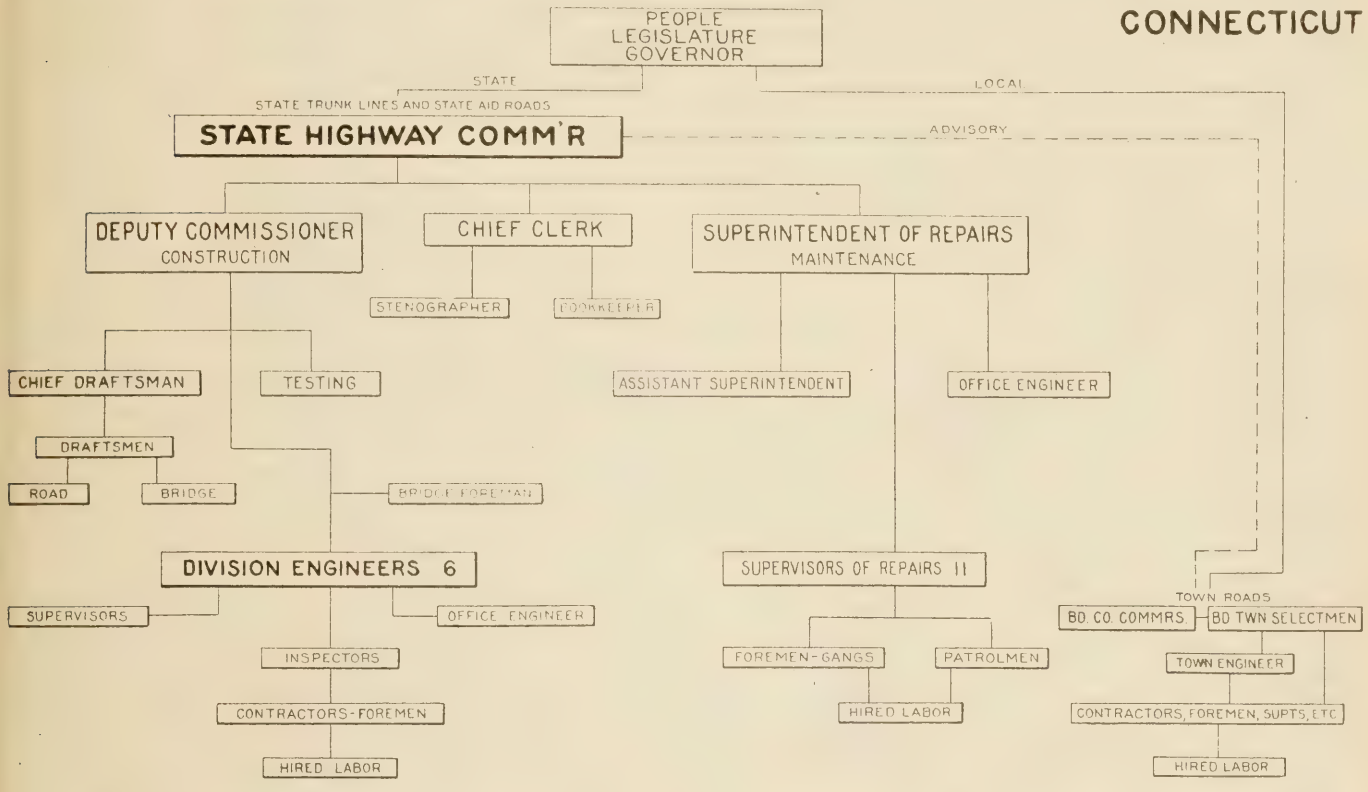
State.—The State highway department is controlled by a commissioner appointed by the governor with the advice and consent of the senate for a term of four years. The law provides that he must be a capable road builder. The present commissioner is not only the administrative and executive head of the department, but, being an engineer, he also has charge of the engineering work. All subordinate employees are appointed by the commissioner and are under the civil service.

The department is divided into two main branches, namely, construction and maintenance. A deputy commissioner has charge of construction, with six division engineers under him in charge of field work. There is also under the deputy commissioner a bridge foreman, who has charge of all repairs on trunk-line bridges. A superintendent of repairs has charge of maintenance with one assistant superintendent and 11 supervisors of repairs in charge of field work. The clerical and accounting work of the department is handled by a chief clerk.

Local.—The boards of selectmen of the various towns have full authority over public roads other than trunk-line and State-aid roads. These boards usually consist of three or more members elected annually at the town meetings. Some towns have a town engineer or other official who has immediate charge of town roads. If selectmen refuse or neglect to maintain town roads, the boards of county commissioners of the various counties may have the work done when petitioned to do so; otherwise, county officials have practically no authority over roads, and the power to take over roads for maintenance is seldom exercised.

CLASSIFICATION, CONTROL, AND PROCEDURE.

The public roads of Connecticut, comprising 14,061 miles, are, for the purpose of fixing responsibility of construction, control, and maintenance, divided into three groups—trunk-line, State-aid, and town roads.



Trunk-line roads are selected by the State highway commissioner with the approval of the legislature, and comprise 950 miles of the most important main traveled roads of the State. They are constructed and maintained entirely at the expense of the State with funds appropriated solely for use on trunk lines. The State highway department has complete control and supervision of construction and maintenance of trunk-line roads, and of all bridges on such roads having a span of 25 feet or more. The highway department also has charge of the elimination of grade crossings and other dangerous places on trunk lines.

When bridges of 25-foot span or over on trunk-line roads are constructed within a town, the cost is borne equally by the State and town. If such bridges are built between towns, one-half of the cost is paid by the towns in proportion to the assessed valuation of each. If located between counties, the counties are required to pay one-fourth each of the cost. Trolley companies using bridges are required to pay one-third of the cost.

All work costing more than $1,000 is let by contract by the State highway commissioner. Trunk-line roads are maintained by the State under the gang and patrol systems, the gang system being largely used. Funds for this purpose are derived from State appropriations and the receipts from the automobile registration fees.

State-aid roads, comprising 520 miles on January 1, 1918, are designated by the selectmen of the various towns with the approval of the State highway commissioner. They are constructed and maintained under the supervision of the State highway department. They are not links in a comprehensive system, but an effort is being made by the highway department to have them connected on continuous lines. Surveys, plans, specifications, and estimates are made by the State and submitted to the town selectmen for approval. The work is done by contract let by the State highway commissioner. Towns may submit bids for doing the work in their own limits and work costing less than $1,000 may be let without advertising.

In towns having an assessed valuation exceeding $1,250,000 the State pays three-fourths the cost of construction, and in towns having a valuation of $1,250,000 or less, the State pays seven-eighths of the cost. Payments are made by the State until the State allotment is exhausted, then the State comptroller bills the town for its share of the cost. Upon completion of construction, the State assumes responsibility for maintenance, but the towns are required to pay one-fourth of the cost.

Town roads include all other roads not referred to in the above groups. The work of construction and maintenance of town roads and bridges is done under the direction of the town selectmen.

REVENUES.

State.—Appropriations are made by the legislature for two-year periods. The amount appropriated and the purposes for which the appropriations were made for the two-year period, October 1, 1917, to September 30, 1919, are as follows:

Trunk-line construction, $1,500,000.
Trunk-line maintenance and reconstruction, $1,000,000 and auto fees.
State-aid construction, $1,000,000.
State-aid maintenance and reconstruction, $350,000 and refunds.
Trunk-line bridges, $450,000 and refunds.
Elimination of dangerous conditions on trunk lines, $75,000 and refunds.
Thames River bridge, $450,000.
Drawbridges and ferries, $66,700.
Niantic River bridge, $80,000.
Miscellaneous for salaries and administration of highway department, $253,000

To this should be added the receipts from automobile registration fees which are used for the maintenance of trunk-line roads, and will amount to approximately $2,000,000 for the two years referred to, thus making a grand total of State funds available for the two fiscal years, exclusive of refunds, of approximately $7,224,700, or $3,612,350 per annum. These funds are expended at the discretion of the State highway commissioner, except that no town can receive more than $20,000 State-aid money during a two-year period.

Local.—It is estimated that the towns are now expending under local control approximately $1,250,000 per annum for construction and maintenance of local roads and bridges. The funds for town roads are usually paid from the town budget tax.

Bonds.—No local bonds are issued, but from time to time the State has issued bonds for roads and other purposes. In 1907, and again in 1911, when deficits occurred in the State treasury, there were issued to cover them a total of $7,000,000 of State bonds, the larger portion of which was appropriated to pay the State's share of State-aid and trunk-line roads.

DELAWARE.

DEVELOPMENT.

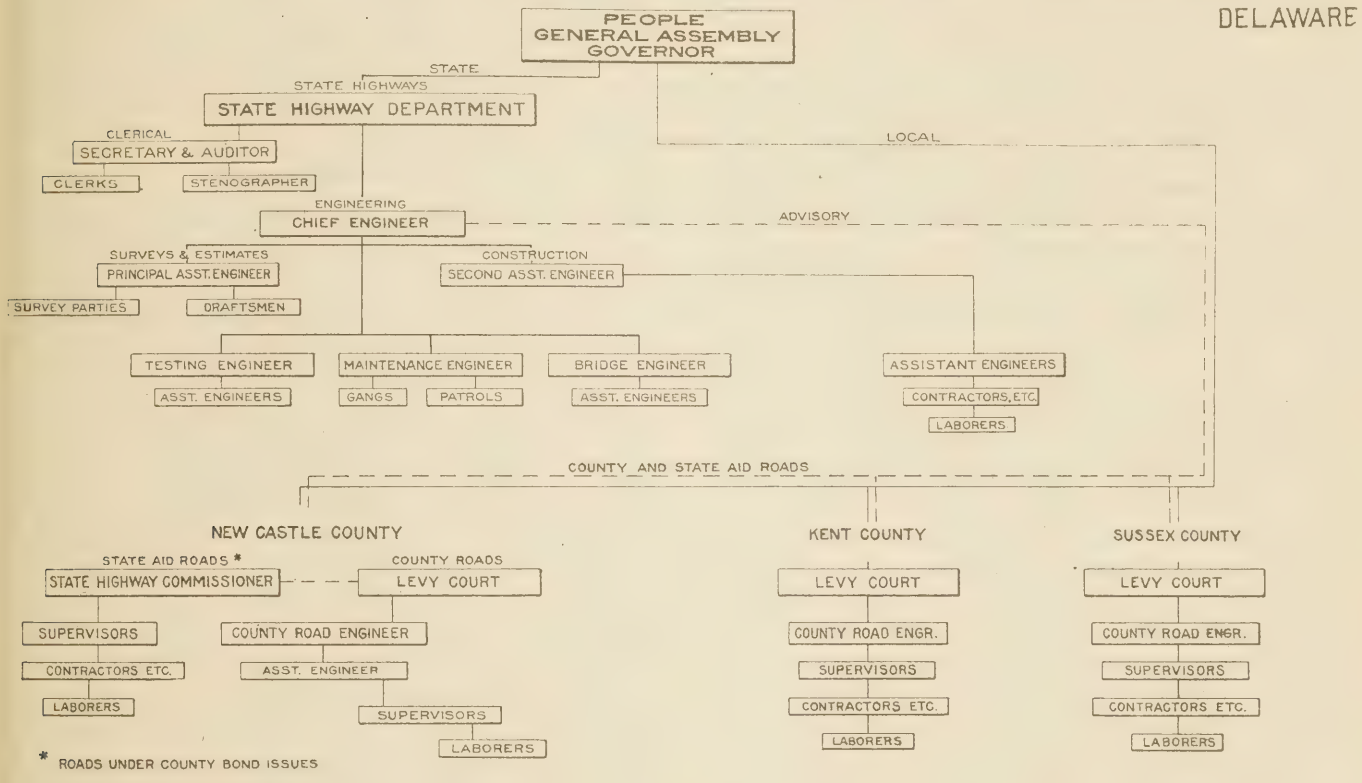
State participation in road work in Delaware is of recent origin. The present policy of the State is to build and maintain entirely at State expense a system of State highways and to aid the counties by annual donations amounting to $10,000 for each county. The State will exercise complete control over the proposed system of State highways which will include about 5 per cent of the total road mileage of the State.

The first State-aid law was enacted in 1903. This provided money aid to the amount of $10,000 per annum for each of the three counties to be expended with an equal amount raised by the counties under a State highway commissioner for each county. In 1905 this law was changed by providing a State highway commissioner for each of the counties of New Castle and Kent. Shortly after this law was enacted, Kent County ceased to avail itself of the right to use the State highway commissioner, and all State-aid work was handled by county engineers in Kent and Sussex from that time to the present. From 1903 to 1917 about 180 miles of road, more or less, disconnected, were constructed under this State-aid system. In addition to the money appropriated for each county, $1,000 was appropriated by the general assembly, to pay the salary of the State highway commissioner for New Castle County.

The legislature of 1917 created a State highway department and provided for the construction, reconstruction, and maintenance of a system of State highways entirely at the expense of the State. This system is to include about 650 miles of road and the cost of construction and reconstruction is to be paid from the fund derived from State bond issues, proceeds of the automobile licenses and State

income tax. Thus the State has two systems of roads under its jurisdiction or to which it contributes money aid, namely, State-aid roads and State highways, each controlled by separate and distinct sets of officials with apparently no coordination of authority.

Local road and bridge expenditures not under State control now amount to approximately $250,000 per annum. Total expenditures from all sources in 1917 amounted to $321,600. The State has 3,674 miles of road, of which 275 miles, or 8 per cent, have been improved.



ORGANIZATION.

