U.S. DEPARTMENT OF AGRICULTURE

BUREAU OF PUBLIC ROADS

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BRICK SECTION, EXPERIMENTAL ROAD, CHEVY CHASE, MARYLAND

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Recent issues of Public Roads have contained chapters on "State Highway Management, Control and Procedure." It was the original intention to give in each issue the chapters devoted to eight or ten States, but it has not been possible to do this. The articles have, however, been of such interest and the demand for the additional chapters is such, in connection with pending road legislation in many States, that in order to make them available at once, most of the space in this issue is devoted to the completion of the series.

Owing to the necessarily limited edition of this publication it will be impossible to distribute it free to any persons or institutions other than State and county officials actually engaged in the planning or construction of highways, instructors in highway engineering, periodicals upon an exchange basis, and Members of both Houses of Congress. Others desiring to obtain "Public Roads" can do so by sending 15 cents for each number or $1.50 for annual subscription to the Superintendent of Documents, Government Printing Office, Washington, D. C.

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TABLE OF CONTENTS

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BRICK PAVEMENTS IN THE MIDDLE WEST.

Report of Inspection by A. T. GOLDBECK, Engineer of Tests, and F. H. JACKSON, Assistant Testing Engineer.

THE following report is based on a recent inspection by the authors of a large number of brick roads throughout the Middle Western States. Although particular attention was given to a study of the merits of "semi-monolithic" and "monolithic" brick roads, other points affecting the design and construction of brick highways were studied as well. The behavior under traffic of various types and sizes of brick, as well as different joint fillers, was noted and compared, and numerous modifications in design and interesting details of construction, etc., were observed. Furthermore, every failure encountered was analyzed for the purpose of determining its cause as well as suggesting means for guarding against similar failures in future work. In this way it was hoped that first-hand information might be obtained regarding the various problems encountered in the construction of brick roads, as well as the possibilities in the way of modification in design to meet different conditions.

CONCRETE BASE, CONNEAUT, OHIO, SHOWING RESULT OF SLOPING JOINT. EXPANSION HAS CAUSED ONE SECTION OF BASE TO SLIDE UP AND OVER THE OTHER.

The tour of inspection extended over city streets and county highways in six States—Ohio, Indiana, Illinois, Iowa, Missouri, and Nebraska and covered a period of 16 days. One of the outstanding results was the remarkable state of preservation of roads that had been under traffic for from 20 to 25 years.

A detailed report of the various streets and roads examined follows:

CLEVELAND'S OLD STREETS GOOD.

Most of the pavements in the city proper are laid on a natural-soil foundation, which, in the main, consists of a fine sandy loam. Most of these old streets are in good condition, and such longitudinal cracks as have formed are probably the result of poor drainage. Where good drainage conditions were found, very few longitudinal cracks were in evidence. Various failures of grouted brick streets laid on sand cushions were noted. These included the characteristic arching of the grouted brick surface over the sand cushion, due to expansion as well as the falling away of the sand cushion due to the vibration of traffic. This condition was particularly noted at street intersections and was determined by listening to the peculiar rumbling sound made by iron-tired vehicles when driven over the street. Spalling at the joints of the brick was likewise frequently observed. This condition was brought about by imperfect penetration of the grout into the joints, which had become partially filled with sand forced up into them from the underlying sand cushion during the rolling of the brick, or to too thin a joint due to imperfect lugs.

It was stated that about 75 per cent of the brick streets of Cleveland are laid on natural soil-foundation. Practically all of the older streets are constructed with standard re-pressed block, with cement grout filler. The present standard construction in the city, however, provides for a monolithic or semimonolithic street with a 4 to 6 inch concrete base, sand-cement bed, and wire-cut lug brick.

A number of the older brick streets of West Cleveland were examined for the purpose of noting their condition after 18 or 20 years' service on the natural soil foundation. These streets were laid about 1900, and with one exception are in very good condition to-day. Their general freedom from longitudinal cracks appears to be due principally to the fact that they were laid on a naturally well-drained subsoil.

The results of using a poor grade of brick were noted on West Fourteenth Street, which is a through street extending west from the center of the city. Brick in this case were laid on a 6-inch concrete base, with 2-inch sand cushion. Pockets varying in size from less than a square foot to 1 or 2 square yards were frequently observed. They were due probably to the use of inferior brick in the pavement or possibly to an excessive sand cushion. The rattler loss on these brick was stated at 30 per cent, old rattler test.

A number of streets in the eastern part of Cleveland, in general, showed characteristics as mentioned above. One very old sand-filled pavement made with building size brick was of particular interest in view of its splendid condition after about 25 years of service. The edges of the brick were somewhat worn and rounded, but otherwise there was no appreciable wear.

ON THE CLEVELAND-AKRON ROAD.

Inspection of the Cleveland-Akron road brought out some very interesting facts. This road has failed recently at a number of points due to the present extremely heavy traffic between the two cities. This traffic consists principally of very heavily loaded automobile trucks and local officials claim that the road carries a greater tonnage than any other intercity highway in the United States. The following table shows the construction record for the road:

Section.	Between limits.	Length (miles).	Built—	Construction.
1	Cleveland-Tinker Creek.....	6.2	1906	Brick.
2	Tinkers Creek, Top of Hill.....	.2	1916	Do.
3	Top of Hill, Summit County line..	2.8	1916	Asphalt-concrete.
4	County line, Twinsburg Township.	2.4	1915	Brick.
5	Twinsburg Township, Twinsburg .	1.2	1912	Do.
6	Twinsburg-Stow Township line....	4.1	1913	Do.
7	Stow-Hudson line, Cuyahoga Falls.	7.0	1912	Do.
8	Cuyahoga Falls, Cuyahoga Falls Avenue.	.4	1916	Do.
9	Cuyahoga Falls Avenue, Akron....	1.0	1912	Do.

Section 1, laid on rolled slag base with 2-inch sand cushion.
Section 2, laid on 6-inch concrete base, 1-inch cement-sand cushion.
Section 3, 2-inch top on 7-inch concrete base.
Section 4, laid on 4-inch concrete base on 2-inch crushed slag cushion.
Section 5, laid on concrete base on 2-inch sand cushion.

The failures on this road had either been repaired or were being repaired at the time of inspection. They occurred for the most part in the early spring of 1918, and in nearly every instance could be traced directly to poor drainage conditions. More failures occurred on section 1, which was laid on a rolled slag base, than on any of the other sections of the road. The conditions observed were probably due to the overloading of the base by traffic at a time when the earth foundation was saturated with water, thus greatly decreasing its bearing value. An inspection of various places on the road where failures had taken place confirmed this theory.

THE CUYAHOGA COUNTY ROADS.

Most of the roads inspected in Cuyahoga County had been down for some years and were of the standard sand cushion type. The outstanding features noted were the large number of longitudinal cracks, and also the typical failures due to the pushing up during construction, of the sand cushion between the brick joints, which resulted in imperfect grouting. Failures of sand cushion pavements in this way are to be noted in a great many instances and are characterized by the cracking of the brick in small areas, sometimes accompanied by the flaking off of the top surface.

None of the roads in Cuyahoga County is subjected to the extremely heavy traffic carried by the Cleveland-Akron road. Typical foundation failures of the extreme type noted in the Cleveland-Akron road therefore were not in evidence, although there are places where failure of the pavement could be attributed to insufficient bearing value of the subgrade. By referring to a soil map of Cuyahoga County, it will be noted that the predominating soil is a clay loam and this, in all probability, is highly retentive of moisture The high percentage of longitudinal cracks observed may be attributed to this characteristic of the soil, which permits great expansive action due to the severe frost in this section.

Two recently laid monolithic brick roads were in very good shape, but were somewhat rougher than the standard sand cushion type.

AT CONNEAUT, OHIO.

Of the brick streets in Conneaut, Ohio, Main Street was of peculiar interest on account of the fact that it was laid about 25 years ago, and had been continuously subjected to a considerable amount of traffic such as might be expected on the main street of a town with a population of 12,000. This street is also on the main highway between Cleveland and Buffalo and the East.

When visited, the street department was about to repair a heave which had occurred some years before, and it was decided to inspect the work of removal of the brick, in an effort to determine the cause of the failure. Upon removal of the brick it was noted that the sand cushion had not separated from the brick that had heaved, but had readjusted itself under them, showing that the failure was not primarily due to expansion of the brick pavement. Upon removing the sand cushion it was found that

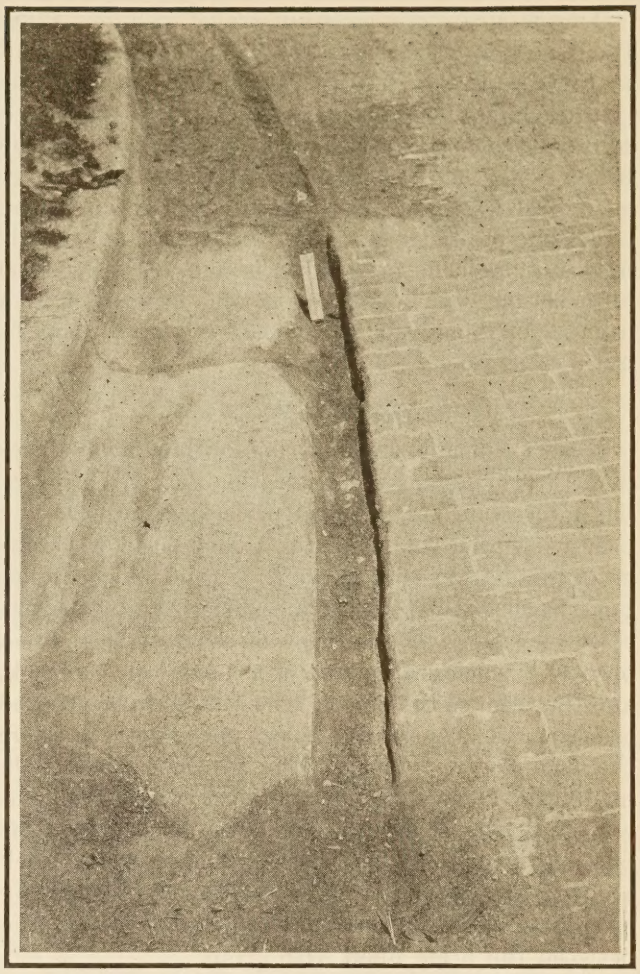
the heave had taken place over a sloping joint in the concrete base and that it was due to the sliding up of one section over the other when expansion of the base took place, thus causing the brick surface to rise. Fortunately, one of the workmen who constructed this street was detailed to make the repairs and had a distinct recollection that the day's work was ended at this particular spot. He also stated that broken stone had been used in the concrete on one side of the joint and that gravel had been used in continuing work.

This type of failure emphasizes the necessity for constructing joints in the concrete base by putting up a vertical bulkhead, such as is used in good present-day practice. The accompanying illustration shows the concrete base after removal of the sand cushion, and the angle of slope at the end of the day's work is seen very plainly. The amount of rise of one section over the other was about 2 inches. The same kind of a failure was noted one block away on the same street.

An interesting instance showing the relative amount and kind of wear to be expected from a grout-filled and a bituminous-filled pavement was noted on a business street in Conneaut where transverse joints consisting of six or seven courses of bituminous-filled brick were used. The edges of the brick at the expansion joint were battered down and some of the brick were badly worn, whereas the brick having a Portland cement grout filler were quite smooth along the edges and did not seem to be breaking out. This sort of failure is quite characteristic of the brick in many bituminous-filled pavements.

An interesting case of frost action was noted in a newly laid semimonolithic brick pavement. All construction details had received careful attention, yet during the winter the pavement heaved at the center, causing a wide longitudinal crack to form. Levels run by the city engineer showed the amount of this heave in the center to be about 3 inches, with very little vertical movement at the sides. The explanation was made that this difference in vertical movement was due to the protective action of the uncompacted snow at the sides of the road, which prevented the penetration of the frost to as great a depth as at the center. The city engineer likewise determined the frost penetration and found that at the center of the pavement the ground was frozen to a much greater depth than at the sides, thus bearing out this theory.

It is to be noted that the subgrade on this street consisted of a sticky clay. In other parts of the city, on the other hand, pavements which had been laid on the sandy soil existing there remain practically free from cracks of any kind. This is almost certainly due to the better drainage afforded by the more porous foundation, and is another instance of the effect of the character of the subgrade on the pavement. When the subgrade is of a porous nature and is well drained, heaving is much less likely to happen than where the subgrade is composed largely of clay which is highly retentive of moisture and hard to drain. Likewise, when the frost comes out of the ground, the porous, easily drained soil is able to support the pavement under much heavier live loads than is the poorly drained moisture retaining soil, consequently decreasing the chances of a foundation failure.



FAILURE OF CONCRETE GUTTER ON CURVE, NEAR CONNEAUT, OHIO. NOTE THE SMALL BATS AT THE ENDS OF THE COURSES OF BRICK WHICH ARE STILL INTACT.

A type of failure somewhat common in city pavement work is shown herewith. This view was taken near Conneaut of a pavement laid on a rather steep grade on a curve, and with 1-inch sand cushion. The concrete gutter has been worn by traffic into a groove about 4 inches wide and from 2 to 3 inches deep. This was aided perhaps by the original width of the bituminous-filled expansion joint between the gutter and the pavement. This joint was probably three-fourth inch in width. It can be seen in the illustration that although traffic has been grinding along the edges of the brick pavement, none of the brick has been displaced, not even the small bats serving as fillers at the end of the courses.

This is an extreme case of traffic grinding along the edge of a brick pavement. The bats at the end of the courses are likewise very small, so that the conditions are very favorable for the breaking down of the edges of the pavement by displacement of the brick. The fact that such displacement has not occurred is a good indication that the protecting action of a concrete curb along the sides of a monolithic or semimonolithic brick road is unnecessary. This observation was borne out in the inspection of a number of monolithic pavements constructed without a concrete curb or edging.

USING VERTICAL FIBER BRICK.

Near Conneaut, Ohio, a monolithic brick pavement was in course of construction and was of peculiar interest in that vertical fiber brick were being used. A detail of the brick laid on the wet concrete foundation and before the grout had been applied is shown. It will be noted that the lugs at the sides of this particular type of vertical fiber brick occupy a considerable area of the sides of the brick, and thus reduce the area of the surfaces to be grouted together, because the grout can not penetrate where the lugs are in contact with adjacent brick. On monolithic and semimonolithic work it is of the highest importance that the side bond be as strong as possible, so as to protect the bond between the brick and the concrete base. This can best be secured by having as large a proportion as possible of the area between the brick filled with grout.

ROADS IN THE VICINITY OF GOSHEN, IND.

A very good example of the semimonolithic type was observed in the new Paris road near Goshen, Ind. It was built with a 3½-inch concrete base, a 1-inch cement-sand bed, and 4-inch wire-cut lug brick. The road is 16 feet wide and carries considerable through traffic. It was in very good condition and no longitudinal cracks were noted.

An interesting expansion failure was observed on the Lincoln Highway, west of Goshen, which at the point in question is 14 feet wide and built on a gravel base and 1½-inch sand cushion, with 6 by 12 inch concrete curbs at the sides. The failure occurred on a curve at the intersection of two long tangents. As a result of temperature stresses in the pavement during the present summer, the pavement was pushed out at the curve to a distance of 9 inches at the point of greatest movement, leaving the curb on the inner side and sliding up and over the outside curb. The detail view shows the inner curb. The remarkable fact about this failure was that as far as could be observed there was no breaking up or crushing of the pavement itself.

Another interesting failure was observed on Prairie Avenue, near Goshen. This is typical of a number which have taken place on this road. It has been down five years and is sand-cushion type of construction. The longitudinal cracks and settlement at the edges of the road probably are due either to the shifting of the sand cushion or to carelessness in construction, since the traffic is not heavy enough to have produced failure.

An interesting example of failure due to poor grouting was observed on the East Lincoln road, which is 16 feet wide and was laid on a gravel base with 1-inch sand bed and 6 by 12 inch curbs at the sides. The breaking up of the brick is due to poor grouting, which failed to properly protect the edges under traffic. This condition is typical where proper attention is not paid to grouting at the time of construction, and emphasizes the necessity of the utmost care being paid to this detail.

ROADS NEAR PARIS, ILL.

The Springfield road was built in 1915 and consists of a 4-inch brick surface on a 4-inch concrete base. It is 10 feet wide over one section and 13 feet wide over the rest of the road. The traffic consists of grain and coal hauling, automobiles and heavy trucks. Transverse cracks have occurred in this road from 25 to 75 feet apart. These, however, are barely noticeable and do not seem to have any deteriorating effects on the road. The surface is quite smooth, and there are no signs of disintegration. The road is an excellent example of the monolithic type of construction.

The Cherry Point road is built on a 4-inch concrete base with a 1½-inch sand cushion and is 6 years old. It is rougher than the monolithic type on the Springfield road. The surface, however, is in very good condition.