The highway organizations of the State and the relations existing between them and the local forces are shown on the diagram above.

State.—The State highway department which has control of the construction and maintenance of State highways is composed of the governor and four members appointed by the governor. The terms of office of the first commissioners appointed are two, four, six and eight years, respectively. After the expiration of the terms of the first commissioners they are appointed for the full term of eight years. They serve without compensation and not more than two members shall belong to the same political party. One member must be a resident of the city of Wilmington, one a resident of New Castle County outside of the city, one from Kent County, and one from Sussex County. The administrative head of the department is the chief engineer, who is appointed by the State highway commission, three members concurring in his appointment. He must be a civil engineer not less than 30 years of age, shall have been in active service of his profession for 10 years, and shall have had responsible charge of engineering work for at least five years, and shall be qualified to design and direct road work. Graduation from a school of engineering of recognized reputation shall be equivalent to two years of active practice. The chief engineer may be paid a salary of $7,500 per annum. He has charge of all engineering work for the highway commission, and upon its approval may act as consulting engineer for the counties. He must approve the construction of the bond-built roads in New Castle County. The commission is authorized to appoint a secretary, whose salary may not be more than $3,000 per annum. On the recommendation of the chief engineer, the department also appoints such technical and clerical employees as may be necessary.

A State highway commissioner for New Castle County controls the roads constructed in that county with joint State and county funds, and cooperates with the levy court in the construction of roads improved with funds derived from bond issues. He is appointed by the governor for a term of four years and must be a resident of New Castle County. If he also holds the position of county engineer, his salary is $2,500, of which the State pays $1,000, and the county of New Castle $1,500.

The State aid funds appropriated for Kent and Sussex Counties are expended under the direction

of the county engineers of those counties without any State control or jurisdiction. The annual appropriation of those two counties, therefore, practically amounts to a donation on the part of the State, but the funds appropriated by the State must be expended together with an equal amount raised by the counties for improvement and maintenance of roads.

Local.—The levy courts are responsible for the improvement, repair, and maintenance, financing, and management of local roads in each county. In Sussex County the levy court is composed of three members, who are elected for 6 years, each of whom receives $1,200 per annum. In Sussex County the levy court appoints a county engineer at $1,800 per annum. All local and State aid work is carried on under the immediate direction of the engineer and the supervisors who are appointed by him. In Kent County the levy court of 10 members appoints the county road engineer at $1,500 per annum. All local and State-aid work is handled by the engineer and the supervisors, of whom there is one appointed by the levy court for each district or hundred. There are seven members of the levy court in New Castle County, in which permanent improvements are carried on under the direction of the State highway commissioner for the county and such supervisors as may be appointed by him. These supervisors receive $3 per day for time actually employed and must be practical men experienced in road construction. All maintenance work in New Castle County outside of the city of Wilmington is handled by the county supervisor who is appointed by and reports to the county engineer.

CLASSIFICATION, CONTROL, AND PROCEDURE.

The public roads of Delaware are for the purpose of fixing responsibility for construction, control, and maintenance, divided into three groups, namely, State highways, State-aid roads, and county roads.

State highways.—This is a tentative system of roads, at present embracing about 650 miles, which it is proposed to take over and permanently improve and maintain entirely at the expense of the State. The entire jurisdiction over this system for selection, construction, and maintenance is invested in the State highway department established during 1917. No State bonds have been issued, no State highways have yet been constructed. However, the State has taken over part of this system, about 19 miles of road known as the Coleman Du Pont Boulevard, which was constructed by Gen. Coleman Du Pont entirely at his own expense. That portion which is already completed starts at the Maryland line in the southern part of the State and extends in a northerly direction toward the city of Wilmington. Gen. Du Pont has agreed to pay for the completion of this road to Wilmington, a distance of 80 miles, making the total of the Du Pont Road approximately 100 miles.

State-aid roads.—Those which are built from joint State and county funds under the direction of the State highway commissioners of New Castle County, and the county road engineers of Kent and Sussex counties. About 180 miles were constructed up to January 1, 1917. Contracts are let by the levy courts and the roads when completed are maintained at the expense of the counties.

County roads.—All roads except those above referred to are classed as county roads and are under the jurisdiction of the levy courts. All State-aid roads after completion are maintained by the counties as county roads.

REVENUES.

State.—The State treasurer is authorized to issue State bonds with which to construct a system of permanent State highways. Two sources of funds are provided with which to pay interest and principal of these bonds, and for the support of the State highway department as well as for the maintenance of State highways, namely, the gross receipts from automobile registration fees and the gross receipts from the State income tax less $250,000 per annum, which goes to public schools. After deducting enough each year to pay interest on the bonds outstanding and 2½ per cent of the total of outstanding bonds for sinking funds, the balance is used for the support of the State highway department and for the maintenance of the State highways. The funds are appropriated at the discretion of the State highway department on the budget system. Additional bonds may be issued whenever the funds available will justify. The amount of bonds that may be issued will depend, of course, on the amounts received from the sources above referred to and upon amounts which will be necessary to support the highway department and maintain State highways. No State bonds have as yet been issued. During 1917 the gross receipts from the automobile registration fees amounted to $140,000, but the general assembly provided that $50,000 of this should be reserved, leaving $90,000 for the purpose outlined. In 1918 and thereafter the gross receipts from this fund are to be placed to the credit of the State highway fund to be used as indicated.

The general assembly in 1917 appropriated $10,000 for State aid to each of the three counties for the years 1918 and 1919; also $1,000 per annum toward the salary of the State highway commissioner from New Castle County, making a total of $31,000 per annum for the two-year period.

Local.—Special taxes to meet State aid and regular taxes for maintenance are levied by the levy courts of the respective counties. These local funds amount to approximately $250,000 per annum.

BONDS.

State.—Bonds shall bear not to exceed 4½ per cent interest and must be paid within 40 years, but the bonds must be issued subject to call after one year from the date of issue, and if called, the State buys them at 103. A sinking fund is established by the State treasurer with which to retire the bonds amounting to 2½ per cent per annum of the total bonds outstanding.

Local.—Most of the funds with which roads have been permanently improved in the various counties have been derived from county bond issues. On January 1, 1915, Kent County had $30,000 of road bonds outstanding and New Castle County, $1,250,000. Sussex County had not issued any bonds. The general assembly in 1917 authorized additional issues as follows: One hundred thousand dollars in Kent County, $600,000 in New Castle County, and $1,000,000 in Sussex. In New Castle and Sussex the bonds may bear not to exceed 4½ per cent interest, while in Kent 5 per cent may be paid. All of the county bonds are to be deferred serial type, the first payment falling due 10 years from the date of issue, and the last payment, 39, 43, and 49 years in Kent, New Castle, and Sussex, respectively. All of the bonds, however, may be issued subject to call after five years, at which time they may be redeemed at 5 per cent.

FLORIDA.

Development.—State participation in road work in Florida has been of such small amount as to be relatively unimportant, as the State road department was not created until 1916 and then acted only in an advisory capacity over such road matters as were brought to its attention. However, in assenting to the provisions of the Federal aid road act in 1917, the legislature provided a limited amount of funds to be expended by or under the supervision of the State road department in the construction and maintenance of a system of State roads and as aid to counties in the construction of certain designated roads, and extended and broadened the powers and duties of the department.

Road improvement in Florida has, heretofore, been left to the various counties, and while about 20 per cent of the road mileage of the State has been hard surfaced, the various counties have not followed uniform standards of construction or cooperated with each other to secure a well connected State-wide road system.

Under the new powers delegated to the State road department the State will be represented in the construction and maintenance of certain roads and will have limited general supervision or powers over a large amount of local construction and repair.

In 1916, the State road department expended $10,484 in educational and advisory work, while about $4,000,000 was expended by the counties for road construction and maintenance. In 1917 the total expenditures for road and bridge purposes were $6,384,797.

The total amount of mileage included in the State road system has not been made available for publication.

ORGANIZATION.

The organization of the highway forces of the State and the relation existing between them is shown on page 32.

State.—The State road department consists of five nonsalaried members appointed by the governor for terms of four years, one member being resident in each of the four Congressional districts of the State, and one member from the State at large. A chairman and secretary are elected annually from the membership of the department. The State road commissioner, who is required to be a competent and efficient engineer well versed in the building of good roads, is selected and employed by the department. Such other assistants and office force as may be required by the amount of work in hand are provided by the department. In addition to the duties shown on the chart, in the appendix, the State road department is required or empowered to designate a system of State roads and a system of State-aid roads. The department may, when requested by local officials, take charge of construction and maintenance of local roads or bridges.

The department also is directed to inspect the books, records, methods of construction and repair of roads and bridges of the various county boards of commissioners, and to point out improper practices or procedure, and to bring the matter to the attention of the governor of the State upon neglect or refusal of the board to remedy the conditions or practices criticised by the State road department. The governor has the power to remove county officials for malfeasance or misfeasance and to appoint their successors. The department is required to compile and to furnish road officials and other interested citizens of the State, data relative to road mileage, methods and materials of construction and repair, and to publish road maps when practicable.

County.—Each county is governed by a board of five commissioners elected from the five districts of the county. This board has full control over all

roads of the county except the mileage included in the State or State-aid system. The board may appoint a county road superintendent to take active charge of the road and bridge work of the county, or the commissioners may assume charge of the work in their respective districts and appoint overseers to take local charge of the work.

CLASSIFICATION, CONTROL, AND PROCEDURE.

The roads of Florida, comprising about 18,000 miles, are for the purpose of fixing responsibility for construction, control and maintenance, divided into three groups: namely, State roads, State-aid roads and county roads.

State roads are designated, constructed, and maintained by the State road department. State funds for their construction and maintenance are provided by the legislature or by a State-wide tax. Federal funds allotted to the State are expended on State or State-aid roads.

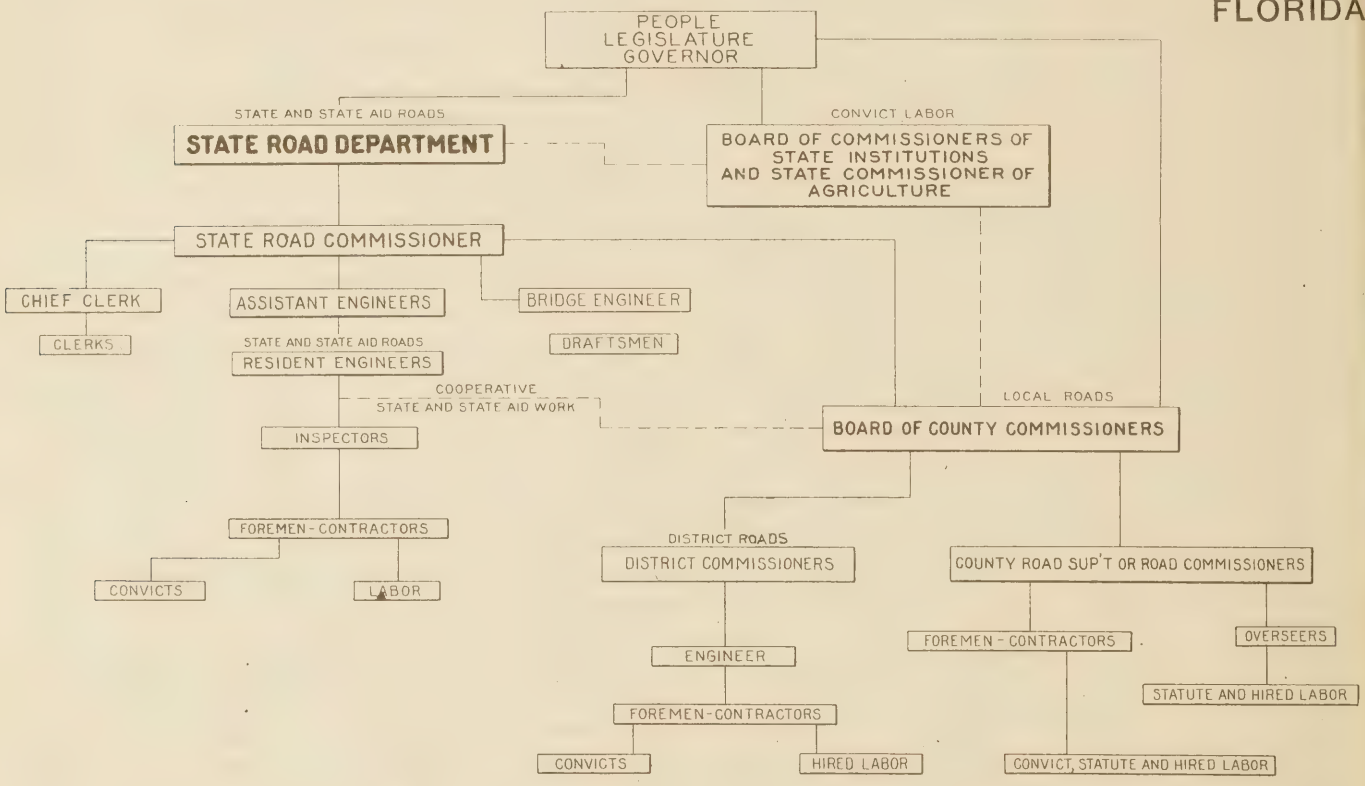
State-aid roads are selected by the State road department in cooperation with the county board of commissioners. The cost of plans and estimates is paid jointly by the State and county. The cost of construction is borne equally by the State and counties but Federal funds may be substituted for State funds. The State road department furnishes the engineer, and the county pays the field and travel expenses. Construction is under control of the State road department, and may be executed by force account, convict labor, or by contract.