A monolithic road under construction at Paris was 10 feet wide with a 4-inch brick wearing surface and a 4-inch concrete base. A new tamping template was being used in constructing the concrete base. It is made of structural shapes in the form of a truck upon which is mounted a gasoline engine. The truck runs on the steel forms at the sides of the concrete base. The forward and rear I-beams serve to strike off the concrete. A steel frame is set inside of the main frame of the machine and is oscillated by the gasoline engine, so that the forward and rear beams of the oscillating frame tamp the concrete as the frame rocks. The rear I-beam

of the main frame serves to give the concrete a final smoothing off. The device is provided with drum and wire cable for propelling itself forward. The concrete after treatment with this machine is so well tamped that it will bear a person's weight with an indentation of perhaps only one-eighth inch

On this particular work the brick were set in the green concrete immediately after laying. Some detail photographs were taken to illustrate interesting points in connection with the laying of the brick. In one a number of the brick had been removed from the green concrete base. The concrete was found to be indented, and extended up into the joints between the brick. The ridge thus formed should be of material aid in resisting horizontal shear at the plane of junction between the brick and concrete. The green concrete adhered to a few of the brick. On the other hand, many of them were removed without the slightest difficulty and without any sign of the concrete sticking to them.

VERTICAL FIBRE BRICK READY FOR GROUT, NEAR CONNEAUT, OHIO. NOTE THE NARROW GROUT SPACES BETWEEN BRICK AT CERTAIN POINTS.

In this particular case of monolithic construction it is the opinion of the authors that the contractor was using too dry a mix. It would seem preferable for the concrete to be of such a consistency that the process of tamping will bring a thin coat of mortar to the top and that the brick should be set immediately in this green soft grout. In this way very good adhesion should be developed between the brick and the concrete due to (*a*) better adhesion at the horizontal surfaces and (*b*) a greater projection of the grout up into the vertical joints. If the grouting of the brick were then done immediately a truly monolithic construction probably would result.

There is also shown a method of laying brick on a curve, whereby the use of small bats is eliminated by laying the course of longitudinal brick and the transverse courses extending to this longitudinal course in the form of saw teeth. Treatment at the side of the pavement is shown. Here the small bats are set not at the edge of the pavement, where they would be in more danger of being displaced, but at the inner end of the whole brick placed along the edge. This detail probably aids in preventing the edge of the pavement from being battered by steel-tired vehicles.

ROADS NEAR DANVILLE, ILL.

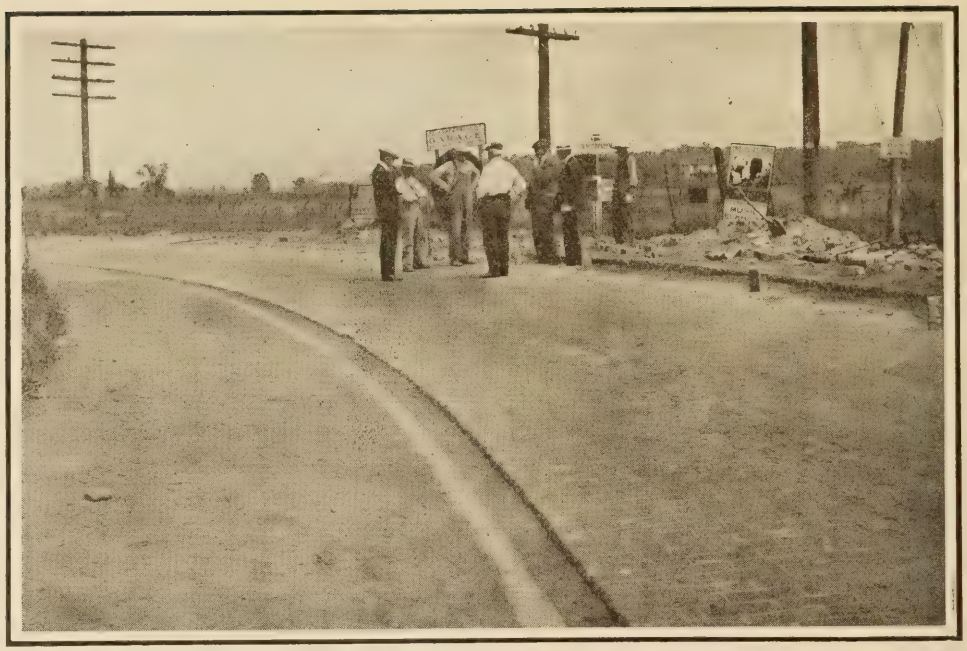
The Danville-Tilton road is of peculiar interest because of its radical type of construction. It is built on a concrete base with a sand-cement cushion and wire cut lug brick, laid on their sides with lugs down. Bituminous filler was used. The joints of this road do not seem to be well filled. The brick are chipping at the edges, and there are soft brick in spots. This road was built as an experiment about one year ago and its behavior is being watched with interest.

The base of the Danville-Batestown road was an old brick road made of building brick, sand-filled, and laid about 15 years ago. Under heavy traffic the old road had settled very badly, making an uneven pavement. This foundation was covered with a course of 1–2–3 concrete, using pea-size gravel. Just enough concrete was used to level off the base. Wire cut lug brick were set directly in the green concrete and then grouted. At one end of the road 3-inch brick were used and at the other end the brick were 4 inches thick.

The resurfacing work was done about one year ago, and the road was in good condition when inspected.

A short section of experimental road near Danville was built of wire cut lug brick laid on 1, 2, and 3 inches of concrete, respectively. It was built in 1915, and since then subjected to heavy traffic. All of the sections are in uniformly good shape. There is no difference in their appearance. It might be pointed out that the idea of using so thin a base as 1 inch of concrete was simply to prevent the soil from being pushed up into the vertical joints in the brick, as well as to provide a bedding course upon which to lay them. More perfect grouting of the brick is thus insured. The same results probably would have been secured by the use of a 1 inch sand-cement bed, such as noted on other roads.

The condition of this section brings out very forcibly the possibilities of light design for the monolithic construction when the conditions are favorable. In this, as in other cases of light construction sustaining heavy traffic, the underlying soil is of a character which permits good drainage so that it is possible to keep the foundation dry and thus maintain its bearing power. On the other hand, a soil such as the clay of Cuyahoga County, Ohio, which retains and attracts moisture through capillary action and is hard to drain, loses the greater part of the bearing power it would possess in a dry state. Light construction would obviously be poor engineering under such conditions.



HORIZONTAL EXPANSION ON CURVE, LINCOLN HIGHWAY, NEAR GOSHEN, IND. THE PAVEMENT IN THE FOREGROUND HAS MOVED OUT FROM THE CURB FOR A DISTANCE OF NINE INCHES.

It has, moreover, been observed that even a 4 to 6 inch concrete base, as on the Cleveland-Akron road, although undoubtedly helping to distribute the loads, sometimes fails to properly support the surface. This whole question of the character of the underlying soil and the part it should play in the design of a road surface is one that unquestionably deserves careful study.

An interesting feature in connection with this experimental road was the fact that a previous inspection made by the county engineer had shown that a monolithic bond existed between the base and the brick. He stated that he had occasion to take up a considerable area of this pavement after it had been under traffic for some time and that the brick adhered to the concrete very well.

At Hoopeston, Ill., was noted an interesting method of laying brick on a curve on the Lincoln Highway. The brick were laid longitudinally around the curve, instead of transversely as in general practice. Close inspection of this curve showed no fects, indicating that this method of construction is satisfactory. This road is 2 years old and is subjected to fairly heavy traffic.

ROADS NEAR DIXON, ILL.

A section of the Lincoln Highway near Dixon is of grouted repressed brick laid on a sand cushion and on old macadam base. Before the brick were laid the macadam base was widened, and there is considerable settlement at the side of the road, causing failure of the brick surface at these points. This fact emphasizes a point which has often been brought out, viz, that in order to prevent unequal settlement of the subgrade it must receive uniform compaction. When additional broken stone is placed alongside of an old macadam road it is a very difficult matter to roll the shoulders to the same degree of compaction as in the old macadam road. It is the opinion of the authors that it is advisable to plow up the old macadam base and reroll it over the entire width in order that it may be compacted evenly, and thereby settle evenly. There are some longitudinal cracks in the center of this brick road. In general, however, the surface is in very good shape except where settlement has taken place. These bad spots probably could be repaired satisfactorily by the application of bituminous material and stone screenings.

The Lincoln Highway west of Dixon is of semi-monolithic construction with a ⅜-inch sand-cement bed and a 4-inch concrete base. There is no edging of concrete at the sides of the road and no evidence of breaking down of the brick. The road is only one year old but is in excellent condition. There are very few defects except a few longitudinal cracks. A defect was noted in the wearing surface of the road where it passes over a culvert. A concrete slab was used at this point and is very badly worn, making rather unpleasant riding. It would seem desirable in all cases of culvert construction to carry the road surfacing clear across the culvert and thereby make for more uniform wear. It also would seem good practice to reinforce the concrete base across the approaches to culverts of this character.

ROADS NEAR STERLING, ILL.

On the Lincoln Highway east of Sterling there is a re-pressed brick road on a gravel base. It is 16 feet wide and 4 miles long. The joints are filled with tar. A great deal of the tar has flowed out of the joints into the ditches at the sides. The edges of the brick do not seem to be well protected, as the joints are not completely filled. Although built on a gravel base and carrying fairly heavy traffic there are no evidences of foundation failure.

FAILURE OF BRICK PAVEMENT, SAND CUSHION CONSTRUCTION, GOSHEN, IND.

A road 16 feet wide, constructed on a gravel base with a 1-inch cement-sand cushion and 4-inch wirecut lug brick, is part of Indian Head Trail, north of Sterling. It was laid in the summer of 1917. There is moderate traffic, with occasional heavy loads. The surface is in excellent condition, with no indications of punching through of the brick or breaking down at the sides. There are some transverse cracks, but no longitudinal. Transverse cracks occur at about the same distance as in a concrete road. The subgrade is a fine black loam and is not provided with tile drainage.

DES MOINES–CAMP DODGE ROAD.

This road is 20 feet wide and is built on a 4-inch concrete base with 4-inch wire cut lug brick on a thin sand-cement bed and has neither edging nor curb. The road was built in 1917 on a new fill in many places. The fill was placed in 1-foot layers, each rolled with a heavy roller. The traffic consists of a large number of automobiles and a considerable number of heavy trucks. The surface is in excellent condition. A careful examination of the concrete base was made in several places and it appeared to be rather weak and porous.

At the Des Moines end the city has put down a side-cut, lugless, brick pavement laid on a cement-sand bed, with grouted joints. The joints between these bricks are very narrow in many places and it is probable that the grout has not penetrated more than one-half inch, judging from the appearance of some defective bricks that had been removed. This road is provided with cross-expansion joints every 75 feet. At about the same time the Camp Dodge road and the lugless brick street were laid a bituminous concrete pavement was also put down. All three sections carry about the same traffic. In Camp Dodge proper there is a Portland cement concrete road and all four of these sections will, for some time in the future, be subjected to very heavy traffic leading to and through Camp Dodge. An interesting comparison of different types and construction is here furnished, and a future inspection should prove to be very instructive.

ST. LOUIS, MO.

Present practice in the construction of brick streets in the city of St. Louis makes no provision for expansion joints at street intersections. A number of semimonolithic brick streets using 1:3:6 concrete foundation and 1-inch sand-cement bed have been constructed recently along the above lines and no evidences of expansion failures at street intersections have as yet been noticed.

A semimonolithic brick street in which a type of expansion joint consisting of one course of wood block across the street every 100 feet was observed. This road has a 6-inch concrete base, 1-inch sand-cement bed for part of the way, and limestone screenings for the rest of the distance, and 4-inch brick. The use of limestone screenings in place of sand in the cushion is an improvement over the old standard construction in that there is much less likelihood of the cushion pushing up into the joints when the brick are rolled. Subsequently a number of streets were built, using this construction.

The oldest brick street in St. Louis was observed on Euclid Avenue and found to be in good condition, although laid about 25 years ago. Traffic on this street, however, is not heavy at present. The joints are sand filled.

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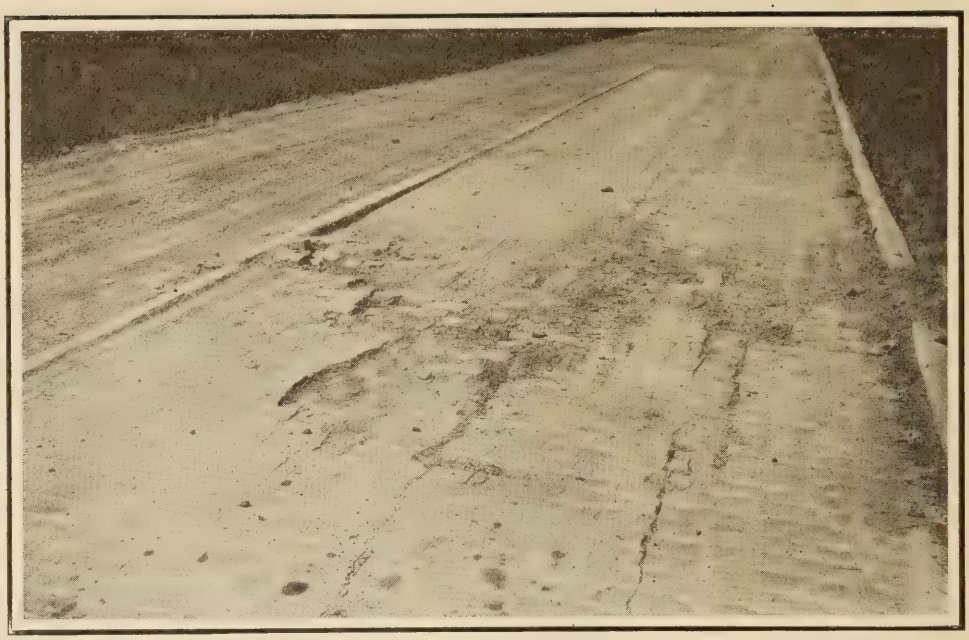


FAILURE OF BRICK PAVEMENT, SAND CUSHION CONSTRUCTION, GOSHEN, IND.

A brick intersection laid in December, 1915, on the north and south road as a demonstration of semi-monolithic construction is in the form of a cross with three arms 200 feet long and the other 360 feet long. All but the outer 160 feet of the long arm was built on a 4-inch concrete base, using 4-inch brick. The outer 160 feet was laid on a 2-inch concrete base. The traffic on this road is very heavy and has caused a number of local failures, such as longitudinal cracks, transverse cracks, brick spalling at the joints, broken brick, etc. The surface is very badly broken up, a condition particularly noticeable at the extreme end of the section. An analysis of this failure indicates that it is due primarily to poor grouting combined with an inferior quality of brick. The appearance of the longitudinal crack would likewise indicate that some settlement had possibly taken place. This condition emphasizes very strongly the necessity of properly filling the joints in the brick with grout, thereby forming a truly monolithic surface. This undoubtedly would have protected the brick and to a certain extent would have prevented the breaking up which was observed. It was suggested at the time that a much better penetration of the grout would have been secured by the use of a modern machine grout mixer instead of the old-style box mixer which was used. This experiment clearly demonstrates what may be expected to happen to a brick pavement subjected to heavy traffic when all the details of construction are not very carefully observed.

NORTH ALTON, ILL.

An example of light monolithic brick pavement was inspected at North Alton, Ill. A short section of road 12 feet wide was laid on the main highway leading north from Alton. The construction was 4-inch brick laid on a 2-inch 1:4 sand-cement bed, with no concrete base or edging. There appeared to be no evidences of foundation failure, in spite of the very light base. The condition of the brick and of the grouted joints was likewise good. This is a very good example of the possibilities of light monolithic construction under favorable conditions of subsoil and drainage.

KANSAS CITY, MO.

An instance of rather poor grout penetration was observed in Kansas City on old Twenty-fourth Street, which carries very heavy traffic, consisting principally of horse-drawn and motor trucks hauling from railroad yards. The pavement is laid on an 8-inch concrete base and consists of vertical fiber lug brick on sand cushion. The pavement is in fairly good condition in spite of the heavy traffic. Small local failures due to spalling of the brick were observed. That this condition was due to poor grout penetration was borne out by an inspection of a number of brick which had been taken out to make a cut. Very few brick showed evidence that the grout had penetrated to a depth greater than one-third that of the brick.

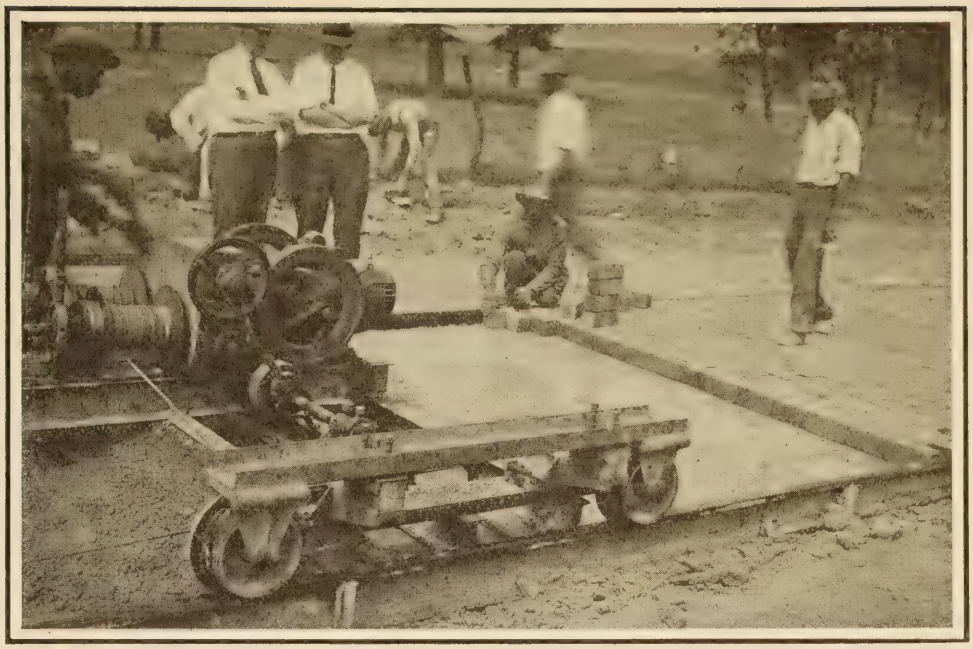
On Roanoke Road there is an example of the use of an asphalt filler. This pavement was laid on an 8-inch concrete base, with sand cushion and 4-inch vertical fiber-lug brick. The asphalt was squeegeed into the joints, the excess being allowed to flow over the surface of the pavement so as to form an asphalt wearing mat or carpet, which entirely covers the brick. This road is 5 years old and the asphalt mat is still adhering in spots. In other places it has worn away entirely exposing the brick. About the only evidence of failure observed on this road was a certain amount of wear on the brick, due probably to the impact of traffic on the unprotected edges.

Another example of an asphalt-filled pavement was noted on Thirty-ninth Street. This pavement likewise was laid on an 8-inch concrete base, using 4-inch vertical fiber-lug block on a sand cushion. The street has been down three years and, except for the fact that the asphalt does not appear to be adhering to the joints very well, is in good condition.

An instance of the use of lugless vertical fiber block with an asphalt filler was observed on Prospect Avenue. This street is about 1½ years old. The

joints of the brick in this case had apparently been very poorly filled, due either to an attempt to use the filler at too low a temperature or to the fact that the spaces between brick were not wide enough. This resulted in an excess of asphalt on top in some places, while in others such filler as originally found its way into the joints has been pulled out by traffic.

On Vine Street, from Twenty-fifth to Twenty-seventh, there was a job under construction. This was of lugless vertical fiber block on an 8-inch concrete base with 1-inch sand cushion and cement grout filler. The principal feature of interest about this job was the extremely poor manner in which the brick were being laid. An inspection of the joint on a single course showed the space between courses to vary from nothing to as much as an inch. It is obvious that proper grouting under these conditions would be impossible.



TAMPING TEMPLATE FOR MECHANICALLY PREPARING CONCRETE BASE TO RECEIVE BRICK WITHOUT THE USE OF SAND-CEMENT BED.

LINCOLN, NEBR.

A number of asphalt-filled brick streets and roads in and around the city of Lincoln, Nebr., presented outstanding features that may be summed up as follows: They range in age from 3 to 7 years, and are, for the most part, laid on a 5-inch concrete base, composed of 1 part cement and 6 parts of fine local gravel 1 inch sand cushion and vertical fiber-lug block. As in Kansas City, the hot asphalt, ranging in temperature from 350 to 450° F., is squeegeed into the joints and considerable excess allowed to flow over the surface of the street which, with a sand covering, forms a wearing mat or carpet which remains intact for some time. The most interesting example of this construction was found on South Street west from Tenth. This street is 7 years old and is subjected to very heavy traffic. It is in excellent condition, with the asphalt mat still adhering in spots. On the exposed portions of the brick surface an examination failed to show any appreciable wear at the joints of the brick. This is one of the best asphalt-filled brick streets examined.

OMAHA, NEBR.

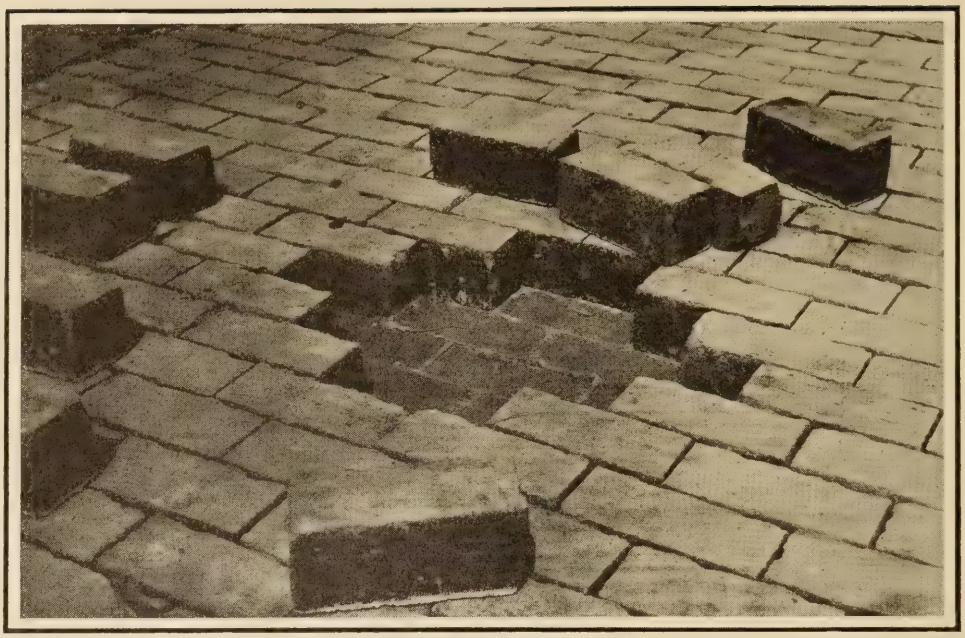
A number of streets inspected in Omaha include some old sand-filled streets, such as the Dodge Road, which are still in good condition. These are laid for the most part on a 5-inch concrete base, using repressed block. The modern streets are practically all asphalt-filled vertical fiber brick. The lugless vertical fiber brick are now being tried under the assumption that the kiln marks and warping of the brick may be utilized instead of lugs to form the proper spaces between the brick courses. They have not been in service long enough to form any conclusions as to their practicability. An isolated example of the use of an old lugless block was shown at Twenty-second and Chicago Streets. This is a brick street laid about 18 years ago on an old concrete base. The brick were building brick size without lugs, laid on edge, and filled with a 1:1 cement mortar grout. This street is in very good condition, the grout giving every indication of having penetrated properly. The traffic is not heavy. Inasmuch as the grout spaces appear to be very uniform it is to be presumed that considerable care was used in forming the joints.

GENERAL DISCUSSION.

Unfortunately the inspection did not include examples of brick pavements having a bituminous mastic filler. The following discussion, which does not include this type of construction is based upon the observations made by the authors during this

inspection as well as upon the experiences of engineers and contractors who have done a great deal of work along this line.

The brick road considered as a structure divides itself into (1) the foundation or subgrade; (2) the base course; (3) the cushion or bedding course; (4) the brick wearing course; and (5) the joint filler, and a general discussion of all brick roads naturally lends itself to a discussion of these various divisions.



SHOWING JOINT BETWEEN BRICK AND CONCRETE BASE. MONOLITHIC BRICK ROAD CONSTRUCTION, PARIS, ILL.

TYPE OF FOUNDATION OR SUBGRADE.

In a very large number of the roads inspected there were to be observed many evidences of foundation or subgrade failures, and the importance of a study of subsoil conditions was very forcibly impressed on the writers. It has been pointed out that a great many longitudinal cracks were observed, and these occurred on fills where there was apparently good drainage, as well as in localities where the drainage was obviously bad. The character of the soil seemed to play a very important part in influencing the number of longitudinal cracks, and it was very evident that sticky, clay soils that would retain a large amount of moisture and undoubtedly show considerable heaving during freezing and thawing weather were much more likely to produce longitudinal cracks than were the more porous, sandy soils. Specific instances of brick pavements in the city of Conneaut, Ohio, some laid on a sandy foundation, and others on a clay foundation, have already been noted—those on the clay foundation having cracked and heaved, those in the sandy part of the town having remained intact. Throughout the sections visited the same general condition existed.

It can not be too strongly urged that a thorough study must be made of the underlying soil and the drainage conditions before attempting to design a road for a particular locality. It should be noted also that certain kinds of soils are not susceptible of drainage by the methods ordinarily practiced, using tile drains and French drains along the side of the road. It is apparent that capillarity plays a very strong part in influencing the retention of moisture by the subgrade, even though apparently good drainage facilities are provided. A thorough study of capillarity and methods of draining various kinds of soils would be of great benefit.

Instances have been cited, notably in the Cleveland-Akron road, in which the superimposed loads were such that the subgrade, softened by the presence of moisture, readily gave way and was unable to support the slab which, in turn, did not possess sufficient strength to act as a beam but was broken through in spots. It is possible that soils of this character could be improved very greatly in their bearing value by the use of a porous filling material, such as cinders, broken stone, slag, or gravel, and in this way the high-unit pressures transmitted directly through a pavement would be so distributed that the unit pressure on the natural soil foundation would be within the bearing value of the soil. It is also possible that correct methods of drainage might accomplish the same end, that is, increase the bearing value of the soil by drying it out.

It has been suggested that as an aid to such drainage measures a treatment of bituminous material might be beneficial. An instance of the value of a filling of porous material and of good drainage may be noted in the case of Goodfellow Avenue in St. Louis, where telford drains were placed at the side of the road and a subbase of cinders used under the broken stone wearing surface. There are no instances of foundation failures in this road, although it carries considerable traffic. It has been suggested that a good method of increasing the bearing value of the soil is to provide blind drains along the sides of the road with frequent outlets, so that the water table will be lowered considerably below the wearing course, notwithstanding the effects of capillarity.

TYPE OF BASE.

The object of the base of a brick pavement is so to properly support the wearing surface that it will

maintain its original contour and not become depressed in spots or wavy. It is perfectly obvious that the character of the subsoil, which supports the foundation, and the character of the loading transmitted through the wearing course to the foundation, should control this design. Thus, one would not expect that there would be a necessity for a heavy concrete foundation if the subbase were always exceedingly firm and unyielding. On the other hand, if the subgrade were exceedingly soft, such as obtains in clay saturated with moisture, a thick base is obviously necessary in order to properly distribute heavy loads to the subgrade and reduce the unit pressure within the bearing value of the subgrade.

From these considerations it should be plain that it is perfectly possible that a wearing surface of brick laid directly on the soil might remain in very good condition if the traffic is not very heavy and if the subbase is well drained and therefore firm and unyielding under all conditions. Instances of such construction have been noted, such in Cleveland, Ohio, and Sterling, Ill., and other cases of an exceedingly light concrete base from one to two inches thick have been noted at Danville and North Alton, Ill. A number of other instances have been pointed out in which the brick surfacing has been laid on a rolled slag or a rolled stone foundation and has proven to be highly satisfactory.

OBJECT LESSON IS APPARENT.

The object lesson furnished by these roads is that the character and thickness of the base should be very largely governed by the local soil and traffic conditions. It should be emphasized very strongly that it can not be considered good practice to make a standard design for a brick road and apply this design to all sections of the country irrespective of these local conditions.

It is the practice in various sections of the country to build a brick wearing surface upon an old macadam road used as a foundation, and in a number of instances the brick wearing surface is wider than the old macadam road. Failures of the brick surface laid upon such roads have been noted, such, for instances, as occurred at Dixon, Ill., in which the sides of the brick road settled in spots due to the settlement of the new macadam foundation. Had the macadam foundation settled uniformly, trouble of this character could have been avoided, so that, unless the macadam is given uniform compaction, it is to be expected that future settlement will be unequal.

METHOD OF LAYING BRICK ON A CURVE. WIRE-CUT LUG BRICK READY FOR GROUT. PARIS, ILL.

It is the opinion of the authors that when an old macadam road is used as a foundation it is advisable to plow up the old surface and reroll it as evenly as possible, especially when the new surface is wider than the old. This applies particularly to an old road surface which is badly rutted and pitted or the crown of which must be changed to make it suitable for the brick wearing course. In some cases it might be economical to resurface the old macadam with a cement-sand bedding course, making it no thicker than is necessary to produce the proper crown. Attention has been called to the use of an old brick pavement as a foundation course for new wearing surface. Such practice seems to have worked out very successfully when a cement-sand bed was used, as evidenced by the roads at Danville, Ill.

FOUNDATION OF THE ROAD.

Since the foundation plays the part of distributing the load to the subbase, it is obvious that where the subbase is soft and the traffic heavy, the greatest possible distribution of load must be obtained, and this can be accomplished best by the use of a concrete base, since its resistance to bending aids in distributing the load. The proper thickness of a concrete base has been a mooted question. In certain types of brick construction, there is no doubt that the wearing surface adds to the slab strength of the concrete base, and thus aids in reducing the unit pressure on the subbase. Such a condition is true

in the case of strictly monolithic construction, to a lesser degree in semimonolithic, and still less in sand-cushion construction.

A discussion of the design of a concrete base is impossible from a theoretical standpoint at the present time, in view of the fact that the exact distribution of the reaction against the under side of the slab is unknown, and will have to be determined by suitable tests. The distribution of this reaction determines the bending moment under the load and, as has been pointed out, the soil conditions greatly influence this distribution. At the present time, therefore, a determination of the proper thickness of concrete base for different types of brick roads must be based on precedent. It would seem from the results of observations that the present-day heavy traffic can be carried safely on a 4-inch concrete base with 4-inch brick wearing course when monolithic construction is used, and when the subgrade conditions are favorable. It would seem highly desirable that the thickness of this base be increased along any stretches of the road in which the subbase conditions might be open to question. On very heavily traveled city streets the thickness of the concrete base will likewise have to be increased.

Where a sand-cement cushion is used, although it is not believed that such construction is a true monolith, a 4-inch concrete base should prove sufficient under heavy traffic, provided this base is increased in thickness over bad spots in the subgrade. When sand-cushion construction is used with a grouted brick surface, a 6-inch concrete base should give good results under heavy traffic, with an increase in thickness over the soft spots in the subgrade. If a bituminous filler is used in the brick-wearing surface, theoretically the concrete base should be thicker than in the case of a grouted surface. In the absence of test data, however, it is impossible to state how much thicker.

TYPE OF CUSHION OR BEDDING COURSE.

In the old standard type of construction a cushion of sand or other fine material up to 2 inches thick was advocated, the idea of this cushion being to permit laying the brick to a smooth surface and also to give a cushioning effect for the traffic. When sand is used as a cushion it generally is brought to a level surface by rolling and the brick are placed on this cushion and rolled down with a light roller. The effect of this rolling in a number of instances has been to force the sand cushion up into the joints between the brick and thus the space which should be occupied by joint filler is partially filled with sand. In a number of sand cushion brick pavements, this has had a very detrimental effect in that when expansion takes place in the brick in hot weather, most of the compressive stress is thrown toward the top of the pavement and results in buckling, in the crushing of the top surface and the cracking or scaling of the brick. This is one very serious defect in sand cushion construction with cement grout-filled brick.

METHOD OF BATTING IN WIRE-CUT LUG BRICK AT SIDES OF PAVEMENT READY FOR GROUT, PARIS, ILL.

It is inevitable that moisture must find its way down through any cracks in the brick to the underlying sand cushion, and the amount of moisture in all probability is very much larger in the vicinity of transverse and longitudinal cracks in the brick surface than under that part of the pavement which has remained intact. Sand has the well-known property of expanding when it absorbs as high as about 10 per cent of moisture, and due to this action there is a probability that the brick surface is caused to bear unequally on the sand cushion unless the sand cushion is caused to shift its position. Again, in those parts of the sand cushion containing the greatest amount of moisture the expansion due to freezing will be greatest. Then, too, under the vibration of traffic and the movements of the concrete base and brick surfacing, due to expansion and contraction, the sand cushion undoubtedly is caused to shift its position.

The washing away of the sand cushion from under the brick, leaving it unsupported, is not an infrequent occurrence. The possible cushioning effect of the sand cushion becomes of minor importance in view of its many disadvantages in other respects.

INDIAN HEAD TRAIL LOOKING NORTH FROM STERLING, ILL. THIS ROAD WAS LAID ON A GRAVEL BASE. NOTE THE ABSENCE OF CONCRETE CURB.

DEVELOPMENT OF MONOLITHIC TYPE.

In order to eliminate some of the bad features of sand cushion construction, a semimonolithic or cement-sand bed construction was introduced. In this type of pavement a mixture is made of about 4 parts of damp sand to 1 part of Portland cement, and this is used in place of the plain sand cushion, the brick being placed and rolled on this as on the old standard type of construction. After the brick are rolled they are well wet down so that water will impregnate the sand-cement bed thoroughly, thus causing it to harden. Such construction provides most of the advantages of the sand cushion type with none of its disadvantages. It permits the brick to be brought to a smooth surface without the danger that the cushion will shift its position or come up between the joints during rolling. Moreover, there is a considerable bond between the brick surface and the concrete base, at least so far as shearing is concerned, and a stronger pavement is the result.