Male convicts from the State Penitentiary may be utilized for road construction and maintenance purposes as follows: Not to exceed 300 may be placed at the disposal of the State road department. All expenses incurred on account of convicts so detailed are paid by the State road department out of funds provided for road construction and maintenance purposes. Such additional convicts as may be available may, when requested, be leased to the county boards of commissioners. Such convicts are at all times subject to supervision by, and the rules and regulations of, the board of commissioners of the State institutions, and the State commissioner of agriculture. When the convicts are leased to counties, the county pays either $1.00 or $10.00 per month per man, the rate being dependent upon the physical conditions of the convict.

When State or State-aid work is to be left to contract, due publicity by the State road department is required. The contract is let by the State road department to the lowest responsible bidder conditioned on his filing an acceptable bond.

Payment of State funds may not be made except on a voucher signed by the secretary and approved by the chairman of the State road department, the voucher being drawn against the Comptroller of the State, who issues his warrant to the State treasurer.

State-aid roads are maintained under the supervision of the State road department. One-half of the cost of maintenance on these roads is paid by the county.



County roads, comprising all other roads of the State, are opened, constructed, and maintained by the county boards with county funds. However, the State road department is required on the request of the county officials to detail competent assistants to advise with local officials or to take charge of construction of county roads or bridges.

REVENUES.

State.—A state-wide tax not exceeding one-half mill on each dollar of valuation of the taxable property of the State is levied each year. The proceeds of this tax estimated at $150,000 for the fiscal year 1918 are at the disposal of the State road department for construction and maintenance of State and State-aid roads. The legislature provided appropriations of $56,000, $112,000, and $168,000, available for the years beginning July 1, 1916, 1917, and 1918. These sums are not in addition to the proceeds of the tax levy fund, as these amounts are deducted therefrom and the balance remaining, if any, may be used by the State road department. Fifteen per cent of the net revenues, estimated at $40,000 for the calendar year 1918, from the licensing of motor vehicles and chauffeurs is set aside for the maintenance of the State road department.

County.—Eighty-five per cent of the net revenues from licensing of motor vehicles and chauffeurs is set aside as a State maintenance fund for the maintenance of State and State-aid roads and bridges, and is apportioned among the counties in proportion to the total State tax paid by each county into the State treasury. When this fund is not required for State or State-aid road maintenance purposes, it may be expended for new construction of roads of those classes.

The county boards may levy a special tax at a rate of not less than 3 or more than 8 mills on each dollar of taxable property for road and bridge purposes, provided that 50 per cent of the amount collected within the corporate limits of towns and cities be delivered to the municipal authorities for street improvements. Special districts of the county may be formed and may levy additional taxes for road improvement.

A labor tax of not to exceed five days' labor is required of each person residing more than 30 days in the county and who does not pay any real or personal tax. This tax may be commuted in whole or in part by the payment of $1 for each day of labor required.

BONDS.

Sinking-fund bonds may be issued by counties or special districts when authorized by a majority of the voters resident therein. The amount of the issue, the term, and the rate of interest are specified in the proposal submitted to the voters.

On January 1, 1915, there was outstanding a total bonded indebtedness of $5,959,199.22 incurred by counties for road and bridge construction.

These bonds bore interest at 5 and 6 per cent and ranged from 20 to 30 year terms.

IDAHO.

Development.—State interest in road and bridge improvement in Idaho has been manifested intermittently since 1905. During the period 1905 to 1913 the legislature provided additional funds for various local projects in communities unable to bear the financial burden imposed by the construction of improvements tending to be of more than local benefit.

With the organization of the State highway department in 1913 and the provision of funds for the support thereof, State participation in road and bridge improvement became a fixed State policy, and is now being extended to a system of State highways which comprises about 9 per cent of the total road mileage of the State and which has been selected with the approval of and is administered by the State highway commission.

Idaho, in common with other thinly settled States, is handicapped by a lack of funds necessary to construct roads and bridges essential to the encouragement of immigration and the development of the mining and timber resources of the State. However, State funds in combination with local funds are being expended for substantial bridges and culverts and the grading of rights of way selected to insure proper alignment and easy gradients. While the need of surfaced roads is recognized, the policy of the State highway department has been to defer that stage of construction until more funds are available, as the graded earth roads with but few exceptions serve the present needs of the public, and surfacing may be added at a later date when a larger amount of funds becomes available.

At the close of 1916, 800 miles or 3.3 per cent of the total State mileage had been improved. Of this mileage 413 miles have been built under State supervision.

Road and bridge expenditures during 1916 amounted to $100,057 of State funds and $348,061 of local funds expended by or under the supervision of the State highway department.

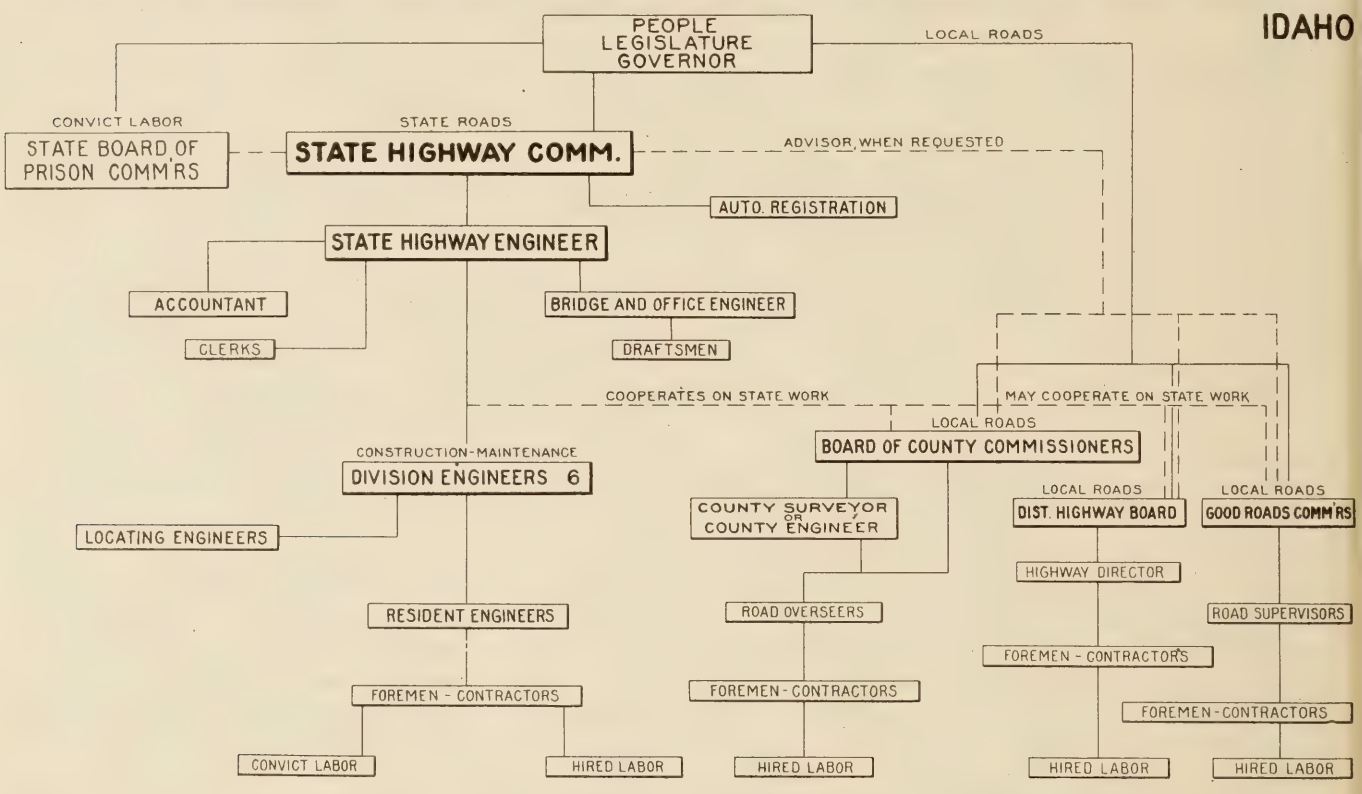
The total expenditure by all road forces of the State for the same period reached $1,948,118. The State thus exercised supervision over 23 per cent of the total expenditures. In 1917 the total was $2,092,723.

ORGANIZATION.

The organization of the road forces of the State and the relation existing between them is shown in the chart on the next page.

State.—The State highway commission is composed of the secretary of the state and two members appointed by the governor for terms of three years. The State highway engineer is selected by the commission and serves as the executive official of the State highway department. He selects with the approval of the commission such office and field assistants as may be required to carry out the duties imposed on him by law and the orders of the commission. Field operations are carried out under the control and direction of six division engineers who report to and represent the State highway engineer. The State highway department has full control over construction, financed wholly or in part with Federal or State funds, and is responsible for the proper maintenance of such work when completed.

County.—Road affairs in the county are administered by a board of county commissioners, elective officials, who levy and expend the proceeds of the ordinary taxes prescribed by general State law for the construction and repair of county roads and bridges. Whenever improvements financed by special taxes or the proceeds of local bond issues are contemplated, a special highway district or a good roads district may be formed within the limits of the county and an administrative board consisting of three elective members is chosen to take charge of the work. In the case of the good-roads district, the board is dissolved upon completion of the project. The highway district is an organization of a more permanent nature, the members of the board being elected for terms of four years and the organization may continue until dissolved by action of the residents of the district. The county board or district board may cooperate with the State highway commission in the construction of State highways located within the limits of the county or district, and may construct under their exclusive authority roads of local importance. The county or district may employ an engineer to supervise work not under the supervisory control of the State highway department. Road overseers are appointed by county boards to supervise statutory or paid labor used for minor repairs or ordinary maintenance.



CLASSIFICATION, CONTROL, AND PROCEDURE.

The 24,386 miles of public road in Idaho are, for the purpose of fixing responsibility for control, construction, and maintenance, divided into two groups, namely, State highways and county roads.

State highways.—These comprise about 2,200 miles of road selected by the State highway commission for improvement under their direction with funds provided by the State and local governments. The State highway department executes all surveys, prepares plans and estimates, and supervises the construction for all roads of this group. The cost of the work, exclusive of the cost of right of way, is borne as follows: In all counties or districts having an assessed valuation of $1,000,000 or more, the State pays one-third of the cost and the county or district pays the remainder. In districts of less than

$1,000,000 valuation the cost is shared equally by the State and county or district. When completed the road is maintained by the State or the commission may arrange with the county or district to execute maintenance.

Initiative for improvement of roads of this group is taken by the county or district board which makes application to the State highway commission for State assistance. If deemed feasible and funds therefor are available, the necessary preliminary work is executed by the State highway department. The plans and specifications are approved by the State highway engineer and the local boards concerned, and when the estimated cost exceeds $2,000, the work is let by contract or with the consent of the board of prison commissioners and warden of the penitentiary, State convicts may be employed by the State highway commission to execute the work. If done by contract, contracts are let by the State highway commission and a resident engineer is detailed to take charge of the work during its progress. He prepares monthly estimates covering 85 per cent of the completed work and these estimates when approved by the local boards, the State highway engineer, and the State board of examiners, are paid by the State treasurer. Final payment is made in a similar manner.

County roads.—All other public roads of the State are classed as county roads and are located, controlled, constructed, and maintained by county or district boards with local funds. The State highway department exercises no authority over roads of this group, but may advise local officials relative thereto at their request. County prisoners may be required by order of the county board to labor on public highways.

REVENUES.

State.—The State highway fund is composed of the remainder of the proceeds of the State bond issue of $1,000,000, or about $500,000, 22½ per cent of the revenues accruing from the registration of motor vehicles and 22½ per cent of all fines and penalties accruing from violation of the motor vehicle act. This fund is available for the support of the State highway department and for the construction and maintenance of State highways. It is estimated that State's portion of the motor vehicle fund will amount to about $98,000 for the calendar year 1918. Two and one-half per cent of the revenues from motor-vehicle registration and a State highway tax of one-tenth of 1 mill upon the assessed value of property within the State are placed on redemption funds for the payment of the principal and interest of State highway bonds.

County.—County road and bridge funds are obtained from the imposition of a cash poll tax levied at a rate not exceeding $4 per year on each able-bodied adult male person between the ages of 21 and 50 years. Seventy-five per cent of the amount collected within the borders of incorporated cities, towns, and villages is returned to the road fund of the corporation. Seventy-five per cent of the auto revenues originating in each county are returned to the counties and districts for road improvement purposes. It is estimated that about $300,000 will be distributed by State authorities for the calendar year 1918. Property taxes at a rate not exceeding $1 on each $100 of assessed valuation may be levied by counties or district boards. The county board is entitled to receive 25 per cent of the funds raised by ordinary taxation in a highway district.

BONDS.

Bonds of the sinking-fund type may be issued by the State at a rate of interest not exceeding 4½ per cent for a term not exceeding 20 years. Similar bonds may be issued by a good-roads district at a rate not exceeding 6 per cent for a term not exceeding 20 years. Highway districts may issue bonds of similar type at the same rate of interest for a term not exceeding 10 years.

INDIANA.[1]

DEVELOPMENT.

State supervision over and participation in road improvement in Indiana has recently become a fixed State policy as the legislature in 1917 provided for the establishment of a State highway commission, for the designation of a State-wide system of main market roads to be improved at State and county expense, and for the extension of the supervisory and advisory powers of the commission to other roads of the State on request of the local officials in charge thereof.