A further development in the monolithic type of construction has been adopted, in which the cushion or bedding course is omitted altogether. In this type of construction the brick are laid directly on the green concrete and rolled to a smooth surface. Portland cement grout then is applied preferably before the concrete base has set up. In this way a considerable adhesion is developed between the brick and the concrete base. There has been some question regarding the efficiency of this adhesion and particular pains were taken during the present inspection to gain evidence on this point. A number of pavements were examined at the sides in order to see if there was any evidence of separation between the brick and the concrete, and in no case could such evidence be found. This would seem to indicate that such construction usually is really "monolithic."

In conversation with several engineers having considerable experience with this type of construction, conflicting opinions were obtained. In general, however, it can be said that a considerable bond does exist between the brick and the concrete, provided the grouting immediately follows the laying of the brick. It is the opinion of the authors that a more truly monolithic construction is obtained when the concrete base is tamped so as to bring a thin coat of mortar to the surface and the brick laid in this mortar bed. It is believed that this flush coat or mortar works its way up into the vertical joints between the bricks and thus adds greatly to the horizontal shearing strength between the brick and the concrete. At this plane, or in its vicinity, the horizontal shear is greatest.

It often has been questioned whether or not the original bond between the brick and the concrete will be retained after several years of traffic. It has been stated that the vibration due to traffic and unequal expansion of brick and concrete will tend to loosen the bond, and in this way the supporting power of the original monolithic slab will be no greater than that of the two separate slabs of concrete and brick. This would seem to be an argument in favor of increasing the bond between the concrete base and the brick just as much as possible.

TYPE OF BRICK.

Until the year 1911, practically the only type of paving brick in use in this country was the so-called standard repressed brick with lugs molded on one side and the edges rounded. It was claimed orig-

inally that the appearance and shape of a brick were not only improved, but the density and strength were likewise increased in the process of repressing. In 1910 a type of brick was introduced in which the lugs were wire cut on the sides and repressing was omitted, the brick going directly from the wire cutter to the drying ovens. Inasmuch as the repressing was omitted, the edges of the wire-cut lug brick were square instead of rounded.

DETAIL OF FAILURE, EXPERIMENTAL SEMIMONOLITHIC BRICK INTERSECTION LAID ON A 2-INCH CONCRETE BASE IN 1915 AT ST. LOUIS, MO.

A recent development in the type of brick used is the so-called vertical fiber lug brick which differs from the older wire-cut lug type in that the brick are laid in the pavement with the wire-cut surface up instead of on the side. The lug on the vertical fiber brick is produced in the process of forcing the clay through the die, the upper side of which is cut in the shape of the lug desired. This forms what is known as a "bar" lug. It is usually about 1 inch wide and there are ordinarily four lugs on each brick.

Since wire-cut lug brick were first introduced they have gained greatly in popularity, especially when used in conjunction with a cement grout filler. Many manufacturers, as well as engineers, have reached the conclusion that the process of repressing adds nothing to the strength or density of a paving brick. The rounded edge of the repressed brick furthermore appears to be a detriment rather than an advantage when used with grout filler, as the grout is more apt to hold to the square-edged brick than where the edges are smooth and rounded. Numerous instances were noted of grout-filled repressed brick streets where the grout had been ground out of the brick to the depth of the rounded edge. On the other hand, in wire-cut lug grouted brick pavements the grout in the brick appeared to wear down evenly, so that the surface remained smooth and continuous.

Vertical fiber brick with cement grout filler have hardly been in use long enough to draw any definite conclusions regarding the advantages which have been claimed for them. Such observations as the authors were able to make would indicate that a number of objections to their use with cement grout might exist. Most important of these is the fact that the lugs, being rectangular, touch the adjacent brick over a considerable area instead of at points or lines as in the other types of lug brick. Cement grout can penetrate only the spaces between the lugs, leaving, in the case of the vertical fiber brick, a relatively large area of the sides of the brick over which no adhesion to the adjacent brick is possible. It would seem hardly possible under such conditions to obtain as truly a monolithic bond as exists where practically the entire space between the courses is filled with grout. As before stated, in monolithic and semimonolithic construction, the side bond between the brick should be as strong as possible, in order to protect the bond between the brick and the base. Vertical fiber lug brick were intended primarily for use with bituminous fillers and are now successfully used in this way to a considerable extent in Kansas City, Mo., and Lincoln and Omaha, Nebr.

LUGLESS TYPE OPEN TO CRITICISM.

Experience with the lugless type of vertical fiber brick has been confined almost entirely to Kansas City, Mo. Such observations as were made would indicate that the use of this type of brick was open to serious criticism in that unless great care is used in laying, unequal spacing will result. This was illustrated forcibly in construction work under way in Kansas City. The condition shown in the illustration, while typical of this particular job, is an extreme one. It should be possible to lay lugless brick in much straighter courses than are here shown. It would ordinarily seem reasonable to suppose,

however, that a better job of setting would result if lug brick were used, because greater care in selection is necessary in the case of lugless brick if uniform joints are to be obtained. This is due to the fact that in the lugless brick, warping and kiln marks which vary with individual brick are depended upon to form the grout spaces.

Advocates of the lugless bricks maintain that uniformity of the grout spacing is not essential to good construction. This opinion, it seems to the authors, is not well founded in view of the fact that wherever the sides of the brick come into actual contact, as they often do if not spaced carefully by hand, no penetration of grout or filler will be possible. This results in a greatly weakened side bond and permits water to leak through the joints. The first brick pavements built were of the lugless type, but great care was exercised by those in charge of construction to insure uniformly spaced joints. Lugs were introduced simply to insure this spacing automatically. It would seem extremely unwise to run the chance of failure through imperfect grouting simply in order to avoid the use of lug brick. The work already started in Kansas City and that being started in Omaha will be watched with interest.

ROANOKE ROAD, KANSAS CITY, MO. BITUMINOUS-FILLED BRICK PAVEMENT ON 8-INCH CONCRETE BASE. NOTE THE SURFACE MAT WHICH HAS BEEN FORMED AS THE RESULT OF USING AN EXCESS OF BITUMINOUS FILLER.

JOINT FILLERS.

Among the older streets of many cities in the Middle West are still to be found brick pavements with sand-filled joints. While the majority of these streets are rough and uneven, due both to the cobbling of the individual brick and to unequal settlement of the foundation, a large number still were in fairly good condition. Practically all were laid on the natural soil foundation. Possessing no slab strength, these sand-filled streets conformed to the contour of the foundation under all conditions, so it is not surprising that after 18 or 20 years they are somewhat uneven. The principle disadvantage of sand as a filler, assuming a stable and unyielding soil condition, is that it does not protect the edges of the brick from chipping out under the action of the traffic. It is more difficult to keep such a street clean, and water is sure to wash down through the joints into the sand bedding course.

The most widely used filler for brick pavements at the present time is Portland cement grout. It has the advantage, if properly applied, of producing practically a monolithic slab capable of resisting bending stresses. On the other hand, this slab, when subjected to temperature changes, expands and contracts like any other monolithic structure, resulting in cracks due to contraction and bulges or heaving due to expansion. Expansion failures usually occur, as would be expected, at the top of vertical curves, or at any other place where for one reason or other the pavement is crowned transversely. Contraction cracks manifest themselves always by the cracking of the grout, usually in a straight line across the road, and ordinarily occur about as far apart as on a concrete road. On account of the greater resistance to abrasion of brick over concrete the contraction cracks in brick roads do not wear nearly as rapidly as in concrete roads, and are, therefore, not as serious a maintenance consideration.

Provision for expansion sidewise against curbs always is made by inserting some form of bituminous joint either poured or prepared, between the brick and the curb or gutter. Provision for expansion longitudinally usually is made in the case of city streets at intersections, while in the case of country highways transverse expansion joints usually are omitted, except under special conditions.

TRANSVERSE JOINTS.

There is apparently some difference of opinion regarding the necessity of transverse joints on both city streets and country highways. In sections where numerous expansion failures have occurred, those in charge of construction are either advocating the use of bituminous fillers exclusively or else regularly spaced transverse expansion joints. The former attitude is illustrated by experience in such cities as Lincoln and Omaha, Nebr., and the latter by the experience in Vermillion County, Ill. A number of types of joints have been tried, such as courses of wood block, as noted in St. Louis, spaced about 75 or 100 feet apart, or courses of bituminous filled brick spaced about the same distance. In other sections where little expansion trouble has developed engineers seem to prefer to run the chance of an occasional blowup rather than risk excessive wear at joints.

Observations made by the authors would indicate that for city work transverse expansion joints should

be installed at street intersections in at least one direction across the intersection and in both directions if the intersection is crowned; while for highways they may be omitted except in special cases, such as curves at the intersections of very long tangents and at abrubt changes in grade. Joints not over one-fourth inch in thickness seem to give the best results.

Although there is considerable opposition to the general use of bituminous fillers for brick pavements, good results in using asphalt have been obtained in certain cities west of the Mississippi as has been previously noted. The prinicipal disadvantage of bituminous fillers appeared to be the lack of protection afforded the brick at the joints; moreover they do not give any slab strength to the brick surface. The former fact was noted in a number of cases on old bituminous filled streets in which the edges of the brick have worn badly. The relative action of traffic on bituminous filled and grout filled joints was noted on those streets where expansion joints consisting of a number of courses of bituminous filled brick had been installed. The difference in wear was very noticeable.

Another disadvantage of bituminous fillers is the tendency, particularly noted in tars, of running out at the sides of the road in hot weather or chipping in cold weather. They possess still another disadvantage of requiring constant attention at the time of application to insure that the temperature of the bituminous material remains at the proper point; since, if too cold, they will bridge the joints instead of penetrating, and, if too hot, they will become hard and inert. On the other hand, they possess the undoubted advantage of being free from expansion troubles. They likewise make a somewhat quieter pavement.

The ease of making service cuts in city streets through this type of pavement is another advantage.

It should be emphasized that when a bituminous filler is used particular care should be taken in its selection in order to avoid the troubles incident to ill-suited materials. In those asphalt filled streets examined in the cities west of the Mississippi, it was noted that by the use of considerable excess of bituminous material a wearing mat of appreciable thickness was formed over the surface of the brick pavement. This mat apparently remains for some years, depending upon its thickness and the character and volume of traffic, and while still intact undoubtedly protects the brick from the action of traffic to a very large extent. This probably is the reason brick streets in this section have worn so little.

LUGLESS VERTICAL FIBRE BRICK READY FOR GROUT, VINE STREET, KANSAS CITY, MO., SHOWING THE POOR MANNER IN WHICH BRICK WERE LAID.

CONCLUSIONS.

The authors have drawn the following conclusions as a result of their study of brick pavements:

1. The type and thickness of base for any brick pavement should depend upon (*a*) the maximum weight of the loads to be carried, and (*b*) the bearing value, under all weather conditions, of the underlying soil.

2. In all cases where the traffic to be carried is likely to be heavy or where the underlying soil is of such a nature that its bearing value is not sufficient to support the pavement under all conditions, a concrete base of sufficient thickness to properly distribute the loads should be provided.

3. Where the maximum weight of the loads to be carried is not excessive and the subsoil is of a porous well-drained nature, the thickness of the concrete base may be decreased or under very favorable conditions, it may even be omitted altogether.

4. Other things being equal a somewhat lighter construction may be permitted in the case of the "monolithic" and "semimonolithic" types than where the ordinary sand cushion type is provided, on account of the increased slab strength which these types appear to possess.

5. A concrete curb or edging is not necessary when "monolithic" or "semimonolithic" construction is used.

6. Paving brick with well-formed contact lugs are to be preferred to brick without lugs.

7. Paving brick with square edges are to be preferred to brick with rounded edges.

8. Given the requisite care in construction, satisfactory results may be obtained with either cement grout or bituminous filler.

9. Vertical fiber lug brick with bituminous filler have given good service in those cities west of the Mississippi where they were inspected, possibly due to the protecting action of the asphalt mat which prevents wear from coming upon the brick irect.

10. Expansion joints in grout filled pavements would seem advisable at street intersections and at points of tangency on curves, and longitudinal joints should be used against all rigid curbs or structures.

APPORTIONMENT OF FUNDS AVAILABLE UNDER FEDERAL-AID LAW AND THE AMENDMENT THERETO.

THE Post Office appropriation bill for the fiscal year 1920 as passed contains the roads amendment increasing the amount of Federal-aid funds by $200,000,000 and funds for forest reservation roads by $9,000,000. It also broadens the definition of a rural post road, and raises the limit of Federal contribution from "not to exceed $10,000" to "not to exceed $20,000 a mile." The apportionment of funds now available for Federal-aid roads among the States is as follows:

States.	Amount available for fiscal years 1917, 1918, 1919.	$50,000,000 additional fiscal year 1919.	Totals for fiscal year 1919.	Fiscal year 1920 allotment.	Fiscal year 1920 additional $75,000,000.	Fiscal year 1920 totals.	Fiscal year 1921 allotment.	Fiscal year 1921 additional $75,000,000.	Totals for fiscal year 1921.	Grand total.
Alabama	$625,903.17	$1,050,264.10	$1,676,167.27	$420,105.64	$1,575,396.15	$1,995,501.79	$525,132.05	$1,575,396.15	$2,100,528.20	$5,772,197.26
Arizona	411,081.14	685,043.57	1,096,124.71	274,017.43	1,027,565.36	1,301,582.79	342,521.79	1,027,565.36	1,370,087.15	3,767,794.65
Arkansas	498,085.77	840,229.53	1,338,315.30	336,091.81	1,260,344.30	1,596,436.11	420,114.76	1,260,344.30	1,680,459.06	4,615,210.47
California	909,358.99	1,524,248.30	2,433,607.29	609,699.32	2,286,372.45	2,896,071.77	762,124.15	2,286,372.45	3,048,496.60	8,378,175.66
Colorado	508,349.34	867,570.90	1,375,920.24	347,028.36	1,301,356.35	1,648,384.71	433,785.45	1,301,356.35	1,735,141.80	4,759,446.75
Connecticut	185,487.77	307,064.65	492,552.42	122,825.86	460,596.98	583,422.84	153,532.32	460,596.98	614,129.30	1,690,104.56
Delaware	48,965.10	81,384.45	130,349.55	32,553.78	122,076.68	154,630.46	40,692.22	122,076.68	162,768.90	447,748.91
Florida	338,652.69	573,797.20	912,449.89	229,518.88	860,695.80	1,090,214.68	286,898.60	860,695.80	1,147,594.40	3,150,258.97
Georgia	806,897.89	1,346,044.75	2,152,942.64	538,417.90	2,019,067.12	2,557,485.02	673,022.38	2,019,067.12	2,692,089.50	7,402,517.16
Idaho	363,862.05	610,509.27	974,371.32	244,203.71	915,763.91	1,159,967.62	305,254.64	915,763.91	1,221,018.55	3,355,357.49
Illinois	1,321,102.17	2,185,550.65	3,506,652.82	874,220.26	3,278,325.97	4,152,546.23	1,092,775.32	3,278,325.97	4,371,101.29	12,030,300.34
Indiana	813,473.04	1,349,919.40	2,163,392.44	539,967.76	2,024,879.10	2,564,846.86	674,959.70	2,024,879.10	2,699,838.80	7,428,078.10
Iowa	873,180.41	1,443,046.20	2,316,226.61	577,218.48	2,164,569.30	2,741,787.78	721,523.10	2,164,569.30	2,886,092.40	7,944,106.79
Kansas	858,754.08	1,436,313.93	2,295,068.01	574,525.57	2,154,470.89	2,728,996.46	718,156.96	2,154,470.89	2,872,627.85	7,896,692.32
Kentucky	585,400.35	976,865.17	1,562,265.52	390,746.07	1,465,297.76	1,856,043.83	488,432.59	1,465,297.76	1,953,730.35	5,372,039.70
Louisiana	406,179.27	680,729.03	1,086,908.30	272,291.61	1,021,093.55	1,293,385.16	340,364.51	1,021,093.55	1,361,458.06	3,741,751.52
Maine	290,161.92	481,231.35	771,393.47	192,492.62	721,847.33	914,339.95	240,615.78	721,847.33	962,463.11	2,648,196.53
Maryland	263,013.09	434,737.02	697,750.11	173,894.81	652,105.53	826,000.34	217,368.51	652,105.53	869,474.04	2,393,224.49
Massachusetts	442,814.70	736,883.30	1,179,698.00	294,753.32	1,105,324.95	1,400,078.27	368,441.65	1,105,324.95	1,473,766.60	4,053,542.87
Michigan	872,707.53	1,447,213.80	2,319,921.33	578,885.52	2,170,820.70	2,749,706.22	723,606.90	2,170,820.70	2,894,427.60	7,964,055.15
Minnesota	853,047.58	1,420,774.53	2,273,822.11	568,309.81	2,131,161.80	2,699,471.61	710,387.26	2,131,161.80	2,841,549.06	7,814,642.78
Mississippi	535,469.12	899,488.26	1,434,957.38	359,795.31	1,349,232.39	1,709,027.70	449,744.14	1,349,232.39	1,798,976.53	4,942,961.61
Missouri	1,017,765.21	1,695,314.11	2,713,079.32	678,125.64	2,542,971.14	3,221,096.78	847,657.05	2,542,971.14	3,390,628.19	9,324,804.29
Montana	593,382.46	999,467.15	1,592,847.61	399,786.86	1,499,200.73	1,898,987.59	499,733.58	1,499,200.73	1,998,934.31	5,490,771.51
Nebraska	639,757.68	1,066,642.07	1,706,399.75	426,656.83	1,599,963.10	2,026,619.93	533,321.04	1,599,963.10	2,133,284.14	5,866,303.82
Nevada	386,424.72	642,933.45	1,029,358.17	257,173.38	964,400.18	1,221,573.56	321,466.72	964,400.18	1,285,866.90	3,536,798.63
New Hampshire	125,599.97	207,810.38	333,410.35	83,124.15	311,715.57	394,839.72	103,905.19	311,715.57	415,620.76	1,143,870.83
New Jersey	354,995.26	594,050.80	949,046.06	237,620.32	891,076.20	1,128,696.52	297,025.40	891,076.20	1,188,101.60	3,265,844.18
New Mexico	474,847.98	798,785.78	1,273,633.76	319,514.31	1,198,178.67	1,517,692.98	399,392.89	1,198,178.67	1,597,571.56	4,388,898.30
New York	1,501,835.01	2,487,956.40	3,989,791.41	995,182.56	3,731,934.60	4,727,117.16	1,243,978.20	3,731,934.60	4,975,912.80	13,692,821.37
North Carolina	685,702.23	1,139,977.47	1,825,679.70	455,990.99	1,709,966.20	2,165,957.19	569,988.74	1,709,966.20	2,279,954.94	6,271,591.83
North Dakota	458,015.09	768,360.27	1,226,375.37	307,344.11	1,152,540.42	1,459,884.53	384,180.14	1,152,540.42	1,539,720.56	4,222,980.46
Ohio	1,118,759.68	1,854,462.47	2,973,222.15	741,784.99	2,781,693.71	3,523,478.70	927,231.24	2,781,693.71	3,708,924.95	10,205,625.80
Oklahoma	691,906.34	1,153,055.50	1,844,961.84	461,222.20	1,729,583.25	2,190,805.45	576,527.75	1,729,583.25	2,306,111.00	6,341,878.29
Oregon	472,394.85	787,459.10	1,259,853.95	314,983.64	1,181,188.65	1,496,172.29	393,729.55	1,181,188.65	1,574,918.20	4,330,944.44
Pennsylvania	1,382,078.29	2,296,075.85	3,678,154.14	918,430.34	3,444,113.77	4,362,544.11	1,148,037.92	3,444,113.77	4,592,151.69	12,632,849.94
Rhode Island	69,969.51	116,530.95	186,500.46	46,612.38	174,796.43	221,408.81	58,265.48	174,796.43	233,061.91	640,971.18
South Carolina	430,437.00	717,297.05	1,147,734.05	286,918.82	1,075,945.58	1,362,864.40	358,648.52	1,075,945.58	1,434,594.10	3,945,192.55
South Dakota	486,013.67	810,720.68	1,296,734.35	324,288.27	1,216,081.02	1,540,369.29	405,360.34	1,216,081.02	1,621,441.36	4,458,545.00
Tennessee	683,123.95	1,132,103.50	1,815,227.45	452,841.40	1,698,155.25	2,150,996.65	566,051.75	1,698,155.25	2,264,207.00	6,230,431.10
Texas	1,752,770.13	2,926,219.37	4,678,989.50	1,170,487.75	4,389,329.05	5,559,816.80	1,463,109.69	4,389,329.05	5,852,438.74	16,091,245.04
Utah	341,613.62	567,592.10	909,205.72	227,036.84	851,388.15	1,078,424.99	283,796.05	851,388.15	1,135,184.20	3,122,814.91
Vermont	136,662.33	225,987.70	362,650.03	90,395.08	338,981.55	429,376.63	112,993.85	338,981.55	451,975.40	1,244,002.06
Virginia	597,102.90	992,052.95	1,589,155.85	396,821.18	1,488,079.43	1,884,900.61	496,026.48	1,488,079.43	1,984,105.91	5,458,162.37
Washington	432,183.03	722,367.25	1,154,550.28	288,946.90	1,083,550.87	1,372,497.77	361,183.62	1,083,550.87	1,444,734.49	3,971,782.54
West Virginia	319,525.27	532,009.10	851,534.37	212,803.64	798,013.65	1,010,817.29	266,004.55	798,013.65	1,064,018.20	2,926,369.86
Wisconsin	767,790.41	1,272,946.53	2,040,736.94	509,178.61	1,909,419.79	2,418,598.40	636,473.26	1,909,419.79	2,545,893.05	7,005,228.39
Wyoming	367,396.24	612,912.45	980,308.69	245,164.98	919,368.68	1,164,533.66	306,456.22	919,368.68	1,225,824.90	3,370,667.25
Total	29,100,000.00	48,500,000.00	77,600,000.00	19,400,000.00	72,750,000.00	92,150,000.00	24,250,000.00	72,750,000.00	97,000,000.00	266,750,000.00
Administration	900,000.00	1,500,000.00	2,400,000.00	600,000.00	2,250,000.00	2,850,000.00	750,000.00	2,250,000.00	3,000,000.00	8,250,000.00
Grand total	30,000,000.00	50,000,000.00	80,000,000.00	20,000,000.00	75,000,000.00	95,000,000.00	25,000,000.00	75,000,000.00	100,000,000.00	275,000,000.00

INCREASED HIGHWAY WORK SHOWN BY RECORD OF FEDERAL-AID PROJECTS.

IN December and January a total of 128 Federal-aid projects were approved or went to final agreement. While the number of the projects was small in December there was a big increase in January. The record for that month in the amount of Federal-aid allowed and the estimated cost of construction is the largest month's record since the Federal-aid law was enacted. A total of $3,066,185.32 Federal-aid allowance is called for in the 98 projects in the list for that month.

In December the total allowance was only $795,301.69. Four allowances were made for roads in Alabama, all sand-clay, the total amounting to $38,217.95. Four projects in Nevada were considered, two of which were approvals and two allowances. Three North Carolina projects were approved and two reached final agreement. Three projects in Ohio which went to final agreement were allowed $112,195, the largest allowance to any one State. The largest allowance for a single project was $89,878.71, for 11.19 miles of concrete road in Maryland, estimated to cost $179,757.43.

In January Michigan was given the largest total allowance, $533,098.30, for six projects, for 90.279 miles of gravel and macadam, graded earth, gravel surface treated macadam and concrete roads having an estimated cost of $1,115,692.79. Montana led in the number of projects—eight. They were for six gravel roads and two bridges, with a total estimated cost of $330,118.08 and a Federal-aid allowance of $110,469.65. The four Nebraska projects considered, all of which went to final agreement, for earth and sand-clay roads, showed the greatest mileage, 148.53. The estimated cost of the four is $272,298.95, and the allowance $137,993.42.

A single road in Delaware, 11.5 miles long, of concrete, is estimated to cost $537,827.40. The allowance was only $20,000. Missouri, for two roads 27.5 miles long, receives an allowance of $136,149.47, while Illinois for two roads, 30.38 miles long, estimated to cost $781,404.86, will receive $308,193.36. These are concrete and bituminous macadam roads. Louisiana came next to Montana in the number of projects considered, with seven, all gravel roads, with a total estimated cost of $323,473.44 and an allowance of $147,456.95. Iowa followed with six projects, estimated to cost $382,364.86 and an allowance of $106,706.77

RECORD OF FEDERAL AID PROJECTS IN DECEMBER, 1918.

State.	Project No.	County.	Length in miles.	Type of construction.	Project statement approved.	Project agreement executed.	Estimated cost.	Federal aid allowed.
Alabama	3	Pike	9.11	Sand-clay		Dec. 21	$20,662.73	$10,331.36
	4	Dale	8.71	do		do	20,064.58	10,032.29
	6	Covington	7.67	do		Dec. 19	20,003.50	10,001.75
	36	do	2.00	do		Dec. 11	15,685.10	7,842.55
Arkansas	22	Lafayette	6.95	Gravel	Dec. 4		48,950.95	22,205.52
Louisiana	24	Ouachita	4.82	do	Dec. 11		25,560.70	12,500.00
	25	do	7.00	do	do		44,697.15	15,000.00
	28	Iberia	8.59	do	do		46,255.22	22,000.00
Maryland	7	Baltimore and Harford	11.19	Concrete		Dec. 4	179,757.43	89,878.71
Michigan	12	Iosco	4.75	Gravel		do	54,963.23	27,481.61
Mississippi	39	Marshall	4.25	do	Dec. 26		49,632.00	24,816.00
Missouri	13	Buchanan	2.20	Asphaltic		Dec. 11	42,822.32	21,401.16
Nebraska	5	Madison and Platte	47.60	Earth and sand-clay		Dec. 4	104,455.50	52,227.75
Nevada	3	Churchill	7.61	Sand-clay		Dec. 7	70,707.78	35,353.89
	4	Douglas	4.00	25 per cent macadam, balance graded earth.		do	9,885.70	4,942.85
	11	Esmeralda	8.90	Earth	Dec. 19		38,330.49	19,165.24
	13	Nye	25.00	do	Dec. 17		40,700.00	20,350.00
New York	14	Chautauqua	7.67	Concrete and brick	Dec. 4		152,800.00	76,400.00
North Carolina	21	Person	7.675	Top soil		Dec. 7	26,998.08	5,000.00
	27	Orange	17.70	Top soil or sand-clay	Dec. 16		33,000.00	12,000.00
	28	Lee	12.05	Gravel	Dec. 4		27,933.95	10,000.00
	32	Edgecombe	3.10	Sand-clay or gravel		Dec. 4	14,088.65	7,000.00
	35	Forsythe	1.87	Concrete	Dec. 4		60,335.87	26,400.00
Ohio	14	Williams	2.69	Reinforced concrete		Dec. 21	90,700.00	19,295.00
	16	Clark	4.93	Concrete or bituminous macadam.		do	137,100.00	49,300.00
	17	do	4.46	Bituminous macadam		do	119,000.00	44,600.00
South Carolina	13	Lockhart-Union		Bridge over Broad River	Dec. 4		44,868.18	22,434.09
South Dakota	10	Clark	14.29	Gravel	Dec. 16		44,143.83	19,932.70
Texas	65	Fisher	23.00	do		Dec. 26	93,525.05	46,429.19
Wisconsin	38	Marathon	8.09	do		Dec. 4	44,940.09	14,980.03
Total	30		277.875				1,718,568.08	795,301.69

RECORD OF FEDERAL AID PROJECTS IN JANUARY, 1919.

State.	Project No.	County.	Length in miles.	Type of construction.	Project statement approved.	Project agreement executed.	Estimated cost.	Federal aid allowed.
Alabama	35	Pike	6.00	Sand-clay		Jan. 25	$20,433.43	$10,216.71
Arizona	5	Mohave	2.184	Grading	Jan. 12		50,930.00	21,840.00
California	9	San Diego	15.00	Concrete		Jan. 8	273,498.03	121,913.95
Colorado	4	Garfield and Rio Blanco	21.00	20 miles surfaced with stone or gravel, balance graded earth.		Jan. 14	[1] 84,012.83	42,006.41
Delaware	2	Sussex	11.516	Concrete		Jan. 16	537,827.40	20,415.10
Georgia	15	Coweta	3.64	Top soil or sand-clay		Jan. 31	20,219.72	7,000.00
	32	Columbia	9.715	do		Jan. 9	19,833.40	9,000.00
Idaho	7	Custer	18.00	Graded earth		Jan. 11	[2] 79,233.96	37,000.00
Illinois	1	Dupage, Kane, Dekalb, Ogle, Lee, and Whiteside.	15.92	Bituminous macadam resurfacing and concrete.		Jan. 4	395,898.41	160,175.26
	2	Kankakee and Iroquois	14.4643	Concrete and bituminous macadam.		Jan. 29	385,506.45	148,018.10
Iowa	25	Blackhawk	4.08	Brick and asphalt or concrete	Jan. 29		126,066.16	21,881.28
	30	Winnebago	7.50	Gravel	Jan. 10		47,437.50	15,425.14
	32	Des Moines	2.82	Brick or concrete	Jan. 20		52,195.00	16,584.93
	33	Clark	9.60	Earth	Jan. 3		38,170.00	16,546.27
	41	Floyd	11.72	Gravel	Jan. 4		75,396.20	19,136.45
	42	Wapello	10.80	Earth	Jan. 14		40,370.00	16,932.90
Kansas	2	Labette	10.159	Gravel or macadam		Jan. 17	115,837.65	17,375.65
	11	Sedgwick	7.375	Concrete		Jan. 18	274,289.97	41,143.50
	20	Johnson	6.00	Bituminous macadam	Jan. 10		65,033.32	9,754.99
	21	Allen	3.25	Concrete and macadam	Jan. 21		52,338.28	7,850.74
Kentucky	5	Mercer	5.00	Earth	Jan. 4		42,909.47	21,954.73
	10	Larue	6.50	Water-bound macadam	Jan. 16		41,547.00	20,773.50
Louisiana	15	Avoyelles	5.41	Gravel		Jan. 27	59,036.67	25,000.00
	16	East Baton Rouge	4.90	do		Jan. 22	35,913.90	17,956.95
	18	Caldwell	2.40	do		Jan. 27	11,462.99	5,000.00
	24	Ouachita	4.82	do		Jan. 7	25,560.70	12,500.00
	25	do	7.00	do		Jan. 7	44,697.15	15,000.00
	28	Iberia	8.59	do		Jan. 7	46,255.22	22,000.00
	29	Franklin	10.47	do	Jan. 25		100,496.81	50,000.00
Massachusetts	10	Norfolk	2.42	Bituminous	Jan. 18		73,123.05	24,200.00
Michigan	1	Muskegon and Oceana	19.864	Gravel and macadam	Jan. 7		333,982.00	166,991.00
	3	Baraga	48.15	Graded earth		Jan. 31	[3] 342,878.60	171,439.30
	7	Alcona	5.972	Gravel		do	78,153.19	39,076.50
	25	Delta and Schoolcraft	8.108	Surface treated macadam	Jan. 21		144,485.00	72,242.50
	27	Charlevoix	5.707	Concrete	Jan. 18		139,700.00	57,070.00
	34	Washtenaw	2.478	Concrete or bituminous	do		76,494.00	26,280.00
Minnesota	2	Chisago	31.50	Gravel		Jan. 7	205,962.80	80,000.00
	27	Douglas	16.00	do		Jan. 17	90,833.31	25,000.00
	34	McLeod	9.10	do		Jan. 16	33,321.97	15,000.00
Mississippi	30	Lauderdale	7.70	do	Jan. 30		41,184.00	20,000.00
	33	Tunica	4.03	Clay-gravel		Jan. 16	37,884.05	12,500.00
	42	Osyka	9.90	Gravel	Jan. 2		71,500.00	35,000.00
Missouri	15	New Madrid	19.50	do	Jan. 22		130,245.50	65,122.75
	16	Salina	8.00	Asphaltic macadam	Jan. 29		142,053.45	71,026.72
Montana	14	Park		Bridge	Jan. 14		33,231.00	16,615.50
	18	Custer	4.00	Gravel	Jan. 22		22,000.00	11,000.00
	19	do	4.00	do	do		22,000.00	11,000.00
	23	Blaine	4.00	do	do		20,004.60	10,002.30
	24	do	5.00	do	do		15,397.80	7,698.90
	30	Broadwater		Bridge	Jan. 11		65,092.50	32,546.25
	31	Park	3.60	Gravel	Jan. 22		21,903.20	10,951.60
	32	do	3.00	do	do		21,310.20	10,655.10
Nebraska	14	Holt and Boyd	42.00	Earth and sand-clay	Jan. 31		83,875.00	41,937.50
	22	Custer	35.00	Earth	Jan. 16		75,900.00	37,950.00
	27	Dodge and Sanders	31.53	do	Jan. 12		50,050.00	25,025.00
	29	Butler	40.00	do	Jan. 16		70,161.85	33,080.92
Nevada	10	White Pine	16.50	do	Jan. 18		94,000.50	47,000.25
	12	Lyon	2.40	Earth and gravel	Jan. 7		9,515.00	4,757.50
	14	Douglas	3.00	Gravel	Jan. 20		19,954.00	9,777.00
	17	Lyon	6.25	do	Jan. 29		36,916.00	18,458.00
New Hampshire	13	Grafton	1.61	do		Jan. 14	15,806.45	7,903.22
	18	Hillsborough	.90	do		Jan. 13	9,070.05	4,535.02
	19	Cheshire	.60	do		do	9,128.84	4,564.42
New Mexico	8	Chaves	7.00	Macadam		Jan. 18	73,787.78	36,893.89
	13	Valencia	28.90	Gravel and sand-clay	Jan. 12		163,933.00	81,966.50
	14	Santa Fe	10.65	Gravel	Jan. 10		74,547.00	37,273.50
New York	12	Cortland	6.54	Bituminous macadam	Jan. 18		130,800.00	65,400.00
North Carolina	20	Yadkin	6.41	Top soil		Jan. 22	25,146.00	8,000.00
	36	Durham	7.482	Concrete and sand-clay	Jan. 29		193,054.05	23,000.00
	37	Gaston	10.405	Bituminous macadam	Jan. 21		174,222.18	12,000.00
	40	Union	4.287	Sand-clay or gravel	Jan. 17		10,230.00	4,000.00
North Dakota	25	Ward	5.00	Gravel	Jan. 17		7,128.00	3,564.00
	33	McIntosh	15.00	Earth	Jan. 21		18,000.00	9,000.00
	34	Emmons	15.00	do	Jan. 31		20,000.00	10,000.00
	37	Hettinger	19.00	do	Jan. 24		20,669.00	10,334.50
	38	do	9.50	do	do		19,250.00	6,046.88
Oregon	13	Grant	7.20	Gravel		Jan. 14	143,817.00	71,908.57
South Dakota	3	do	11.83	do		Jan. 11	26,963.39	13,481.69
	9	Brown	12.60	do	Jan. 21		72,424.00	36,212.00
	11	Union	9.04	do	Jan. 4		41,283.00	16,412.70
Tennessee	6	Washington	21.349	Macadam	Jan. 22		287,709.67	143,854.82
Texas	2	Brooks	20.10	Sand-clay or gravel		Jan. 18	[4] 65,248.80	30,500.00
	7	Mitchell	7.50	Gravel		Jan. 7	40,268.00	20,134.00
	26	Titus	7.26	Bituminous gravel	Jan. 16		45,354.89	14,010.00
	34	Dickens	6.50	Gravel	do		38,979.00	15,345.00
	41	Tarrant	10.00	Bituminous gravel		Jan. 14	66,630.78	32,628.43
	42	do	3.513	do		do	18,029.79	9,014.90
	61	Wichita	4.68	do		Jan. 22	48,518.57	12,500.00
	76	Galveston	5.50	Shell	Jan. 23		19,827.50	8,600.00
Vermont	10	Rutland	4.30	Gravel	Jan. 21		64,262.00	32,131.00
Virginia	17	Hanover and Carolina		Bridge		Jan. 22	23,099.86	11,549.93
	26	Surry and Prince George	4.05	Gravel	Jan. 21		34,778.15	17,389.07
	28	Henry	3.53	Top soil	Jan. 22		33,486.42	16,743.21
Washington	9	Douglas	5.28	Gravel or macadam		Jan. 22	37,976.44	18,750.00
	13	Okanogan	1.077	Bridge		do	33,178.64	13,789.67
West Virginia	25	Lincoln	4.50	Concrete	Jan. 16		59,062.50	25,000.00
	26	do	6.00	do	Jan. 18		78,750.00	10,000.00
Wisconsin	54	Adams	5.75	Sand-clay	Jan. 22		35,823.75	11,941.25
Total	98		954.3853				8,024,454.49	3,066,185.32