The system of main market roads is at present limited to a mileage of 2,000, but after January 1, 1920, may be increased by the State highway commission with the approval of the governor of the State.

Prior to the passage of the legislation above referred to, road construction and maintenance in Indiana was vested in 1,017 township and 92 county boards. Under this form of organization about 31,000 miles or 42.5 per cent of the total road mileage of the State, had been surfaced, gravel and water-bound macadam being the most popular types of construction. However, as financing of road improvements by means of bond issues has been the almost universal practice and as the types of road constructed are ill suited to present-day traffic needs, it

[1] The constitution of the State highway law is now being tested in the supreme court of the State.

became necessary, in order to provide for economical reconstruction and maintenance of roads in actual use, to place trained technical men in supervisory and advisory charge of this work rather than to depend, as had been done in the past, on local officials elected by popular vote.

Local control of road work reached a higher state of development in Indiana than in most States and produced a system of surfaced roads which, under traffic conditions prevalent 20 years ago, would have been eminently satisfactory to the public. However, new traffic conditions have required different administrative measures and in the future action of town supervisors will be confined to roads of lesser traffic, leaving the more important roads under the charge of county and State officials.

The extent to which bonds have been issued for road and bridge improvements is evidenced by the statement that on January 1, 1915, $5,137,671.12 of county bonds and $36,957,686.22 of township bonds were outstanding.

The expenditures by all local forces of the State in 1917 for road and bridge purposes reached a total of $14,014,000.

ORGANIZATION.

The organization of the highway forces of the State and the relation existing between them is shown by chart on page 37.

State.—The State highway commission, a bipartisan body composed of four members appointed by the governor for terms of four years each, one member being chosen from each of the four districts into which the State has been divided by legislative enactment, is the administrative body in charge of the road work of the State. The State highway engineer, required to be a competent and skilled civil engineer, is selected by the commission and serves at their pleasure. He is the secretary of the commission and serves as their executive officer in the enforcement of State and bridge laws and the rules and regulations of the commission. Such technical and clerical force as may be required is employed by him with the approval of the State highway commission.

The State highway commission is required to select a system of main market roads, to cause to be prepared plans, specifications, estimates of cost of proposed improvements, and to enter into contracts for and to furnish competent supervision during the progress of the improvements. The State highway engineer, on request of 50 or more interested property owners, is required to inspect plans, specifications, estimates of cost, etc., of any road costing $2,000 or more per mile or of any bridge costing $500 or more, and the work may not proceed without his approval. The State highway department in general is vested with broad powers over the construction and maintenance of the main market road system.

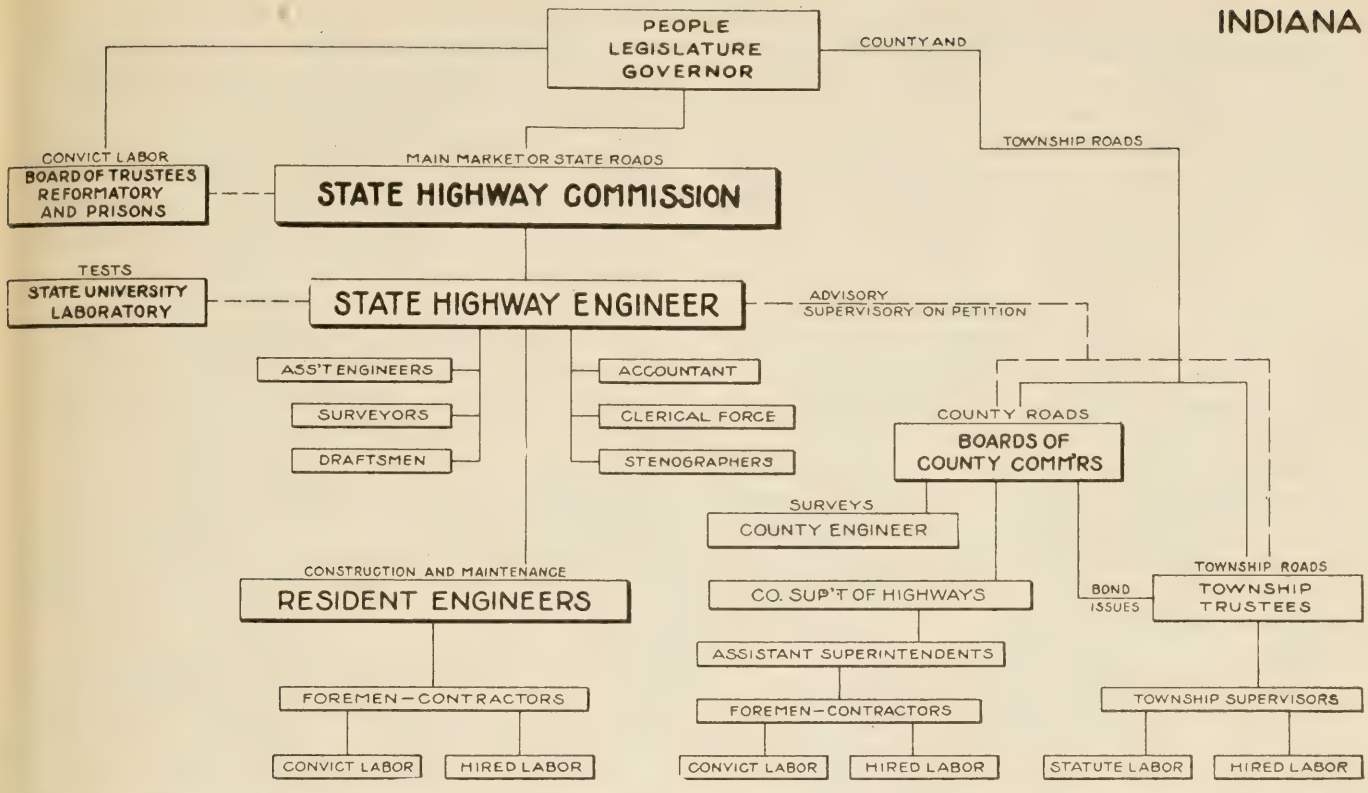
County.—Road administration in the county is vested in a board of three commissioners, one being elected each year. The county auditor and county treasurer are respectively clerk and fiscal agent of the board. The board cooperates with the State highway commission in the improvement of the main market roads of the county and appoints for a term of two years a county highway superintendent who has charge of the maintenance of the improved county roads. He may appoint an assistant superintendent for each 25 miles of road under his care. The county surveyor is ex officio engineer of the county or in case of his inability to execute and to supervise engineering work the board may appoint an engineer.

Township.—The township trustee, elected for a term of four years, has general charge of the road affairs of the township. He is assisted by supervisors elected for a term of two years by the voters of each district into which each township is divided.

CLASSIFICATION, CONTROL, AND PROCEDURE.

The 73,347 miles of public road in Indiana are for the purpose of fixing responsibility for construction, maintenance, and control divided into three groups, namely, main market highways, or State roads, county roads, and township roads. Of this system of main market highways, limited to a mileage of 2,000 until January 1, 1920, 800 miles connecting the principal centers of population of the State, has been designated by the State highway commission, and will be constructed under supervision of the commission with Federal, State, and county funds.

Initiative for construction or reconstruction of roads of this group is taken by the county board which makes application to the commission for State aid, defines in a general way the extent of the project and agrees to provide sufficient funds to pay the county's share of the total cost. On approval of the project by the commission, the State highway engineer causes to be prepared surveys, plans, specifications, and estimates of cost for at least two types or kinds of construction. Bids on both types are requested by the county board through notices published in two newspapers of different political faith in the county. The county board after consideration of the bids selects one of the two types and with the approval of the State highway engineer lets the contract. In case of disagreement between the State highway engineer and the county board over the contract, the power to render a final decision, after five days, lies with the State highway commission. Bridges costing more than $500 are let under separate contract. Road improvements



costing less than $1,000 may, at the discretion of the State highway engineer, be executed by force account labor. The work during progress is under the supervision of the State highway engineer or his representative. Partial payment may be made by the State treasurer when approved by the State auditor at monthly intervals when based on estimates approved by the State highway engineer. Final payment is made in a similar manner on completion and acceptance of the work by the State highway engineer. The amount of cost to be borne by the county, 50 per cent or more, is certified by the State highway engineer to the county board for payment. All payments accruing from this source are deposited with and become a part of the State highway fund. Roads of this group are maintained by the State highway department at State expense. State convicts, with the approval by the governor of arrangements between the authorities having charge thereof and the State highway commission, may be utilized in the preparation of road-building material.

County roads.—The county roads comprise those which have been improved at township expense and are maintained by and at the expense of the county.

Township roads.—These may be improved and surfaced on petition to a county board of 50 freeholders resident of the township or townships affected. In special cases involving the construction of 3 miles or less of road which has termini specified by law, the county board may order the work done without submitting the proposal to the voters of the territory affected. Otherwise an election is held to secure an expression of public sentiment and to authorize the issue of the necessary township bonds. The work during progress is under supervision of the county boards and such engineering force as they may select. However, on petition of 50 or more interested freeholders, the State highway engineer is required to inspect the plans and specifications and may require changes therein, or, if requested, he may detail at township expense a competent subordinate to take charge of the work. Surfaced roads of this group are transferred to group 2 for control and maintenance. The remaining roads of this group are maintained by township forces at township expense. The work done under this head consists principally of minor repairs in grading and such general maintenance as is usually done by district or township officials.

REVENUES.

The State highway fund is composed of (*a*) proceeds of the inheritance tax paid after April 1, 1917, (*b*) receipts from public-service corporations on account of the elimination of grade crossings, (*c*) reimbursement by counties as their share of construction, (*d*) appropriation by the State legislature, (*e*) all unexpended balances remaining in the fund at the close of a fiscal year. For 1918 approximately $1,050,000 will be available, of which $600,000 will be derived from appropriation and $450,000 from the inheritance tax.

From this fund are deducted sums necessary to support and maintain the State highway depart-

ment and provide for the maintenance of the system of main market roads, and the remainder is apportioned among the counties of the State in the proportion that their main market road mileage bears to the total road mileage of the system.

County.—The motor-vehicle fund is apportioned by the secretary of state among the counties as follows: One-third equally among the counties, one-third in proportion to the miles of free gravel or macadam road in the county, and one-third in the ratio of each county's contribution to the motor-vehicle fund. Counties may levy a tax at a rate of not to exceed 1 cent on $100 valuation for maintenance of free improved roads.

Township.—A tax at a rate not exceeding 30 cents on each $100 of valuation may be levied for road and bridge purposes. Up to 20 cents of this tax may be worked out on the township roads, providing that an additional tax paid in cash of 10 cents on each $100 valuation be levied for road and bridge purposes.

Bonds.—Serial bonds in an amount not exceeding 4 per cent of the assessed valuation of the county or township may be issued for road and bridge purposes. Such bonds bear a rate of interest not to exceed 4½ per cent and are generally limited to a term of 20 years.

IOWA.

Development.—State interest in and supervision over road and bridge improvement in Iowa has developed from the organization in 1904 of several members of the faculty of the Iowa State College at Ames as a State highway commission with advisory and research powers to a State highway department provided with limited state-wide powers over all road and bridge work in the State, and with full powers over a fund to assist the various counties in constructing permanent improvements on a specified system of roads.

The work instituted in 1904 by the State College was amplified in 1913 by the creation of an independent highway commission of three members, one of whom was the dean of engineering at the State college with increased advisory duties and a more liberal appropriation for its support.

As the State did not provide funds for road and bridge construction until 1917, practically all improvements have been financed and executed by the counties of the State, generally in accordance with plans approved by the State highway commission.

The legislation of 1917 provided for the selection of rural post roads with a total mileage of not less than 2,000 nor more than 6,000, to include a part of the road mileage of each county as a road system to be improved under State supervision at State and county expense.

Statistics available at the close of 1916 show that about 1,000 miles, or approximately 1 per cent of the total road mileage of the State, had been surfaced.

Expenditures for road and bridge purposes during the year 1916 were as follows: By the State highway commission for its support and operation, $90,821, and $14,337,056 by the local officials under the more or less general supervision of the State highway commission.

A large percentage of the above sum was expended for the construction of bridges and culverts of permanent type and the greater portion of the remainder of the sum was spent on drainage, grading, and dragging of earth roads, leaving a comparatively small sum expended for permanent surfacing. Thus the present road system of Iowa consists almost entirely of earth roads.

Iowa has a large road mileage and is not willing at present to bear the financial burden required to provide surfacing for the present road system. However, the necessary preliminary work for a system of good roads is being executed and surfacing may be added when permitted by financial conditions.

ORGANIZATION.

The organization of the highway forces, State and local, and the relation existing between them is shown on page 39.

State.—The administrative head of the road and bridge forces of the State is a State highway commission composed of the dean of engineering of the Iowa State College and two members of different political faith appointed by the governor for terms of four years each.

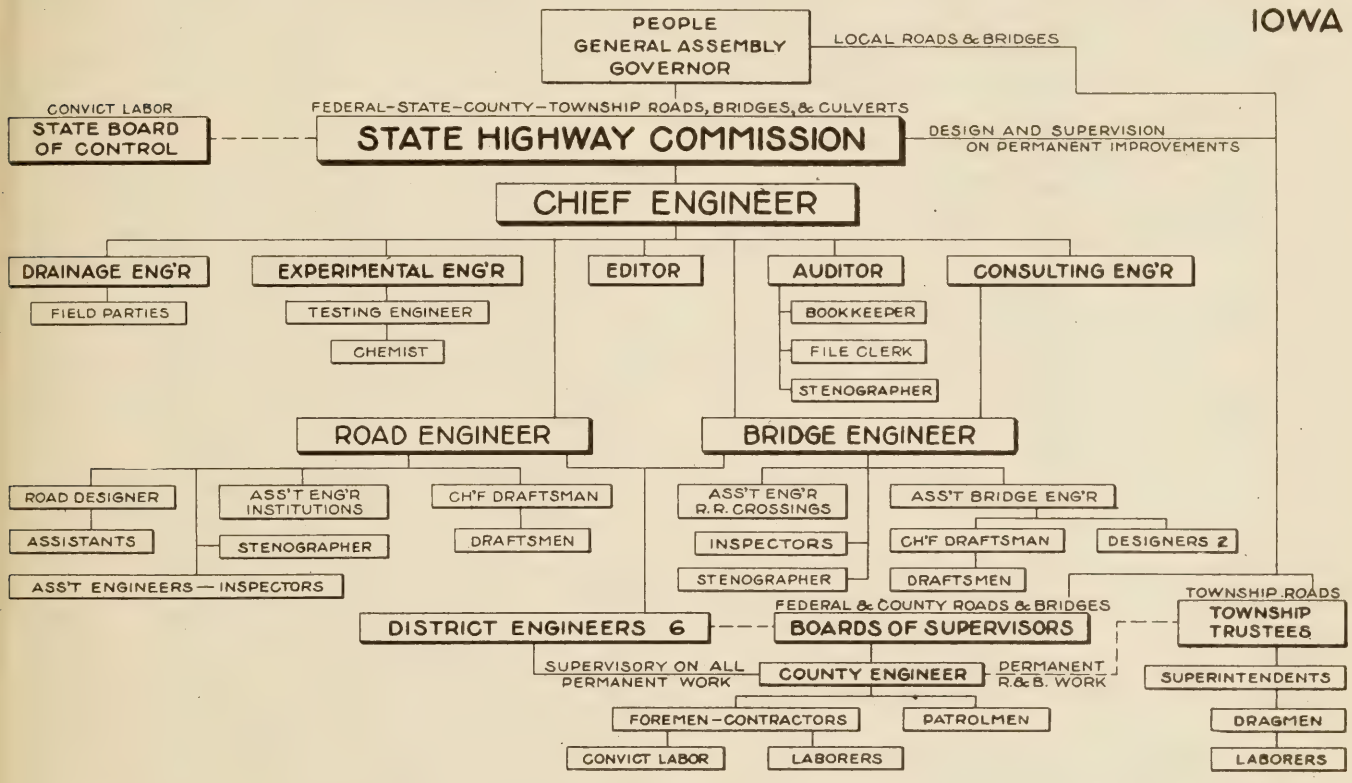
The commission is empowered to select the roads upon which Federal or State funds are expended, to supervise such expenditures, and to exercise general supervision over all road and bridge work throughout the State. All county and township road officials are subject to supervision and inspection by the State highway commission and may at the initiative of the commission be removed from office for negligence of duty or improper or unlawful conduct of their office.

The commission, in cooperation with the Iowa Railroad Commission, has the power to make agreements with railroad companies for the elimination of dangerous grade crossings and may defray, on behalf of the State, a portion of the cost of such work.

The commission has the power to employ and fix the compensation of such employees as may be necessary to carry out the duties imposed upon them by law. The chief engineer appointed by the commission serves as their executive official in charge of the force employed by the commission, and is represented in various sections of the State by five division engineers.

County.—The board of supervisors, consisting generally of three members elected for terms of three years, comprises the body in charge of county road and bridge work. The number of supervisors may be increased to five or seven by a majority vote of the county. The county auditor and the county treasurer are respectively clerk and fiscal agent of the board. The county engineer is selected by the board for a term of office not to exceed one year. He serves under the direction of the board but the State highway commission exercises extensive jurisdiction over the technical part of his duties.

Roads of this group are constructed by the county under the direction of the State highway commission, the cost being borne by the State and Federal Governments from a fund known as Federal-county cooperation road fund. The county contributes whatever additional amount it is possible to divert to such work from regular road levies. All rights of way are secured and all bridges and culverts are constructed at the expense of the county. Initiative in construction is taken by the county board, which requests an allotment of funds for a specified project and contracts with the State



Township.—Road affairs are administered by a board of directing trustees. The township clerk is clerk of this board. The board appoints at least one and not more than four township road superintendents to have charge of the road construction and repair, and to execute or supervise the dragging of township roads required by law.

CLASSIFICATION, CONTROL, AND PROCEDURE.

The 104,074 miles of public road in Iowa are divided for the purpose of fixing responsibility for control into three groups, namely, systems of intercounty roads, county highways, and township roads.

Intercounty roads are selected by the State highway commission from roads recommended by the county board of supervisors of each county. They are required to be important routes of travel and are selected to form as nearly as practicable a State-wide system. The present mileage of this system is restricted by statute to 6,000.

highway commission to provide proper maintenance therefor when the road is constructed. Surveys are made by the county engineer or a representative of the chief engineer of the commission. Final plans and specifications are approved by the county board, the State highway commission, and the United States Secretary of Agriculture. Bids are requested by the county board; and contracts are let by the board with the approval of the State highway commission. The successful bidder files a bond acceptable to the county board and to the State highway commission. The work during progress is generally under the charge of the county engineer or, if it is deemed advisable, an engineer is detailed by the chief engineer of the commission to assist or take full charge of the work.

Monthly payments based on estimates prepared by the engineer in charge and certified to by the contractor are made with the approval of the county board and the State highway commission.

Payment is completed by the presentation of a voucher by the State Highway Commission to the State auditor who issues a warrant on the State treasurer.

Maintenance of the completed roads is executed by and at the expense of the county in accordance with the orders and subject to the inspection of the State Highway Commission.

County roads.—Each county board of the State has been required to designate and to indicate on the map not less than 10 per cent nor more than 15 per cent of the total road mileage of the county. This group of roads when approved by the State highway commission is known as the county road system and is constructed and maintained by county officials with county funds in accordance with plans and specifications approved by the State highway commission. The county system as evidenced by the map approved by the State highway commission and and filed with the county auditor may be modified or extended by the county board with the approval of the State highway commission. Improvement of these roads may be done by contract, by force account, or with convict labor from the State penitentiaries, under supervision of the State highway commission. All bridges and culverts constructed on roads of this group must be erected in accordance with plans furnished by the State highway commission, and all contracts involving the expenditure of $2,000 or more must be approved by the State highway commission. By the terms of a law effective July 4, 1917, the patrol system of maintenance became obligatory on the county systems of highways. Patrolmen are required to give their entire time for the period specified by the county board of supervisors.

The total mileage of county roads is restricted at present by statute to 15,667 miles.

Township roads.—All other public roads of the State not included in the county system comprise the township roads administered by township officials. All work other than minor or emergency repairs and routine dragging done on these roads is executed under supervision of the township officials in accordance with plans and specifications prepared by the county engineer.

REVENUES.

State.—The State treasurer is authorized to withdraw each year from the fund accruing from the registration and licensing of motor vehicles, (1) 5 per cent of the gross receipts for the support of the State highway commission, (2) 5 per cent for the office of the secretary of State to defray the cost of collection, (3) an amount equal to the amount of Federal aid allotted that year to the State by the United States Secretary of Agriculture. This fund combined with the Federal aid forms the Federal-county cooperation fund which is allotted to the several counties of the State in the ratio that their area bears to the total area of the State. (4) A farther deduction from the motor-vehicle fund by an amount specified by the highway commission is made by the treasurer and credited to a fund designated the "Federal aid engineering fund," out of which the engineering expense incurred by the State highway commission in improving the inter-county road system is defrayed. The amounts available for the year July 1, 1917, to June 30, 1918, are estimated to be as follows:

Fund 1	$105,000.00
Fund 2	105,000.00
Fund 3	438,526.80
Fund 4	30,000.00

County.—The remainder of the motor-vehicle fund is apportioned by the State treasurer among the several counties of the State in the ratio that the number of civil townships in each county bears to the total number of townships in the State. Not to exceed 10 per cent of the amount apportioned to each county is apportioned by the county treasurer among the incorporated cities and towns in the ratio that their street mileage bears to the total road mileage of the county. This fund may be expended by cities or towns in improving streets, connecting with county or township roads, or the fund may be transferred to the county cash road fund for expenditure by the board of supervisors.

The county cash road fund is composed (1) of the proceeds of not to exceed 1 mill tax levied on all taxable property in the county. One-half of the amount raised in cities or towns is returned to the city or town for use on its main streets or roads; (2) a 2-mill tax levied on all taxable property outside incorporated cities and towns, and (3) a mill tax levied in cities and towns except cities of the third class and cities having a special charter.

The county road and bridge fund is composed of a tax levied at a rate which may not exceed 5 mills on all taxable property in the county outside cities of the first class.

Township.—The township road fund is composed of the proceeds of a tax levied at a rate not exceeding 4 mills on all taxable property in the township. The township drag fund is raised by a tax of 1 mill. The township drainage fund is raised by a tax of not more than 5 mills. This fund is raised for the payment of benefits assessed against the township on account of the improvement of highways by the formation of drainage districts.

A special tax at a rate of 1 mill may be levied for road purposes on petition of a majority of the voters of the township.

All able-bodied males, not legally exempt, resident in the township, between the ages of 21 and 45, are required to labor two days each year on the township roads or to forfeit $3 for each day's delinquency.

BONDS.

Bonds may be issued by the county boards of supervisors to refund outstanding warrants for which no funds are available. The amount of bonds issued, the term, and rate of interest is left to the discretion of the various county boards. Such indebtedness is limited by State law to 5 per cent of the total assessed valuation of the county. County bonds in the amount of $1,960,780 were outstanding on January 1, 1915.

KANSAS.

Development.—The State government of Kansas is prohibited by a clause of the State constitution from assisting in any work of internal improvement. However, this restriction has been construed by the State courts to refer to the grant of money aid for the work of internal improvement and does not prohibit the delegation of authority to county officials to carry out such improvement nor prohibit State officials from giving advice relative to or preparing plans and specifications for such work and actually supervising the construction and maintenance thereof.

Supervision of road and bridge matters prior to 1917 was vested in the officials of 105 counties and 1,492 townships. The results obtained under this form of administration were a prominent factor in bringing about a State-wide demand for a competent centralized supervisory and advisory road and bridge authority. In deference to this demand the State legislature in 1911 provided that the State engineer of roads and highways at the State Agricultural College should furnish, free of charge, technical or other advice to all local road and bridge officials applying therefor.

In 1917 legislation was enacted creating a State highway commission with limited State-wide jurisdiction over certain groups of roads and supervisory powers to a limited degree over all road and bridge work in the nature of substantial improvements made throughout the State. The county systems comprising the main traveled roads of each county have been selected for improvement under the direction of the commissioner, and these systems have been selected to form a network of roads connecting all of the principal towns of the State.

Kansas has a road mileage of 111,052, of which at the close of 1916, 1,400 miles, or 1.3 per cent, had been surfaced, although many miles of earth roads had been graded and drained. The expenditures for road and bridge work during the year 1916 comprised $10,000 expended by the State highway department for educational and supervisory work, and $5,610,000 expended by local officials subject to supervision by the State highway department as was requested by the local officials in charge of the work. The total State and local expenditure during 1917 amounted to $6,010,000.

With the organization of the State highway commission and the allotment of Federal funds to a system of 3,440 miles of main highways and the supervision of Federal aid projects by the commission, the influence of capable centralized authority will be manifested in better types of improvement, more attention to maintenance, and a greater popular demand for an increased mileage of good roads.

ORGANIZATION.

The organization of the road forces of the State and the relation existing between them is shown on page 42.

State.—The State highway commission, composed of the Governor and two members appointed by him for terms of four years each, has power to employ, remove, define the duties and fix the compensation of such employees as may be necessary to carry out the duties imposed by law. It has general supervision over the administration of all State road and bridge laws, and over the construction and maintenance of all roads, bridges, and culverts throughout the State except the administration of township roads not in receipt of Federal aid.

The commission is required to establish and furnish to the several county engineers plans and specifications for all road, bridge, and culvert construction in the State; to reply to all inquiries from local road officials relative to road and bridge matters; to require reports on standard forms from all county and township road officials; to devise a uniform system of auditing and accounting, and enforce its use by all county and township fiscal officials engaged in road and bridge work.

The commission is empowered to act as agent for the several counties in negotiations conducted with the United States Secretary of Agriculture in matters relating to allotment of Federal funds.

The State highway engineer, the executive official of the commission, is chosen by them and serves at their pleasure.