[1] Revision. Estimated cost increased from $78,314.43 and allowance from $39,415.71, previous agreement; in previous agreement.
[2] Revision. Allowance increased from $25,000.
[3] Revision. Estimated cost increased from $289,950.22 and allowance from $144,975.31.
[4] Revised agreement. Estimated cost increased from $41,725.52 and allowance from $20,000.

OPERATIONS OF BUREAU OF PUBLIC ROADS UNDER THE FEDERAL-AID ROAD ACT.

By P. ST. J. WILSON, Chief Engineer Bureau of Public Roads.
(Address at convention American Road Builders' Association, Feb. 25, 1919.)

WHEN the Federal-aid road act was passed in 1916 it provided not merely a substantial Federal appropriation to help meet the expense of road construction; it went further and sought to develop in the several States a spirit of self-help in the matter of road improvement and to strengthen the policy of State highway control. These purposes, greater in their ultimate benefit than the granting of money aid, have been and are being accomplished in the respective States so thoroughly as to indicate in the fullest measure the wisdom of the framers of the Federal act.

It is generally admitted that only through an efficient State highway department with broad powers and ample funds can any State reach the maximum of accomplishment in road building and maintenance. The requirement of the Federal act that each State could cooperate only through a highway department gave a powerful impetus to the policy of State highway management. At the time the first Federal apportionment was made 17 States were without highway departments within the meaning of the act. To-day every State has a highway department fully meeting the requirements of the act. The assent of all the States has been given, together with a pledge of good faith to cooperate with the Federal Government throughout the life of the Federal measure.

LAW'S EFFECT ON STATE PROGRAMS.

To the end that haphazard road building should not be permitted, the Secretary of Agriculture at the outset asked each State to submit a program or scheme showing what the State contemplated doing under the joint plan. This each State has done and as an outcome of such orderly planning there has come about a strengthening of State highway departments, an appropriation of funds, and a designation of specific State systems of highways as to give the brightest promise for an early and satisfactory working out of our own problems. I shall not burden you with a list of the measures adopted by the several States as a result of the Federal-aid road act, as such a list will include nearly all of the 48 States. I might cite, however, the well-balanced and effective State highway system designed by Wisconsin following the passage of the Federal act, the designation of a specific State highway system in Virginia, the laying out of a trunk-line system in Illinois, as examples of the constructive efforts on the parts of the States to correlate their efforts with those of the Federal Government while working out their own problems to the best advantage.

At the outset of this great cooperative undertaking it was found necessary to harmonize and provide uniformity to some degree at least in the matter of surveys, plans, and specifications for Federal-aid roads. This was brought about through conferences with State officials, with the same success as was obtained in regard to the broader questions of legislation and administration. State standards as to plans and specifications have been submitted for Federal-aid road work in 39 States, and we shall soon have this phase of the question on a routine basis for all of the States.

DELAY CAUSED BY THE WAR.

All of this far-reaching preliminary work, required as it was specifically by the terms of the act or by the necessary regulations issued under authority of the act, took a good deal of time, and when we began to find the ground cleared sufficiently to show prospects of actual road building we were in the midst of the mightiest war in the world's history. We could not take railroad cars, fuel, labor, and money from the supreme test of defeating the Hun save only where the diversion of such forces had a direct bearing upon the winning of the war and served that purpose greater than would the purpose from which the labor, transportation, fuel, or money was withdrawn. Thus road building slowed down and finally, in the summer of 1918, it almost came to a standstill. There were grumblings and mutterings and much honest criticism of the restrictive policy in regard to road work. How much of it was justified no one will ever know. Such communities, however, as had gone on for years with the roads they had, and suddenly thought it necessary to begin their building operations at the particular moment when the fate of the world hung in the balance, could hardly have just ground for expecting that their needs should be met at the expense of munition making, shipbuilding, or other direct war operations. Doubtless some roads were delayed which should have been built, but, however that may be, the point I am chiefly interested in impressing on you is that, due to war conditions, the actual physical benefits of the Federal-aid road act were delayed at least a year.

I am glad to say, however, that with our preliminary work all done, with the throttling influence of war removed, with the mighty stimulus of a blending of public spirit and public need we are on the threshold of the greatest road building era the world has ever known.

FEDERAL AID RECORD TO DATE.

In order that you may know just what we have accomplished in regard to individual Federal-aid projects and just what we anticipate, I may say that to the close of February 21, 1919, a total of 841 projects had been approved by the Secretary of Agriculture, involving a total estimated cost of $61,333,454.94, of which Federal aid was called for to the amount of $23,203,112.41. These projects aggregate 8,615 miles in total length, and involve every recognized type of construction, this being due to our policy of trying to meet the individual needs in the light of the local conditions in each State and locality. You understand, of course, that the approval of projects does not mean necessarily that they are ready for actual construction. Surveys must be made and plans, specifications, and estimates prepared and approved for each project before the construction can be started. In many cases, the plans, specifications, and estimates are ready at the time the application is approved, but in many other cases they are not submitted in satisfactory form until a long time after such approval.

Of the total number of projects approved 434 had reached the stage at the close of February 21, where the plans, specifications, and estimates had been approved so that construction might actually begin. These projects carried a total estimated cost of $30,111,226.79, of which amount $11,663,086.85 consisted of Federal aid. The total mileage of the projects thus made ready for construction was 3,586 miles. On January 31, 316 projects were actually under construction or completed, involving a total estimated cost of $22,672,233 and Federal aid to the amount of $8,382,067.

PRESENT ROAD BUILDING PROGRAM.

That you may understand the scope and extent of our road building program for this year, I would state that the total amounts apportioned to the several States, after deducting 3 per cent for administrative purposes, aggregate $29,100,000 for the fiscal years 1917, 1918, and 1919, this period ending June 30 of this year. An additional $19,400,000 becomes available July 1, making the total apportionment for the four years $48,500,000. Deduct from this the amount of approximately $8,500,000, referred to above, and we may say there are $40,000,000 of Federal funds to apply to this year's projects. As the States must provide at least an equal amount, you can see that there will be a minimum of $80,000,000 for Federal projects if all of the Federal money under existing appropriations is met. As a matter of fact, the States have been putting up in the past a little over 60 per cent of the cost of Federal projects, and if this policy continues, the amount available for Federal-aid roads would run over $100,000,000. To this amount must be added the forest road appropriations which are averaging about $1,300,000 per annum of Federal funds, making available for this class of work, including local funds, approximately $2,600,000.

In discussing the Federal-aid program I have not thus far taken into account the appropriations carried by the amendment to the Post Office bill. This amendment, as you probably know, carries an appropriation of $50,000,000 to become immediately available, $75,000,000 to become available July 1, of this year, and $75,000,000 to become available July 1, 1920. Thus it provides for this calendar year an additional $125,000,000, and if this is met dollar for dollar by the States, it means $250,000,000 added to the $80,000,000 I have already mentioned, or a total of $330,000,000, including administration. The forest road appropriation under the new amendment is $3,000,000 for the fiscal year 1919 and $3,000,000 for each of the following fiscal years, so that it would mean an additional $6,000,000 for forest roads this year. I do not know whether the States will be able to meet this tremendous appropriation, but it is a stirring call to them to rise to the great task of doing a double duty, first, of providing needed public improvements; and second, of meeting the great problem of unemployment.

LAW PROVED BY EXPERIENCE.

It is rare in the history of legislation that any particular measure has been able to stand the acid test of its practical application without developing any weak points. It was to be anticipated that the Federal aid act would in course of time indicate a need for amendment in some particular. The Federal aid act has developed comparatively few weaknesses. The most serious, however, has been the requirement as to the post route status of each project. It has been exceedingly difficult to hold on the one hand the Federal aid improvement to a definite well connected program, and on the other hand to confine the improvements to roads on which mail routes were established or in reasonable prospects of being established. As you no doubt know, rural delivery routes follow very irregular courses in the endeavor to reach the individual patrons and it is, of course, absurd to build an important highway along such meandering routes. Furthermore, in some of the Western States, which are yet in process of development, Federal aid projects

comprised long stretches of highway on which no mail routes were established and which would only depend upon the contingencies of the future for securing mail facilities along with the other benefits of well-organized and enlightened communities. This restriction in the Federal act has undoubtedly delayed and very much hampered the accomplishment of practical results. An amendment, therefore, in the post office bill this year is highly essential to the effective administration of the Federal aid act and it is hoped will remove one of the chief existing obstacles.

When Congress put a limitation of $10,000 per mile in the allotment of Federal aid to individual projects they had in mind that where cities were building expensive boulevards, the Federal money should not by any chance be restricted in its usefulness by becoming absorbed in the construction of a few miles of a purely local utility. Since the act was passed, a tremendous increase in the cost of all products and all efforts has made the $10,000 limitation a hindrance rather than a help to the work, and so the provision in the Post Office bill to raise the limit of Federal aid to $20,000 per mile is just one more shackle removed.

It is a striking tribute to the effectiveness of the act that no other amendment, looking to any change in the existing measure, has been found necessary.

PROCEDURE UNDER THE LAW.

We are trying very earnestly to find ways and means of shortening the present procedure for the approval of projects and for accomplishing the various steps necessary before actual construction can be undertaken. I wish to emphasize, however, that cooperation of the State highway departments is essential to the accomplishment of this purpose, and that while we may, by cutting out some intermediate stops, materially shorten the time which we take in putting a project through, our actual records show that relatively a very great delay is due to the failure of the State highway departments to promptly submit plans, specifications, and estimates, to execute agreements and to carry out the steps plainly set forth in the rules and regulations.

I have heard the opinion expressed that the Government held too rigidly to the requirement of substantial types of construction and thorough engineering. We find in our practical application of the Federal aid road act that it is impossible to establish a hard and fast standard for the entire United States. In some of the poorer and more sparsely settled States the requirement of costly and substantial types of construction will be equivalent to withholding the benefits of the Federal aid road act from the people, while in thickly settled territory where traffic is heavy we must insist upon types of construction amply sufficient to withstand the traffic conditions. Our engineering requirements are consistently held to a point below which inefficiency would result, but here again we try to make the requirement elastic enough to prevent an undue burden upon those States and communities whose needs are slight and whose means are less. I believe by following a "give and take" policy we shall get the utmost benefit out of the Federal aid road act, and I feel that as State highway departments are given more and more authority and facilities by the respective State legislatures, they are becoming more and more able to handle the Federal aid work as well as their other State work with such a degree of efficiency as to require little more than a routine superinspection, and a sort of moral support on the part of the Federal Government.

The underlying principle of the whole Federal measure is cooperation and if we who represent the Federal Government and those who represent the State governments continue to deal with each other in accordance with that fundamental principle, I feel sure that we shall have no troubles that are not easily capable of solution.

MINNESOTA STATE TRUNK ROADS.

The Minnesota Legislature has enacted a law adopting the system of State trunk highways proposed by State Highway Commissioner Babcock and providing for a constitutional amendment permitting the issuance of road bonds by the State, not to exceed $10,000,000 in any year, the interest and sinking-fund charges to be raised by the tax on automobiles and motor trucks.

MOTOR-TRUCK REGULATION.

A measure to regulate motor-truck traffic in Pennsylvania which will probably become a law at the present session of the legislature fixes 24,000 pounds as the maximum weight of loaded trucks, 25 feet as the maximum length, and 8 feet as the maximum width. It requires all municipalities to enact the same speed and crossing rules.

FOR HORSE TRAFFIC.

The New York State grange at its annual meeting in February adopted a resolution asking for a driveway for horse, of suitable footing, and wide enough to accommodate a wagon, along all State highways. There is much interest throughout the country looking to the proper provision for wagon traffic in the improvement of roads.

EFFICIENCY OF BITUMINOUS SURFACES AND PAVEMENTS UNDER MOTOR-TRUCK TRAFFIC.

By PREVOST HUBBARD, Chemical Engineer, United States Bureau of Public Roads.

(Presented at Convention of the American Road Builders Association, Feb. 25, 1919.)

THE title of this paper covers a subject upon which a great deal of thought has been spent by progressive highway engineers as applied to prewar traffic conditions and its prospective normal development. Many engineers had, at least in their own minds, classified the various types of pavements with relation to their efficiency under ordinary variations in traffic encountered on county, State, and municipal highways and their ideas were fairly well fixed on the subject as evidenced by more or less consistent practice in their choice of types when reconstruction or new construction became necessary. Just where the dividing line should be drawn, so far as traffic is concerned, between different types of pavements has always been a matter of individual opinion, but in general with increases in volume and weight of traffic the increasing efficiency of the bituminous types has been rated as follows:

1. Bituminous surfaces.
2. Bituminous macadam.
3. Bituminous concrete.
4. Sheet asphalt and asphalt block.

Suddenly and with little opportunity for anticipation a very large mileage of our important State highways and many of our local county and municipal pavements were subjected to a tremendous increase in traffic. This increase was not only in volume, which would have presented a comparatively simple problem to solve, but in the weight and load carrying capacity of the individual vehicle. This, coupled with an unusually severe winter and immediately followed by war restrictions upon the use of many road materials, labor shortage, excessive costs, and loss of members of highway engineering organizations, created a situation during the year 1918 which was abnormally serious and complicated. With comparatively few exceptions, new construction ceased and maintenance was so handicapped as to become inadequate.

FAILURE UNDER HEAVY TRAFFIC.

Hundreds of miles of roads failed under the heavy motor-truck traffic within a comparatively few weeks or months. Roads with bituminous surfaces, bituminous macadam roads, and bituminous concrete roads all failed alike, together with other types used in State and county work. These failures were not only sudden but complete and almost overnight an excellent surface might become impassable. Such rapid and complete failures in municipal pavements were of less common occurrence, and as sheet asphalt and asphalt block have always been largely confined to municipal work failures of these types have not been noted to the same extent as the other types mentioned.

In the haste and confusion of war activities little opportunity has existed for a systematic and comprehensive study of the problem suddenly thrust upon highway engineers. Reports from all parts of the country have, however, established one outstanding fact which has a most important bearing upon any consideration of the efficiency of bituminous surfaces and bituminous pavements. A very large proportion of the failures have been characterized by an almost simultaneous destruction of the entire road structure, and not merely the disintegration of the wearing course or pavement proper. No type of pavement will be efficient unless provided with a foundation which will hold up the pavement until it is worn out. When, therefore, the entire structure fails suddenly, inadequate subgrade or foundation conditions are primarily responsible and but little basis exists for placing an efficiency valuation upon the wearing course.