County.—County road and bridge affairs are administered by a board of three commissioners elected for terms of four years each. The county clerk and county treasurer, elective officials, are respectively the clerk and fiscal agent of the board. The county engineer, selected by the board with the approval of the State highway commission for a term of two years, is their executive official in all

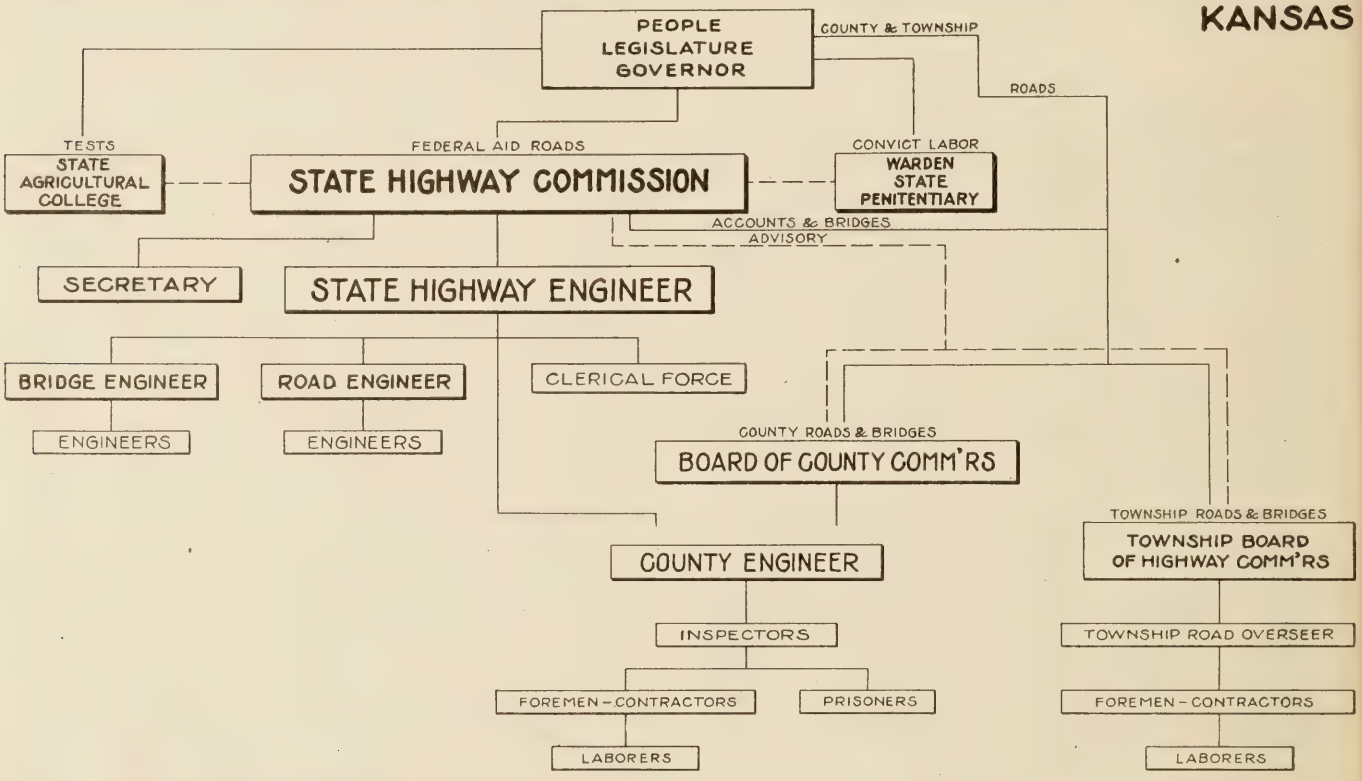
road and bridge matters. He is subject to the rules and regulations issued by the State highway commission relative to road and bridge matters, and may be removed from office by the county commissioner for cause or by the State highway commission for incompetency. In addition to his other duties, he acts in a supervisory and advisory capacity with township road and bridge officials.

Township.—The board of township highway commissioners composed of the town trustee, clerk, and treasurer, each elected for a term of two years, has charge of all work in the township financed with township funds. The board is required to appoint a township road overseer and may, if the county engineer deems it necessary, provide him with suitable assistants.

Township Roads.—All roads of the State not included in the preceding system are classed as township roads and are improved and maintained by township officials with township funds. All contracts let by township boards for construction which exceed $200 in amount and all contracts for purchases of machinery exceeding $100 in amount require the approval of the county engineer.

Roads of either group may be improved by order of the governing board or improvements may be initiated on petition of 51 per cent of the owners of 35 per cent of the land abutting on the road in question, or 35 per cent of the landowners owning 51 per cent of the land or by the owners of 60 per cent of the land within a given district. The petition is addressed to and filed with the county board. The board after finding it to be a public utility orders plans, specifications, and estimates of cost of the improvement to be prepared by the county engineer or the State highway engineer. The plans must be approved by the State highway engineer, and, if Federal aid is requested, by the United States Secretary of Agriculture.

The work may be done by prison labor with the approval of the warden of the State penitentiary, by force account under the direction of the county engineer, or by contract let by the county board in the manner prescribed by statute. The work during progress is under the supervision of the county engineer and is subject to inspection by the State highway engineer.



CLASSIFICATION, CONTROL, AND PROCEDURE.

The 111,052 miles of public road in Kansas are by law divided into county and township roads.

County Roads.—The county board of each county is required to select, with the approval of the State highway engineer, not less than 50 miles nor more than 15 per cent of their total road mileage as a road system to be improved by the county in accordance with plans and specifications approved by the State highway engineer. When the total mileage selected in a county has been improved, additional roads may, with the approval of the commission, be added to the system. On January 1, 1918, 3,440 miles of road had been selected and approved.

Partial payments covering 70 per cent of the completed work may be made by the county board when based on an estimate prepared and approved by the engineer in charge and by the State highway engineer if Federal funds are involved. The road when completed is maintained by the county at county expense. The State highway commission is required to inspect or cause to be inspected yearly all roads financed in part with Federal funds; to inform the county commissioners of the repairs needed, if any, and to require the county board to make the repairs. The total cost of the road is borne as follows: All bridges costing more than $2,000 and all bridges of 20-foot or more span are paid for by the county. From the remainder of the cost the Federal allotment, if any, is deducted and the balance of the cost is apportioned 50 per cent to the county, 25 per cent to the township or townships, and 25 per cent among the landowners adjoining or adjacent to the road so improved.

The county board may under certain conditions assume 60 per cent of the remaining cost, leaving 15 per cent to be borne by the landowners.

If more than 30 miles of road are involved and a majority of the legal voters of the county so approve, the total cost of the work less Federal aid extended, if any, may be borne by the county as a whole.

REVENUES.

State.—An appropriation of $25,000 per year for the support of the State highway commission is made by the State legislature. No other State funds are provided for road and bridge work either directly or indirectly.

County.—Federal funds allotted to the State are apportioned equally among the several counties conditioned on the county providing $85 for each $15 allotted, and further provided that the total sum shall be expended in accordance with the rules and regulations of the United States Secretary of Agriculture.

A road tax at a rate of not less than one-fourth mill nor greater than 1½ mills may be levied by the county board for the construction and maintenance of the county road system. A tax rate greater than 1½ mills may, if authorized by a majority vote of the legal voters of the county, be levied by the board. Fifty per cent of the net receipts collected in each county for the registration of motor vehicles is placed in the county road fund.

Township.—A tax at a rate of not to exceed 3 mills may be levied by the county board on favorable recommendation of the township board. Taxes at a rate greater than 3 mills may be levied whenever authorized by a majority of the voters of the township. All male inhabitants between the ages of 21 and 50 are required to pay a poll tax of $3, or in lieu thereof to labor two days on the public roads. Poll tax collected in cities is refunded to the city treasury.

Fifty per cent of the net receipts collected in each county for the registration of motor vehicles is returned to the townships in which the owners reside, and placed to the credit of the township road fund.

BONDS.

Serial bonds of not less than 10 nor more than 20 years' term, bearing not to exceed 5 per cent interest, may be issued by county boards to finance road and bridge improvement when authorized by a majority vote of the county or of a special district, as the case may be.

KENTUCKY.

Development.—State participation in road and bridge improvement in Kentucky began in 1821 and by 1837 the State had invested $2,509,473 in an improved road system, of which 343 miles had been constructed of macadam and 236 miles were under construction, and a large number of earth roads had been graded and drained. This work was under the supervision and control of a State highway engineer who received a salary of $5,000 per year, and who was assisted by a well-paid force of competent men. State aid was from this date diminished and finally discontinued prior to the Civil War and remained inactive until revived in principle by the appointment in 1912 by a State commissioner of public roads with educational and advisory duties.

In 1914, authority for the selection and designation of a State highway system and a fund for assistance in its construction under the supervision of the State commissioner of public roads was provided by the legislature.

Due in great part to the substantial nature of the roads constructed in early days under State supervision, public interest in road improvement did not entirely lapse with the discontinuance of State assistance, and at the resumption of State aid in 1914, 10,663.5 miles or 18.4 per cent of the entire road mileage of the State had been surfaced and were in fair condition; limestone, macadam, and gravel being the principal materials used.

Under the present law, State aid is extended to assist the counties in the construction of the State system of roads. This system when completed will have a mileage of about 8,000, or 13 per cent of the total mileage of the State. On January 1, 1917, 1,611 miles of road of this group had been improved or reconstructed while 13,400 miles, or 23.2 per cent of the total road mileage of the State had been surfaced.

The State highway commissioner in addition to the supervision of the expenditure of State funds

also on request of local officials exercises supervision over projects financed with local funds. During 1916, $708,346 of State funds and $1,740,187 of local funds were expended by or under his supervision. The total $2,448,553 comprises 55½ per cent of $4,448,553, the total expenditure by all road and bridge forces of the State during the same period. The total expenditure from all sources during 1917 amounted to $4,923,651.

ORGANIZATION.

The organization of the road forces of the State and the relation existing between them is shown on page 45.

State.—The department of public roads is headed and administered by a State commissioner of public roads appointed by the Governor for a term of four years. He is required to be at least 25 years of age, a graduate civil engineer from some reputable university or technical college and shall have had five years experience in civil engineering. All road and bridge work in the State financed wholly or in part with Federal or State funds, or constructed by State convict labor is under the general supervision of, and must be completed in accordance with the plans and specifications approved by, the commissioner.

Engineering and technical assistants necessary to carry out the duties of the department are selected by the commissioner with the approval of the governor. The State, for administrative purposes, is divided into 11 divisions, each in charge of a division engineer who consults with and tenders advice to county road officials, and who has supervisory charge of State and Federal aid construction.

County.—County road and bridge affairs are as a rule administered in the 120 counties by fiscal courts composed of the county judge and a magistrate from each magisterial district of the county. There are a few counties in which road affairs are administered by three or more commissioners who are elected by the people. All of the above officials are elected for terms of four years. The county clerk is clerk to the governing body and the county treasurer is fiscal agent.

The governing body of the county may appoint as county engineer one who is required to be either a reputable civil engineer or a man who has had two years practical experience as a road builder and who shall have passed an examination held by the State commissioner or his representative. He serves as the executive official of the county in all road and bridge matters and receives general instructions from the State commissioner relative to standards and types of construction, gradients, etc., of all public roads and for plans for all bridges costing $500 or more.

CLASSIFICATION, CONTROL, AND PROCEDURE.

The 57,916 miles of public road in Kentucky are divided, for the purpose of fixing responsibility for construction, control, and maintenance, into two general groups, namely, State-aid highways and county roads.

State-Aid Highways.—At present these comprise a system of intercounty-seat highways selected by the governing bodies of the respective counties with the approval of the State commissioner of public roads. This system comprises about 8,000 miles of road connecting county seats constructed under State supervision at the joint expense of the State and county. Of this system about 2,000 miles had been completed or under contract on January 1, 1918. State aid is at present restricted to roads of this group. However, on completion of the present mileage additions may be made to the system by agreement between the county boards and the State commissioner.

Initiative for improvement of roads of this group is taken by the fiscal town or county board. The resolution of the court or board is transmitted to the State commissioner of public roads for his investigation and approval. If the project is deemed feasible, within the extent of the law and the necessary funds are available, the surveys, plans, specifications, and estimates are prepared by the State highway department, the cost being paid one-half by the State and one-half by the county. Construction may be executed by State convict labor, operating under the direction of the commissioner, or the county board may, after due publicity, let the work by contract, except on Federal-aid projects, which are let by the State highway department. All contracts for road and bridge work and all bonds filed by the contractors are required to bear the approval of the State commissioner of public roads.

The work during progress is under the general supervision of the State highway department, the county engineer, and the immediate supervision of an inspector appointed by the State commissioner. Monthly payments, covering 80 per cent of the completed work, may be authorized by the county board when supported by an estimate prepared and certified to by the inspector, and approved by the county engineer.