CAUSES OF FOUNDATION FAILURE.

Inevitably coupled with sungrade and drainage conditions, foundation failures occurring as previously described may be due to one of two causes, lack of thickness or inability of the foundation structure to sustain the loads without appreciable internal movement. So far as bituminous surfaces or bituminous pavements are concerned remedy of the first cause does not affect the general type of construction. If, however, present heavy motor-truck traffic is to continue and possibly increase in weight as well as volume the second cause may have a direct bearing upon possible modifications in design and in the ultimate determination of the efficiency of certain classes of bituminous work. Most subgrades have a much lower carrying capacity in the spring than at other periods of the year. As there is practically no slab effect produced by the structure of a broken stone or gravel foundation, a load applied to any overlying bituminous surface is transmitted quite

directly to the subgrade. In other words, the intensity of load under its point of application is relatively high throughout the foundation thickness.

Under heavy motor-truck traffic the intensity of load transmitted through a 2-inch thickness of dense bituminous concrete to the foundation may be so great as to cause an internal movement sufficient to produce disintegration of the pavement. This is particularly true when the subgrade is of a soft or clayey nature and appears to be quite possible irrespective of any economical thickness of broken stone or gravel foundation which may be used. In general the experience on heavily traveled city streets has demonstrated the necessity of a slab foundation for any wearing course, and there appears to be no reason why such experience should not serve as a guide for new construction of bituminous pavements on State and county highways subjected to modern heavy-truck traffic. On these highways the traffic has certainly been as severe as on many city business streets, so far as weight of unit loads is concerned, and more severe when the high speed often attained by such traffic is considered.

BITUMINOUS SURFACE TREATMENT.

With respect to existing gravel and macadam roads, whether or not they have been previously surface treated with bituminous material, it would seem far safer at the present time to attempt to preserve such roads under heavy motor truck traffic by means of surface treatment with bituminous materials rather than to utilize them as foundations for the construction of new bituminous macadam or bituminous concrete pavements. In other words, for the time being such treatments may prove more efficient than the use of a higher type of pavement placed upon the existing road, although it is clearly recognized that, under heavy motor truck traffic, the bituminous pavements are more efficient, providing the foundation is adequate to support the loads.

Under the same conditions of traffic bituminous surfaces are most efficient in localities where frost action is either absent or not severe. Such treatments used in connection with gravel roads adjacent to Army cantonments in the far South have given reasonable satisfaction, even under heavy motor truck traffic. North of the frost line and particularly in connection with the treatment of clayey gravel roads which become soft during the spring months, bituminous surfaces are apt to completely disappear. If, however, the gravel road is maintained by dragging and at the end of the thawing-out period is reshaped, thoroughly compacted, and again treated with bituminous material, it may be kept in a reasonably satisfactory condition.

HEAVY MAINTENANCE COSTS.

Under very heavy motor truck traffic, however, maintenance costs may be extremely high, so that if a continuation of such traffic is to be expected the construction of a new road may be necessary. Thus during a period of 120 days on a clay gravel road leading from Alexandria to Camp Humphreys, Va., which was subjected to an average daily traffic of some 230 heavy motor trucks, the cost for maintenance amounted to approximately $10,000 per mile. Because of this enormous expense the construction of a new type of road became necessary.

In connection with this road it is of interest to note that prior to its maintenance as a gravel road it had served as a 6-inch foundation for a dense bituminous concrete pavement 2 inches thick. This pavement had successfully passed a year of ordinary country and pleasure traffic, carrying a large number of touring cars between Washington and Mount Vernon. In the spring of 1918 it was suddenly subjected to an average traffic of over 200 heavy motor trucks a day, and within a comparatively few weeks was absolutely ruined, due to failure of the foundation during the thawing out period. An extension of this road in the city of Alexandria consists of a number of sections of very carefully constructed bituminous macadam laid some years ago upon a concrete base. Although subjected to the same heavy traffic, the bituminous macadam, ordinarily considered less efficient than bituminous concrete, did not fail, except in a few places where failure of the concrete base could be held responsible owing to exceptionally poor subgrade conditions.

BITUMINOUS SURFACES ON MACADAM.

Bituminous surfaces on properly constructed macadam roads subjected to heavy motor truck traffic may, as a rule, be maintained in localities north of the frost line with less expense and better results than on gravel roads under the same conditions. Such surfaces, under heavy motor truck traffic, can not be considered as economical from the ordinary standpoint, but may prove the most efficient temporary method of preserving the existing road until money is available for reconstruction. It is believed, however, that under these conditions bituminous surfaces will not even prove efficient unless constantly maintained by a patrol system operating throughout the year.

Maintenance by the Bureau of Public Roads of experimental bituminous surfaces on the Rockville

Pike, Maryland, which is a macadam road, have demonstrated that such surfaces constructed with suitable tar and oil products are efficient under reasonably heavy traffic, provided the patrol system of maintenance is followed. If such a system had not been in use during the past year when from 28 traffic counts an average of 135 motor drays, 816 motor pleasure vehicles, and 61 horse-drawn vehicles per day passed over the road, it would from all indications have been completely destroyed.

With regard to the efficiency of bituminous macadam under heavy motor-truck traffic, there are a number of points to be considered. In general, bituminous macadam has not been thought to be efficient for such traffic but, on the other hand, it has almost invariably been placed upon a broken stone or gravel base. Results obtained in the city of Alexandria, which have previously been mentioned indicate that if properly constructed and laid upon a concrete base the bituminous macadam may prove quite satisfactory.

PAY ATTENTION TO CONSTRUCTION.

Aside from character of foundation, it is believed that sufficient attention has not in general been paid to the important details of bituminous macadam construction so as to obtain best results. Too frequently the coarse stone is not sufficiently compacted before the first application of bituminous material is made, and later uniform compaction is extremely difficult, if not impossible to secure. Rutting the road with certain types of distributors just prior to application of the material is a common cause of lack of uniformity in compaction, and a strong tendency to distribute faster than the road can be satisfactorily compacted and finished by a single roller is another.

Best results from this type of road which have come under the writer's notice have been secured by the hand pouring method, although this method is considered antiquated by many engineers. Where the first application upon the thoroughly compacted coarse stone is made diagonally across the center line of the road and the second pouring or seal coat is made in a direction diagonally across the first, with proper attention to uniformity of distribution it is possible to secure a very excellent pavement, as has been repeatedly demonstrated by Mr. E. C. Dunn, city engineer of Alexandria, Va.

The efficiency of bituminous concrete, sheet asphalt, and asphalt block pavements under city traffic is so well understood as to require little comment in this paper. If laid upon suitable concrete foundations there is no reason to suppose that the results given by these pavements in city construction will not be duplicated on county and state highways subjected to heavy motor-truck traffic. If the foundation is inadequate to support the load, the pavement is bound to fail, but, as previously pointed out, failure can not then be considered a measure of the pavement proper.

MATERIALS OF CONSTRUCTION.

With regard to materials of construction a few comments may not be out of place, as the efficiency of a bituminous surface or bituminous pavement depends not only upon its method of construction but of what materials it is composed.

In general, the author's observation and experience has been that the most efficient bituminous carpets are constructed with the heaviest grade of bituminous material which it is possible to apply and make adhere uniformly to the road surface. For cold-surface treatment this will demand either a cut-back asphalt, a heavy asphaltic oil with specific viscosity of 80 to 120 at 25° C. containing an appreciable amount of volatile material that will evaporate after application and leave practically an asphalt mat residue, or the most viscous refined tar product that can be applied cold. For the latter a specific viscosity as high as 25 to 35 at 40° C. should be used if climatic conditions will permit.

While on old macadam roads it is advisable to keep the thickness of carpet under one-half inch, on certain types of soft gravel it may be of greater thickness provided a hard and tough coarse aggregate cover of sufficient size to force into the old gravel surface by rolling is used. For clay-gravel or sand-clay-gravel roads north of the frost line it is believed that for maintenance under heavy truck traffic light superficial treatment with bituminous materials applied cold will prove more efficient than the construction of a bituminous carpet, although neither will be adequate to carry the road through winter.

With regard to bituminous macadam and coarse aggregate bituminous concrete, there is little to suggest in connection with the grades of bituminous materials ordinarily used. It is believed, however, that even in the northern United States the use of an asphalt cement softer than 120 penetration or a refined tar of less than 120 second float test at 50° C. for bituminous macadam is inadvisable if modern heavy motor traffic is to be sustained. It is also believed that more attention should be given

to specifying and securing a uniform size, and grading within reasonable limits, of coarse stone for bituminous macadam in order to promote uniformity in the penetration of the bituminous material as it is applied and to produce a surface that will wear as uniformly as possible. Such specifications should be based upon tests made with laboratory screens and should at least cover the permissible percentage retained on the maximum and passing the minimum diameter of screens selected, as well as the percentage limits required to pass or be retained upon an intermediate screen.

USE OF HARDER GRADES OF ASPHALT.

In connection with sheet asphalt and the fine aggregate bituminous concretes the tendency to use harder grades of asphalt cement than heretofore used may prove advisable for very heavy traffic conditions. It is quite possible, however, that better results may be secured by a reduction in the compacted thickness of such pavements with a corresponding increase in thickness of binder course where one is commonly used. For fine aggregate bituminous concretes which are commonly laid without a binder course, the introduction of such a course not less than 1½ inches thick may prove advisable with a reduction in thickness of wearing course to not more than 1½ inches. Provided the binder course is properly constructed such practice should tend to produce a pavement less susceptible to displacement under heavy motor truck traffic. In any event it is believed that even more attention should be paid to aggregate grading than heretofore in order to produce most satisfactory results.

The resistance to displacement of compacted bituminous aggregates, containing particles from one-half inch in diameter down and consisting largely of sand, is mainly dependent upon grading of the mineral aggregate and hardness of the bituminous cement. When, however, the particles become very small and possess absorptive or colloidal properties, neither grading nor consistency of the cementing medium are such important considerations. Very large surface contact and high frictional resistance then become the prime factors. Thus, a fine mastic composed of limestone dust or clay and a very soft asphalt cement may exhibit even greater resistance to displacement than a graded sand aggregate mixed with a much harder asphalt cement. The former type is exemplified by certain finely pulverized bituminous limestones. Use of the latter has but recently passed the experimental stage. It is quite possible, however, that future developments will establish such extremely fine bituminous aggregates as being highly efficient under heavy motor truck traffic for both the sheet and block type of construction.

LARGE FEDERAL-AID PROJECT.

The State highway department of Pennsylvania has just submitted the statement for one of the largest projects on which Federal aid has so far been requested. The road is located between Gettysburg and Harrisburg and has a net length of 29.9 miles. An 18-foot concrete pavement is planned for the entire route, an option of a bituminous concrete top on a concrete base being offered. The estimate of the cost as now presented is $1,315,000, which is at the rate of nearly $44,000 per mile.

Projects of this sort indicate the advancement which is being made toward the improvement of long stretches of road with the higher types of surfaces and show conclusively that the public is back of the movement for better highways.

HIGH-CLASS MARYLAND ROAD.

The State highway department of Maryland has recently submitted the project statement for 13.1 miles of concrete highway to connect Claiborne with the present concrete road running out of Easton. The reconnaissance estimate calls for an expenditure of $453,860, which is at the rate of nearly $35,000 per mile. The surfacing is to be 16 feet wide and of standard thickness and will, it is estimated, cost about $3.50 per square yard.

Only a few years ago such a price would have been considered prohibitive. Now it is accepted without question. This difference in attitude speaks volumes as to the extent to which the public at large is back of the movement toward the construction of high-class roads.

ALL WORK ON FEDERAL-AID ROADS.

In order to meet the largely increased amount of Federal aid allotted to California under the new appropriation, the California highway department has decided that it will be necessary to do all State highway work for the next three years on Federal-aid projects.

FOR COUNTY HIGHWAYS.

The 10 towns in Suffolk County, N. Y., will have about $600,000 to spend on roads this year. This amount includes that appropriated by the towns, the State-aid funds awarded by the State highway commission, and balances on hand in several towns from appropriations not used last year.

STATE HIGHWAY MANAGEMENT, CONTROL, AND PROCEDURE

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

IN the foregoing numbers appeared the chapters on State highway management, control, and procedure. In this number are presented the chapters on 28 additional States, completing the series. 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 last calendar or fiscal year.

MINNESOTA.

DEVELOPMENT.

State participation in Minnesota is of very recent origin, of State-wide extent, and consists of advisory and supervisory assistance and monetary aid. State participation had its beginning with the passage of the constitutional amendment in 1897 authorizing the use of State funds for highway improvement and authorizing the establishment of a State highway commission.

The State highway commission, which was first established in 1905, has been subject to additional legislation affecting its powers and duties and personnel until at present State authority over road matters is vested in a commissioner appointed by the governor, who administers the expenditure of State and Federal funds provided for highway improvement. He has limited supervision over certain local funds, which are generally expended under the jurisdiction of assistant engineers appointed by the commissioner and who are located in the various counties of the State in charge of State highway work and such local highway work as may be delegated to them by the county or town officials.

The system of State highways, comprising 13 per cent of the total road mileage of the State, has been selected by the county boards, subject to the approval of the State commissioner of highways. This system is being improved by means of State and local funds. Approximately two-fifths of the mileage in the system of State highways as at present designated has been improved. However, this system may be amended as needed by joint agreement by the State and local officials.

During 1916 the State highway department expended $1,390,525 of State funds and exercised supervision over the expenditure of $3,337,550 of local funds. The total expenditures for the period by all road forces of the State amounted to $8,742,278. Thus the State contributed 15.9 per cent and exercised supervision over 54 per cent of all expenditures. The total expenditure from all sources during 1917 amounted to $8,024,760.

While highway improvement is carried out on an extensive scale in Minnesota, the improvements are so located as to secure the greatest benefit to the counties themselves and at the same time develop a system of main arterial highways throughout the State.

ORGANIZATION.

The organization of the highway forces of the State and their relation is shown on the diagram herewith.

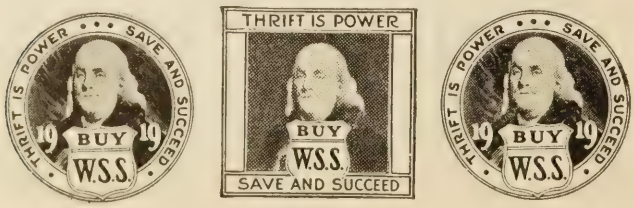
State.—The State highway department is administered by a State commissioner of highways appointed by the governor for a term of six years. He appoints and is assisted by a deputy commissioner, who is required to be an experienced road builder and engineer and who is in charge, subject to the orders of the commissioner, of the technical work of the department, and by a chief engineer in charge of bridges, culverts, and special structures, a first assistant road engineer in charge of maintenance, State aid, etc., and a road-construction engineer in charge of road-construction design and Federal-aid work; also by five division engineers, who

have general supervisory charge of road and bridge work in the various counties to which Federal and State funds are contributed.

Assistant engineers who have charge and supervision of construction and maintenance of State highways in the various counties are appointed by the commissioner. However, one or more counties may comprise the territory to which an assistant engineer is assigned. Other employees, technical and clerical, are employed by the commissioner as required by the volume of work in hand. The total expense of maintaining the State highway department is restricted to not more than 10 per cent of the State road and bridge fund, and the total expense of the central office of the department may not exceed $25,000 per year. The commissioner is required to publish general rules for the construction, improvement, and maintenance of the State roads, taking into consideration the suitability and availability of local materials to allot State funds, and to order payment thereof to the various counties of the State, to enter into contracts for maintenance under certain conditions, and to inspect annually all bridges of 30-foot span or more throughout the State.

County.—Authority over road and bridge affairs is vested in a county board consisting of five members elected for terms of four years. One member thereof is elected chairman. The county auditor is clerk and the county treasurer is fiscal agent of the board. The board has the necessary authority to levy taxes, to enter into contracts for improvement of roads and bridges on State and county highways, and to engage such agents or assistants as may be required to complete such work. The engineering work of the county is generally done by the assistant engineer detailed thereto by the State highway commissioner, and as a general rule a close and harmonious relationship exists between the boards and the engineers cooperating with them.

Towns.—The towns of Minnesota consist of an area generally identical with one or more congressional townships and are governed by a board of three supervisors elected for terms of three years. They have jurisdiction over town roads and employ an overseeer and such other forces as may be required to construct and maintain the same. The board has authority to levy taxes for and to enter into contracts relative to road construction and improvement.



CLASSIFICATION, CONTROL, AND PROCEDURE.

The 93,527 miles of public road in Minnesota are for the purpose of fixing responsibility for control, construction, and maintenance divided by legislative enactment into three groups, namely, State roads, county roads, and town roads.

State roads.—These comprise 12,700 miles of road selected by the respective county boards of the State with the approval of the State commissioner of highways, or by the commissioner on a petition directed to him by 10 or more freeholders. They are constructed under county administration with State and county funds. The percentage of cost borne by the State is 80 per cent in counties having an assessed valuation of less than $5,000,000, 70 per cent in counties having an assessed valuation greater than $5,000,000, and is decreased 10 per cent for each $5,000,000 increase in valuation until only 50 per cent of the cost is paid in counties having an assessed valuation exceeding $15,000,000.