On completion and acceptance of the work and the presentation of certified statements of cost by the inspector and county engineer, the State commissioner orders the State auditor to draw a warrant against the State road fund in favor of the county. The State assumes 75 per cent of the cost of construction of intercounty-seat roads in counties whose assessed valuation is less than $5,000,000; 70 per cent of the cost in counties having an assessed valuation between $5,000,000

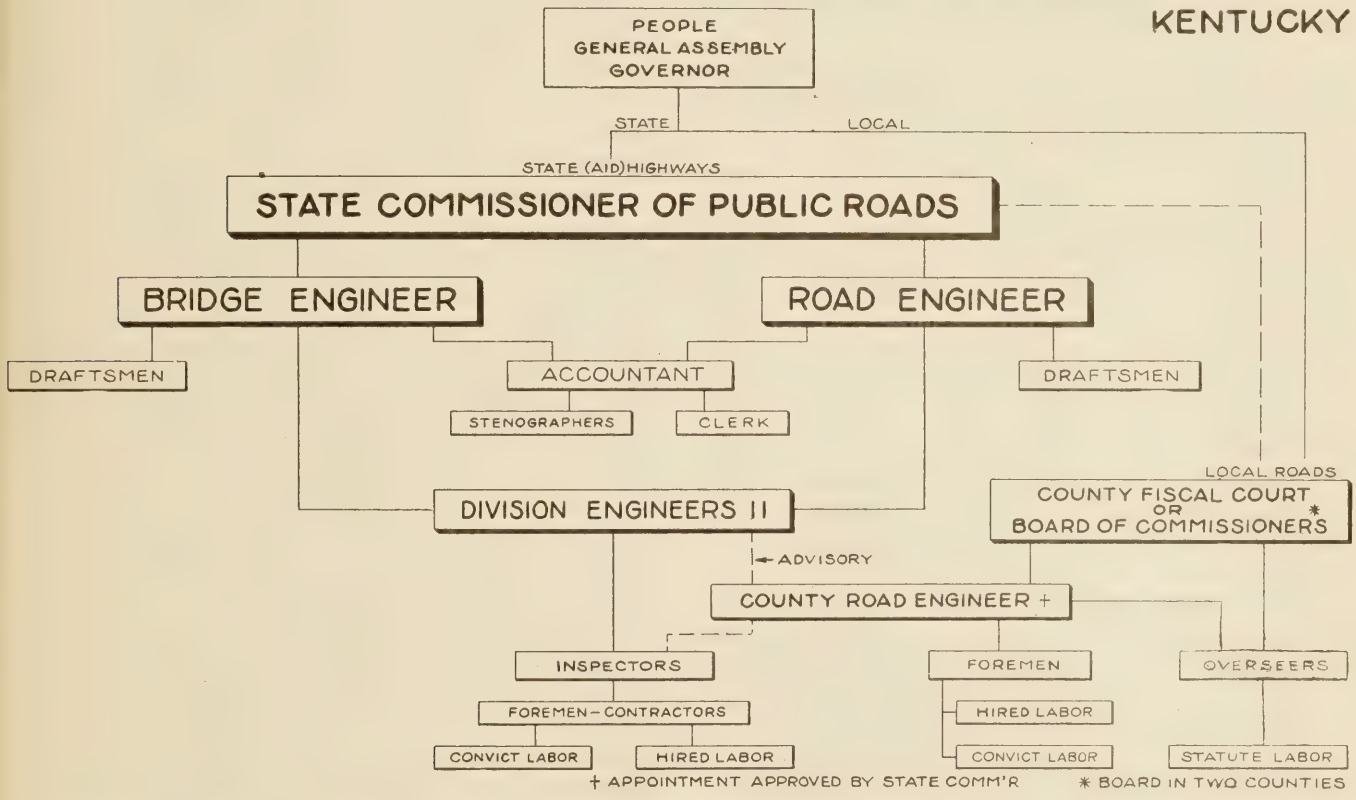
and $6,000,000; 65 per cent of the cost in counties having an assessed valuation between $6,000,000 and $8,000,000; 60 per cent of the cost in counties having an assessed valuation between $8,000,000 and $12,000,000; 55 per cent of the cost in counties having an assessed valuation between $12,000,000 and $16,000,000 and 50 per cent of the cost in all counties having an assessed valuation of $16,000,000 or more.

The State may pay in all counties 50 per cent of the cost of construction of roads added to the State-aid system but which are not intercounty-seat roads. All cost incident to the preparation of plans, surveys, inspection, etc., is considered a part of the total cost of the work, and is borne equally by the State and counties.

construction and repair, or the roads of the county may be divided into sections not exceeding 2 miles in length and sold for maintenance purposes for yearly periods to the lowest bidder.

REVENUES.

State.—The State road fund for aid to the State-aid system is apportioned among the various counties of the State applying therefor, in the ratio that the amounts collected in each county for road purposes, including the interest on bonded indebtedness incurred for road purposes and all donations bear to the total collection made by all counties. No county may receive more than 2 per cent of the fund in any one year, and counties expending an



Roads of this group, when improved, are maintained by and at the expense of the county, but if the counties fail to maintain the roads, State aid may be withheld or State-aid funds apportioned to the county may be used by the commissioner in executing maintenance.

County Roads.—All other public roads of the State, with a total mileage of about 50,000, are included in this group. On January 1, 1917 about 12,000 miles, or 24 per cent of this system had been surfaced.

All expense incident to the construction, repair, and maintenance of these roads is borne by the county. County jail or workhouse labor, statutory labor, or force account labor may be used in their

amount greater than the amount required to allow them to share in State aid may receive the difference as aid during the succeeding years without providing additional funds, provided that the allotment so received be expended for road work under the supervision of the State commissioner.

This fund is composed of revenues raised from the following sources, and it is estimated that during the calendar year 1918 the following amounts will be produced:

(1) A $\frac{3}{10}$ mill State-wide tax	$600,000
(2) Net receipts from motor-vehicle fees	300,000
(3) Whisky tax (one-eleventh of 10 cents on each gallon)	50,000
Total	950,000

An amount not exceeding $25,000 to defray the expenses of the State department of public roads is set aside from the State fund before making allotments to the counties.

County.—Current revenues are obtained from an ad valorem tax levied at a rate not to exceed 50 cents on each $100 of taxable property, one-half of which may be used for road purposes. A poll tax may be levied for road purposes on male inhabitants over 21 years of age at rates which vary in the different counties. These funds are expended by the fiscal court or other governing body for all county purposes, including road and bridge expense. Six days statutory labor on the roads may be required of all able-bodied male citizens between the ages of 18 and 45, but this tax is not generally observed.

The fiscal court may authorize counties to vote on an additional tax of 20 cents on the $100 valuation for road purposes.

BONDS.

Bonds for road and bridge purposes bearing not to exceed 5 per cent interest, payable semiannually, may be issued by the governing boards of counties for a term not less than 5 nor more than 30 years, when authorized by a majority vote of the electors of the county voting at a special election held for that purpose.

The proceeds of the bond issue are administered by the fiscal court, or by a board of commissioners appointed by the fiscal court or elected by the voters at the special election authorizing the bond issue.

The bonds may after five years be retired at the pleasure of the court, or board, or the sinking fund provided for their redemption may be invested in real estate mortgages. On January 1, 1915 there was outstanding a total of $705,000 of road and bridge bonds issued by the counties. Several counties have issued bonds since that date, and it is now estimated that there are outstanding $5,525,000 of road and bridge funds.

LOUISIANA.

Development.—State participation in highway improvement in Louisiana was first manifested in 1909 by cooperation between the board of State engineers, the board of control of the State penitentiary, and the police juries of various parishes in the supervision and use of State convicts for road-building purposes. In 1910 a State highway department was organized and the distribution of State aid in the form of money aid, use of convict labor, or machinery under the supervision of the State highway department was made a permanent State policy.

The State highway department is under the supervision of the board of State engineers, which has charge of all engineering work financed by the State. Prior to 1909 little permanent road improvement had been attempted throughout the State, but with the organization of the State highway forces and the dissemination of the correct principles of road building improvement in the condition of the road became apparent, and on January 1, 1917, 2,400 miles, or 9.8 per cent of the entire road mileage of the State, had been surfaced.

A State-wide system comprising about 5,000 miles of road connecting parish seats and important commercial centers has been selected by the State highway department for improvement by means of Federal, State, and parish funds under the supervision of the State highway department. On January 1, 1918, 752 miles, or 15 per cent of this system, had been improved.

The expenditures for road and bridge purposes during 1916 were $184,533 of State funds and $274,111 of local funds, expended by or under the supervision of the State highway department, and an additional amount of $3,000,000 of local funds expended by the police juries of the various parishes. State supervision thus extended to 13.9 per cent of the total expenditure. The total State and local expenditures during 1917 amounted to $3,540,976.

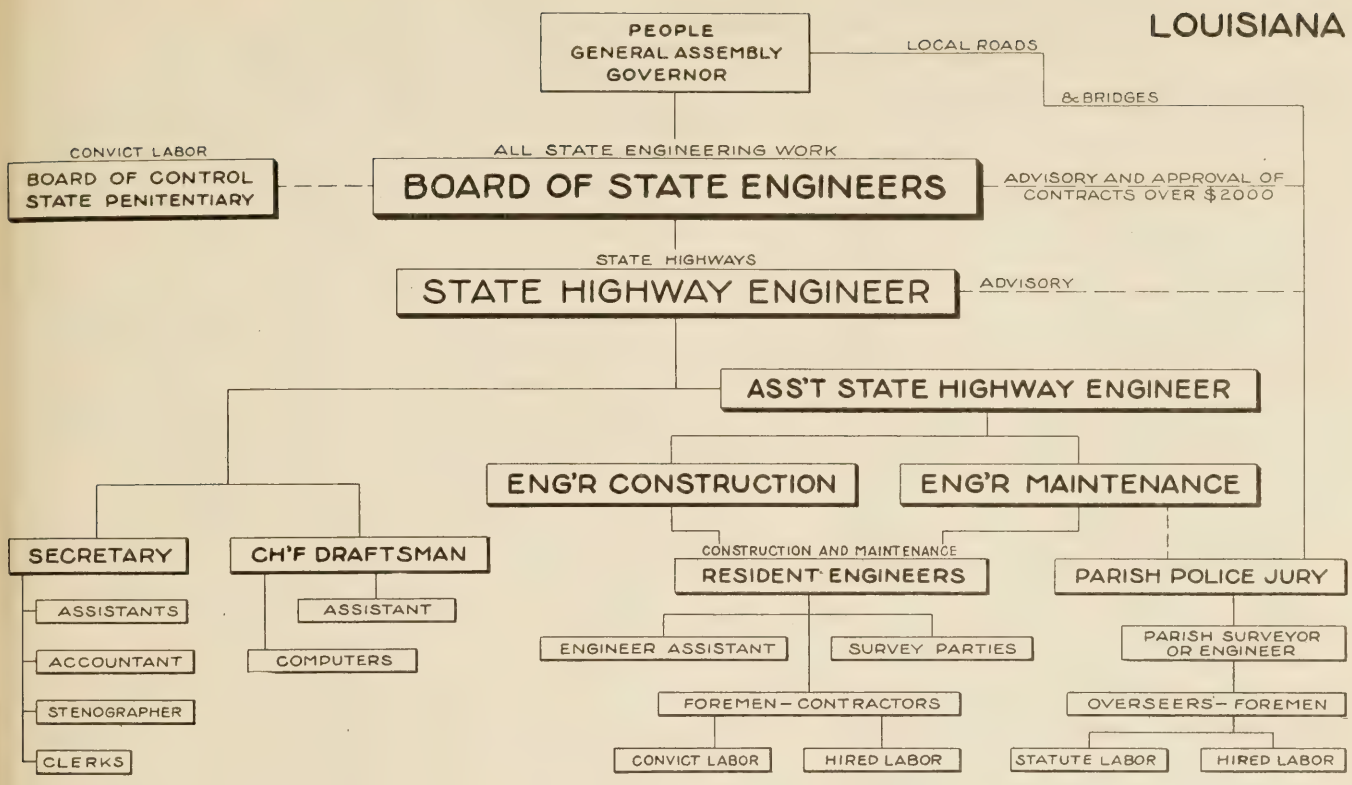
ORGANIZATION.

The organization of the road forces of the State and the relation existing between them is shown in the accompanying diagram.

State.—The State highway engineer selected by the board of State engineers serves at its pleasure and is the executive official in charge of the State highway department. Such assistants as may be required by him are appointed by the board. The board of State engineers is required to consider all questions of general policy of the highway department and the conduct of its work and to bring to the attention of the governor of the State all matters pertinent to appropriations, new legislation, etc.

The State highway engnieer, subject to the general supervision of the board of State engineers, is vested with broad powers over the contributions made by the State for highway improvement, the standards of contruction of state work, and certain local work involving the expenditure of $2,000 or more, and the selection and designation of a system of state highways upon which State aid may be extended. He is required to extend advice and technical assistance to local officials on their request.

Parishes.—The parishes of Louisiana correspond in size, organization, and powers to the counties of



other States. Their affairs are administered by a police jury consisting of an elective member from each of the wards into which each parish is divided. The members elect one of their number as president and employ a nonmember as secretary. The parish treasurer is their fiscal officer. The parish surveyor, appointed by the governor, who is not required to be a civil engineer or a parish highway engineer, may on the order of the police jury be employed on local road work. The police jury has jurisdiction over all road and bridge work in the parish financed with local funds, may levy taxes, issue bonds, and in all respects is a body politic.

District.—The police juries of the several parishes may, in accordance with the statutory restrictions, divide their parishes into road districts. Such districts are governed by the police jury or by a road committee selected by it. All expenditures involving $2,000 or more in road and bridge work may not be made until the plans and specifications therefor have been approved by the board of State engineers. The districts may participate in State aid under the same terms as the parish, except that they deal through the police juries.

CLASSIFICATION, CONTROL, AND PROCEDURE.

The 24,563 miles of public road in Louisiana are, for the purpose of fixing responsibility for construction, control, and maintenance, divided into two groups, namely, State highways and parish roads.

State highways comprise about 5,000 miles of the principal roads of the State, selected by the State highway engineer on the approval of the board of State engineers, for improvement with State and local funds. Initiative for construction or improvement of a road of this group is taken by the police jury of the parish by making written application for aid to the State highway engineer. When the application has been approved by the State highway engineer and the board of State engineers, an engineer is detailed to execute surveys and prepare plans, specifications, and estimates of cost. The salary of the engineer thus engaged is borne by the State. Other expense incident to the survey is borne by the local body.

State aid may consist of money aid up to 50 per cent of the total cost of improvement, dependent, however, on the funds available at the disposal of the State highway department; convict labor furnished by the State with the approval and under the rules and regulations of the general manager of the State penitentiary, the operating expense of this force being borne by the local body or board benefited; or of machinery furnished by the State and operated at the expense of the local board or body. If the cost of improvement is less than $2,000, and it is decided to execute the work by paid labor, it is discretionary with the State highway engineer as to whether contract shall be let or whether force account shall be used. If the cost is more than $2,000, the State highway engineer, after due publicity given in the vicinity of the proposed improvement,

may, with the concurrence of the local boards interested, let the contract to the lowest responsible bidder. The work during progress is under the inspection and supervision of a representative of the State highway engineer. Partial payments covering 80 per cent of the completed work may be authorized by the State highway engineer at monthly intervals. Final payment is made on acceptance of the completed work by the State highway engineer.

Completed roads of this group are maintained under the supervision of the State highway engineer with State and local funds in the same proportions as for construction.

State aid may not exceed $50,000 in any parish in one year if other parishes apply for aid during that period, neither may a parish obtain aid for two consecutive years unless all other parishes applying for aid are supplied.

Parish Roads.—These comprise all other public roads of the State. They are improved and maintained by and at the expense of the parish. The State highway department exercises no jurisdiction over the improvement and maintenance of roads of this group, but may on request of the officials in charge furnish plans and specifications for and advise concerning their improvement and maintenance.

REVENUES.

State.—Revenues for State aid in construction and maintenance of State roads and for support of the State highway department are derived from the imposition of a State-wide tax levied at the rate of one-fourth mill on each $1 of taxable property. This tax produced during the calendar year 1917 about $140,000, of which about $20,000 was expended for the support and maintenance of the State highway department.

Parish.—The funds for road and bridge purposes are derived from various sources, namely:

1. A tax levied at the rate of 1 mill on each $1 of assessed valuation. This rate may be exceeded provided that the total tax for parish purposes does not exceed 10 mills on each $1 of assessed valuation.

2. By transfer of the surplus from the general fund of the parish.

3. By the imposition of an annual license tax on all vehicles except automobiles.

4. By the imposition of a special tax when authorized by a majority vote of the property tax payers elegible to vote in the parish. The tax rate and the purpose for which the proceeds may be used are specified in the proposal submitted to the voters.

5. The net receipts of the State tax on motor vehicles collected and returned by State authority to the parish treasurer.

6. By a per capita tax of $1 per year levied on all male inhabitants between the ages of 18 and 45 and not otherwise legally exempt.

7. By bond issues when authorized by a majority in numbers and valuation of the property-owning voters. Districts may levy special taxes or issue bonds under similar regulations as parishes.

BONDS.

Bonds may be issued in an amount not exceeding 10 per cent of the assessed valuation by parishes or districts when authorized by a majority in numbers and assessed valuation of the property-owning voters. The term of such bonds may not exceed 40 years and the rate of interest may not exceed 5 per cent and the bonds must be sold at par. Bonds must be retired annually beginning at a date not later than 5 years from the date of issue. The amount of bonds outstanding on January 1, 1915, for road and bridge purposes was $1,588,835.26.

MARYLAND' MOTOR TAX IDEA.

Maryland finds it necessary to insist upon taxing motor trucks from other States which use her roads, because, it is argued, reciprocity arrangements with other States were made to cover the comparatively light passenger cars, and with the revolution in motor traffic there must be a revision of charges.

This is pointed out as a concrete illustration of the change which has come over the whole question of motor transportation within the last few years. It regards the change as a permanent one, and says that if there are not freight highways built especially for this heavy business there will have to be a great broadening and rebuilding of existing motor routes.

SOME STATE HIGHWAY BUILDERS.

(Continued from page 22.)

field in 1916, on account of the unsettled condition of the country.

Upon returning to Georgia he was employed by the highway department, and in October, 1917, was elected State highway engineer.

The highway commissioner of Washington, James Allen, was born in Kentucky, at Lexington, in 1871. He moved to the State of Washington in 1888 and has been actively engaged in engineering work in the West ever since. In 1908 Mr. Allen became connected with the State highway department, was made chief engineer in December, 1913, and in March, 1916, was appointed State highway commissioner by Gov. Lister. He was reappointed to the office in December, 1917, for the term ending December 10, 1921.

ROAD PUBLICATIONS OF BUREAU OF PUBLIC ROADS.

NOTE.—Application for the free publications in this list should be made to the Chief of the Division of Publications, U. S. Department of Agriculture, Washington, D. C. Applicants are urgently requested to ask only for those publications in which they are particularly interested. The Department can not undertake to supply complete sets, nor to send free more than one copy of any publication to any one person. The editions of some of the publications are necessarily limited, and when the Department's free supply is exhausted and no funds are available for procuring additional copies, applicants are referred to the Superintendent of Documents, Government Printing Office, this city, who has them for sale at a nominal price, under the law of January 12, 1895. Those publications in this list, the Department supply of which is exhausted, can only be secured by purchase from the Superintendent of Documents, who is not authorized to furnish publications free. In applying for these publications the name of the series as well as the number of the publication should be given, as "Bureau of Public Roads Bulletin No. 32."

REPORTS.

Report of the Director of the Office of Public Roads for 1916.
Report of the Director of the Office of Public Roads for 1917.

OFFICE OF PUBLIC ROADS BULLETINS.

*Bul. 28. The Decomposition of the Feldspars (1907). 10c.
32. Public Road Mileage Revenues and Expenditures in the United States in 1904. 15c.
*37. Examination and classification of Rocks for Road Building, including Physical Properties of Rocks with Reference to Their Mineral Composition and Structure. (1911.) 15c.
*43. Highway Bridges and Culverts. (1912.) 15c.
*45. Data for Use in Designing Culverts and Short-span Bridges. (1913.) 15c.
48. Repair and Maintenance of Highways (1913).

DEPARTMENT BULLETINS.

Dept. Bul. *53. Object-Lesson and Experimental Roads and Bridge Construction of the U. S. Office of Public Roads, 1912–13. 5c.
105. Progress Report of Experiments in Dust Prevention and Road Preservation, 1913.
136. Highway Bonds.
220. Descriptive Catalogue of Road Models of Office of Public Roads.
230. Oil Mixed Portland Cement Concrete.
249. Portland Cement Concrete Pavements for Country Roads.
257. Progress Report of Experiments in Dust Prevention and Road Preservation, 1914.
*284. Construction and Maintenance of Roads and Bridges, from July 1, 1913, to December 31, 1914. 10c.
314. Methods for the Examination of Bituminous Road Materials.
347. Methods for the Determination of the Physical Properties of Road-Building Rock.
*348. Relation of Mineral Composition and Rock Structure to the Physical Properties of Road Materials. 10c.
370. The Results of physical Tests of Road-Building Rock.
373. Brick Roads.
386. Public Road Mileage and Revenues in the Middle Atlantic States.
387. Public Road Mileage and Revenues in the Southern States.
388. Public Road Mileage and Revenues in the New England States.
389. Public Road Mileage and Revenues in the Central, Mountain, and Pacific States, 1914.
390. Public Road Mileage in the United States. A summary.
393. Economic Surveys of County Highway Improvement.
407. Progress Reports of Experiments in Dust Prevention and Road Preservation, 1915.
414. Convict Labor for Road Work.
463. Earth, Sand-Clay, and Gravel Roads.
532. The Expansion and Contraction of Concrete and Concrete Roads.
537. The Results of Physical Tests of Road-Building Rock in 1916, including all Compression Tests.
555. Standard Forms for Specifications, Tests, Reports, and Methods of Sampling for Road Materials.
583. Report on Experimental Convict Road Camp, Fulton County, Ga.
586. Progress Reports of Experiments in Dust Prevention and Road Preservation, 1916.
660. Highway Coat Keeping.
670. The Results of Physical Tests of Road-Building Rock in 1916 and 1917.
691. Typical Specifications for Bituminous Road Materials.
704. Typical Specifications for Nonbituminous Road Materials.
724. Drainage Methods and Foundations for County Roads.

*Department supply exhausted

OFFICE OF PUBLIC ROADS CIRCULARS.

Cir. 89. Progress Report of Experiments with Dust Preventatives, 1907.
*90. Progress Report of Experiments in Dust Prevention, Road Preservation, and Road Construction, 1908. 5c.
*92. Progress Report of Experiments in Dust Prevention and Road Preservation, 1909. 5c.
*94. Progress Reports of Experiments in Dust Prevention and Road Preservation, 1910. 5c.
98. Progress Reports of Experiments in Dust Prevention and Road Preservation, 1911.
*99. Progress Reports of Experiments in Dust Prevention and Road Preservation, 1912. 5c.
*100. Typical Specifications for Fabrication and Erection of Steel Highway Bridges. (1913.) 5c.

OFFICE OF THE SECRETARY CIRCULARS.

Sec. Cir. *49. Motor Vehicle Registrations and Revenues, 1914. 5c.
52. State Highway Mileage and Expenditures to January 1, 1915.
59. Automobile Registrations, Licenses, and Revenues in the United States, 1915.
62. Factors of Apportionment to States under Federal Aid Road Act Appropriation for the Fiscal Year 1917.
63. State Highway Mileage and Expenditures to January 1, 1916.
65. Rules and Regulations of the Secretary of Agriculture for Carrying out the Federal Aid Road Act.
72. Width of Wagon Tires Recommended for Loads of Varying Magnitude on Earth and Gravel Roads.
73. Automobile Registrations, Licenses, and Revenues in the United States, 1916.
74. State Highway Mileage and Expenditures for the Calendar Year 1916.
77. Experimental Roads in the Vicinity of Washington, D. C.

FARMERS' BULLETIN.

F. B. 338. Macadam Roads.
505. Benefits of Improved Roads.
597. The Road Drag.

YEARBOOK SEPARATES.

Y. B. Sep. *638. State Management of Public Roads; Its Development and Trend. 5c.
*712. Sewage Disposal on the Farm. 5c.
727. Design of Public Roads.
739. Federal Aid to Highways.

REPRINTS FROM THE JOURNAL OF AGRICULTURAL RESEARCH.

Vol. 5, No. 17, D–2. Effect of Controllable Variables Upon the Penetration Test for Asphalts and Asphalt Cements.
Vol. 5, No. 19, D–3. Relation Between Properties of Hardness and Toughness of Road-Building Rock.
Vol. 5, No. 20, D–4. Apparatus for Measuring the Wear of Concrete Roads.
Vol. 5, No. 24, D–6. A New Penetration Needle for Use in Testing Bituminous Materials.
Vol. 6, No. 6, D–8. Tests of Three Large-Sized Reinforced-Concrete Slabs under Concentrated Loading.
*Vol. 10, No. 5, D–12. Influence of Grading on the Value of Fine Aggregate Used in Portland Cement Concrete Road Construction. 15c.
Vol. 10. No. 7, D–13. Toughness of Bituminous Aggregates.
Vol. 11, No 10, D–15. Tests of a Large-Sized Reinforced-Concrete Slab Subjected to Eccentric Concentrated Loads.

*Department supply exhausted.

THE PEACE OF UNCONDITIONAL SURRENDER

Let us not be diverted or deceived by any premature or persuasive pleas there or here for a negotiated peace. There can be but one peace with a robber, an assassin, a rapist, and that is the peace of unconditional surrender.

But if our job is a big one, we are big enough for it. By this time next year we shall have four million more men on the western front, and I have the full confidence that with such a force we will plow through the German defenses to such point as we need to go. I know that our soldiers will do it if we sustain them. In their name I appeal to every American citizen to strip for war as they have stripped—to lay aside every weight of indulgence or comfort that encumbers or delays, to assemble every resource of possession, of body, and of mind, and to deliver the mighty blow of a hundred million freemen against the thrones of autocracy which are already tottering to their fall.

Let me express a bit of sentiment that I hope may be of some comfort to those who dread to read the daily casualty lists. I observed in the Boston Post recently a rather striking statement:

> War always takes the bravest and best of a nation. Somehow it seems that the very ones who have made so much of life, the happy warriors, the shining, lovable, knightly souls are the first to fall. Perhaps it is because death has marked them for his own—that in the Eternal Kingdom there are favored places for the chosen of earth, and because they, whom the world has loved so well, are the sacrifices only a brave people can make.

In a literal and earthly sense that is true, but in a higher and spiritual sense it is not true. You may recall that the first man to fall in the Spanish-American War was Ensign Bagley, of North Carolina. I well remember how, as a southern man, I thrilled at the realization that a State which in my childhood was at war with the Union had then contributed freely of its choicest in the Nation's cause. I was at Raleigh, N. C., a short time ago and I saw Bagley—not in the flesh, but in marble—on the State House Square, and I said Bagley is not dead, for I realized that he lives in the heart of every North Carolina youth. In Texas not long ago I witnessed a striking parade at the beginning of the Red Cross drive. The most commanding figure in it was a handsome young woman accoutered as Joan of Arc riding a white horse, and I said, Joan of Arc is not dead but she lives and lifts the heart of every girl in the world. So I like to feel that Edith Cavell, the martyr nurse, is not dead, but in robes of white moves among the battling Britons whether they stand with their backs to the wall or swarm forward across the fields of Flanders. The French who fell at Verdun are not dead but are leading the hosts of their countrymen in another advance across the Marne. The sons of Italy who were betrayed in Italia Irridenta are not dead, but are back across the Alps inspiring their comrades to heroic defense and fresh offense. Your son who may fall in France will only give to the purifying earth his worn and soiled garments of clay and rise in shining garments to be by your side every day that you live. There is no death. What we call death is only a process of life. The thousands that seem to give their lives in this world war will not have died. They will return and will inspire us to erect a purer and nobler temple of civilization.

CLARENCE OUSLEY,
Assistant Secretary of Agriculture.