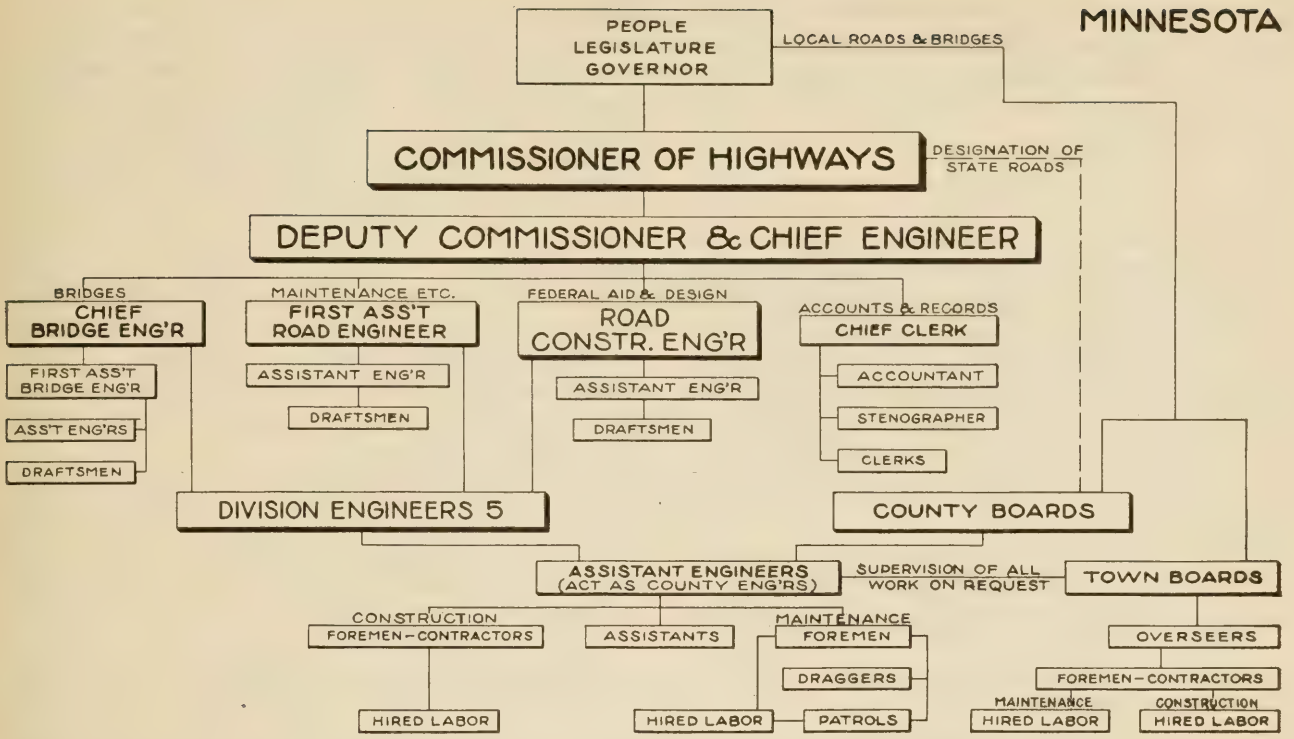
Surveys, plans, specifications, and estimates of cost for roads of this group are made on request of the county board by the assistant engineer detailed in the county. If more than $500 will be involved in the proposed improvement, the plans and specifications are required to be submitted to the State commissioner of highways for his approval. The work may be done by force account under the direction of the assistant engineer, or by contract let by the county board. If by contract, the assistant engineer is in charge of the work during its progress, and partial payment may be made by the county board when approved estimates therefor are submitted by the assistant engineer.

The final payment is not made until the work has been completed and has been viewed and accepted by a majority of the county board and until a certificate of such acceptance has been filed with the county auditor.

The county auditor then files a statement with the State commissioner of highways showing the location and cost of the work done with a report from the assistant engineer showing such details as may be required by the commissioner. When this data has been examined and approved by the commissioner, payment of the State's portion of cost is made on his order by the State treasurer.

Towns may assist counties in construction and may receive their proportionate share of the refund when granted by the State.

Roads of this class when improved are maintained by the county with State and county funds, State funds being allotted in the ratio of the division of costs of construction.



Whenever the county fails to maintain such roads, the State commissioner of highways is authorized to execute maintenance and to defray the cost thereof from the State reserve maintenance fund, and to later reimburse this fund by deductions made from future allotments to the county.

Three counties of the State operating under special laws are exempt from State supervision over road matters except in those cases where State and Federal funds are used during construction.

County roads.—These comprise all roads constructed by the county boards with county funds.

Town roads.—All other roads of the State are town roads. They are constructed and maintained by town boards with town funds.

REVENUES.

State.—The State revenues are derived from four sources, namely, (1) the proceeds of the State-wide 1-mill tax, producing about $1,550,000 annually, (2) net income from "Internal improvement fund," producing about $12,000, (3) net income from motor-vehicle licenses, producing about $50,000 annually, and miscellaneous receipts and fees, amounting to $1,500.

These revenues constitute the State highway fund, which is disbursed in the following manner: On or before January 1 of each year, the commissioner of highways estimates the total amount available for the coming year. After deducting 10 per cent of the total for the expenses of the highway department and $50,000 or less for the reserve maintenance fund, the remainder is allotted to the various counties of the State in such amounts as will provide that no county receive less than 1 per cent nor more than 3 per cent of the total allotment. Not less than 20 per cent nor more than 30 per cent of the county allotment is set aside for maintenance purposes. The maintenance is expended (1) on bridges and roads constructed in part with Federal funds and (2) on bridges and roads constructed in part with State funds.

The amounts so allotted remain in the State treasury subject to expenditure on order of the State commissioner of highways.

County.—The road and bridge fund of the county is obtained by a levy on all taxable property in the county at a rate of not to exceed 5 mills on every dollar of valuation. A special tax to meet Federal-aid funds of 5, 3, or 1 mill may be levied on each dollar of valuation dependent on whether the total valuation of the county is less than $10,000,000, greater than $10,000,000 and less than $25,000,000, or whether the valuation exceeds $25,000,000.

Towns.—The board of supervisors may levy a tax for road and bridge purposes at a rate not to exceed 15 mills on each dollar of taxable property and may if authorized by a majority vote at the annual town meeting levy an additional tax at a rate not to exceed 10 mills on each dollar of taxable property. This special tax may be paid in labor at rates prescribed by statute. A drag tax of 1 mill on each dollar of taxable property outside of the limits of incorporated cities, towns, or villages is levied. The proceeds of this tax may be expended for drag-

ging, removing snow, or placing straw on sandy roads. The surplus in this fund on April 1 of each year may be transferred to the road and maintenance fund provided that at least $100 is left in the fund for emergency purposes.

BONDS.

Deferred serial bonds may be issued when authorized by a majority of the voters affected by counties or towns for road and bridge improvements. The counties may not incur a total bond indebtedness to exceed 15 per cent of their assessed valuation and the term of the bonds is limited to 20 years. Towns may not incur a total bonded indebtedness to exceed 5 per cent of their assessed valuation, and the term of such bonds is limited to a period not exceeding 10 years.

On January 1, 1915, $1,411,889 of bonded indebtedness incurred by counties and towns was outstanding. These bonds bore interest at 4 per cent.

MISSISSIPPI.

DEVELOPMENT.

State participation in Mississippi is limited to advisory, educational, and propaganda work by the State highway commission established in 1916. However, the approval of the State highway department is required on all plans and specifications prepared by engineers employed by county and special road district boards. Approximately $3,250,000 was expended during 1917 by the various counties for road construction and maintenance, and approximately 2,600 miles, or 5.7 of the total road mileage has been surfaced, principally with gravel and sand-clay.

ORGANIZATION.

State.—The organization of the State road department and of the counties and the relation existing between the State and local forces is shown in the accompanying chart, and is briefly described as follows:

The State highway commission is composed of three nonsalaried members appointed by the governor for a term of six years, one appointment being made every two years. The commission appoints a State highway engineer, who must be a competent civil engineer and road builder, who serves as the chief executive official of the department. His salary is $2,500 per annum and he serves four years or until removed for cause by the commission. There is also an assistant engineer appointed by the commission. The State highway department has no power to build, maintain, or supervise construction except on request of local authorities. The highway department upon request conducts campaigns of education, makes surveys, prepares plans, specifications, and estimates, and assists counties in securing competent engineers to take charge of construction work.

Local.—The county boards of supervisors have general charge of construction and maintenance of county and district roads, and the raising of revenues therefor. A county board is composed of one supervisor elected from each supervisors' district. The county treasurer acts as fiscal officer and disburses all road funds. The road taxes are collected by the sheriff, who is the county tax collector. Various provisions of law exist authorizing the building and maintaining of roads by contract and for the creation of special road districts.

Boards of supervisors may appoint a county highway commissioner, who in turn may employ a competent highway engineer to make surveys, plans, specifications, and estimates and supervise the building of improved roads.

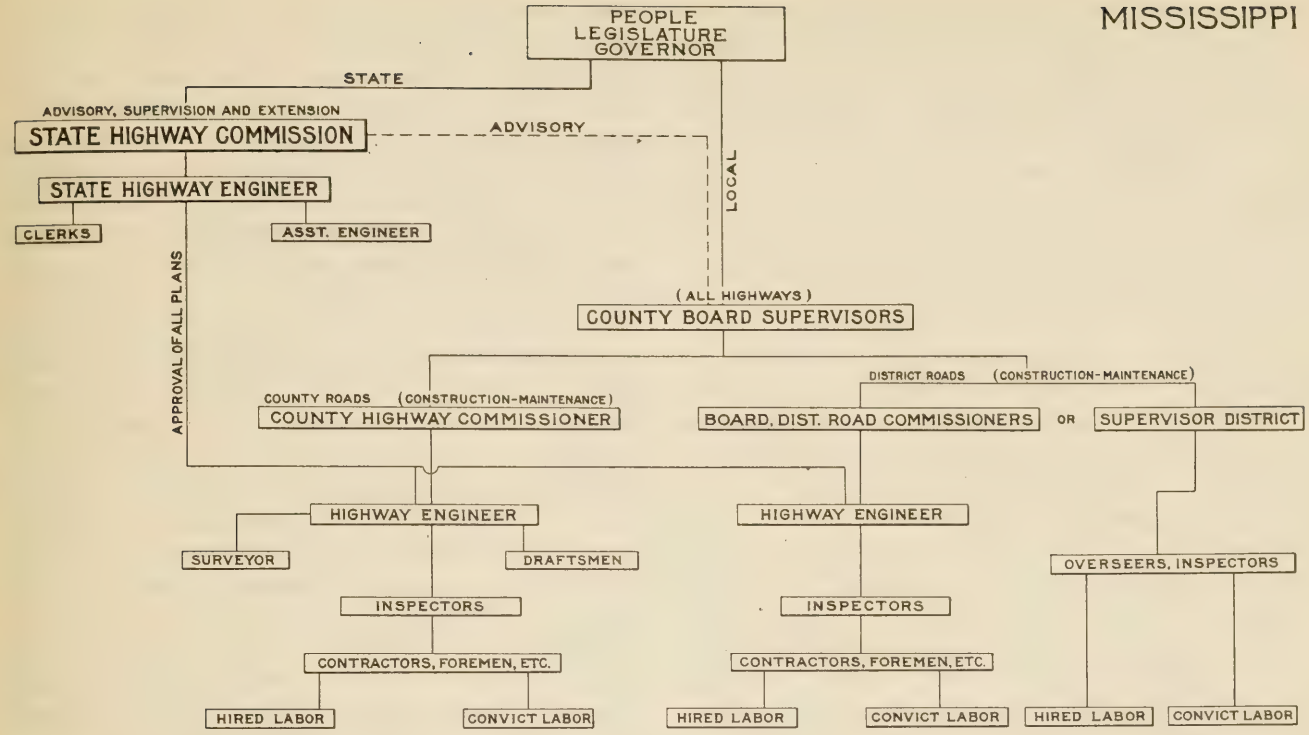
The counties may be divided by the board of supervisors into special road districts in which improved roads may be built under the direction of a district road commission composed of three members appointed by the county boards of supervisors. Such commissioners may employ a highway engineer to supervise the work.

The county supervisor of each district is required to exercise general supervision over the public roads in his district except as above indicated. The district supervisors have the work done by contract, by prison labor, or may divide the roads of their district into convenient links and appoint an overseer for each link.

CLASSIFICATION, CONTROL, AND PROCEDURE.

There are approximately 45,800 miles of public road in Mississippi, of which 2,600 miles, or 5.7 per cent, were surfaced on January 1, 1915. There are no State highways or roads to which financial aid of the State is extended. However, the State highway law provides that engineers of county boards or special districts submit to the State highway department for its approval all plans and specifications. This gives the State highway department a certain control over the construction of improved roads, and will have the effect of standardizing types, widths, gradients, and bridge structures. Local roads are usually classed as county roads, district roads, or special district roads. In those counties

MISSISSIPPI



which have county highway commissioners, or where special district commissioners are provided, the work is done by contract under the direction of an engineer, although prison labor may be employed. Statute labor tax is usually applied to district roads and under the direction of the overseers.

REVENUES.

The only State funds available are those derived from annual legislative appropriations for the support of the State highway department. This appropriation amounted to $6,500 for the year 1917.

Local roads are built and maintained from funds derived from taxation on property, statute labor tax, receipts from automobile registration fees, from funds derived from bond issues, and with jail prisoners. Supervisors are allowed to levy a money tax on all taxable property not to exceed 3 mills when the work is done by contract. An additional tax may also be levied on contiguous property for the maintenance of improved roads. Various other methods exist under the law for raising money in special districts. All able-bodied male citizens between the ages of 18 and 45 years, unless by law exempt, are required to labor eight days on the roads, or pay $3 in cash.

BONDS.

Most of the improved roads so far constructed have been built in special districts from funds derived from bond issues. The general bonding law of the State providing for the improvements of roads in one or more supervisors' districts contains a number of interesting, sound, and business-like features, namely:

1. Bonds may be issued by boards of county supervisors for a county or district on petition of 20 per cent of the qualified electors, provided the issue is not petitioned against by an equal percentage of electors, in which event an election must be held, when a majority vote decides the question.

2. The bonds outstanding must not exceed 10 per cent of the assessed valuation of property in the county or district.

3. The bonds must be paid off in annual installments between the tenth and twenty-fifth year from the date of issue.

4. A special tax must be levied annually for the payment of interest and principal, and the proceeds can be used for no other purpose.

5. A special tax of at least 1 mill must be levied for the maintenance of the road so constructed.

The total county and district bonds outstanding on January 1, 1915, amounted to $8,327,172.

MISSOURI.

DEVELOPMENT.

State assistance in laying out State roads and for the construction of bridges thereon was extended in a limited manner at irregular intervals during the period 1821 to 1860. The grant of money aid was not made a permanent policy, but was provided by special acts of the legislature for each project. From 1860 to 1907 no participation was taken in road and bridge work by State authorities. In 1907

the legislature authorized the appointment of a State highway engineer with advisory and educational duties, provided for the appointment of county highway engineers, and set aside a fund to be apportioned among the various counties of the State for road and bridge purposes. The State highway engineer was appointed by the State board of agriculture, and during the period 1907 to 1913 several bulletins dealing with road matters were published under their joint authority.

In 1913 the office of State highway engineer was abolished and a State highway commissioner was appointed by the governor. Funds were provided by the State to the extent of $15 per mile for the dragging of intercounty-seat highways. During the period 1913 to 1917 little or no supervision was provided by the State for the construction of roads of standard types. During this period, 1913–1917, considerable money was allotted by the State to the counties for construction purposes, although the State exercised little supervision other than inspection and approval of the plans proposed to be followed in the expenditure of the sums allotted. In 1917 a State highway board was authorized, a system of State highways selected for improvement under the superivion of the board, and appropriation equal in amount to Federal funds allotted was made and the State highway department was reorganized and expanded.

At the close of 1916, 7,250 miles or 7.6 per cent of the total road mileage of the State had been hard surfaced.

During 1916, $482,860 of State funds were disbursed by the State highway commissioner. This amount included allotments to counties for construction, payments for dragging of intercounty-seat roads, and the expenses of the State highway department. The total expenditure by all road and bridge forces of the State during the year totaled $7,982,860. State disbursements thus equalled 6.2 per cent of the total expenditures. During 1917 the total expenditure from all sources amounted to $7,374,933.

ORGANIZATION.

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

State.—The State Highway Department is headed by the State highway board, a bipartisan body composed of four members appointed by the governor for terms of four years, two members being appointed biennially. The board selects the State highway engineer who serves at their pleasure and is their executive official. The State highway department is required to select a State highway system, extending to each county of the State, containing not less than 3,500 miles and is required, whenever funds are available, to extend this system by the addition of at least 500 miles per annum.

The State highway engineer has supervision and control over all work done on the State highway system, is required to prepare standard plans and specifications for various types of road, bridge, and culvert construction; to furnish copies of same to all county, township, and district road officials, and to tender advice or instructions relative thereto when requested by such officials.

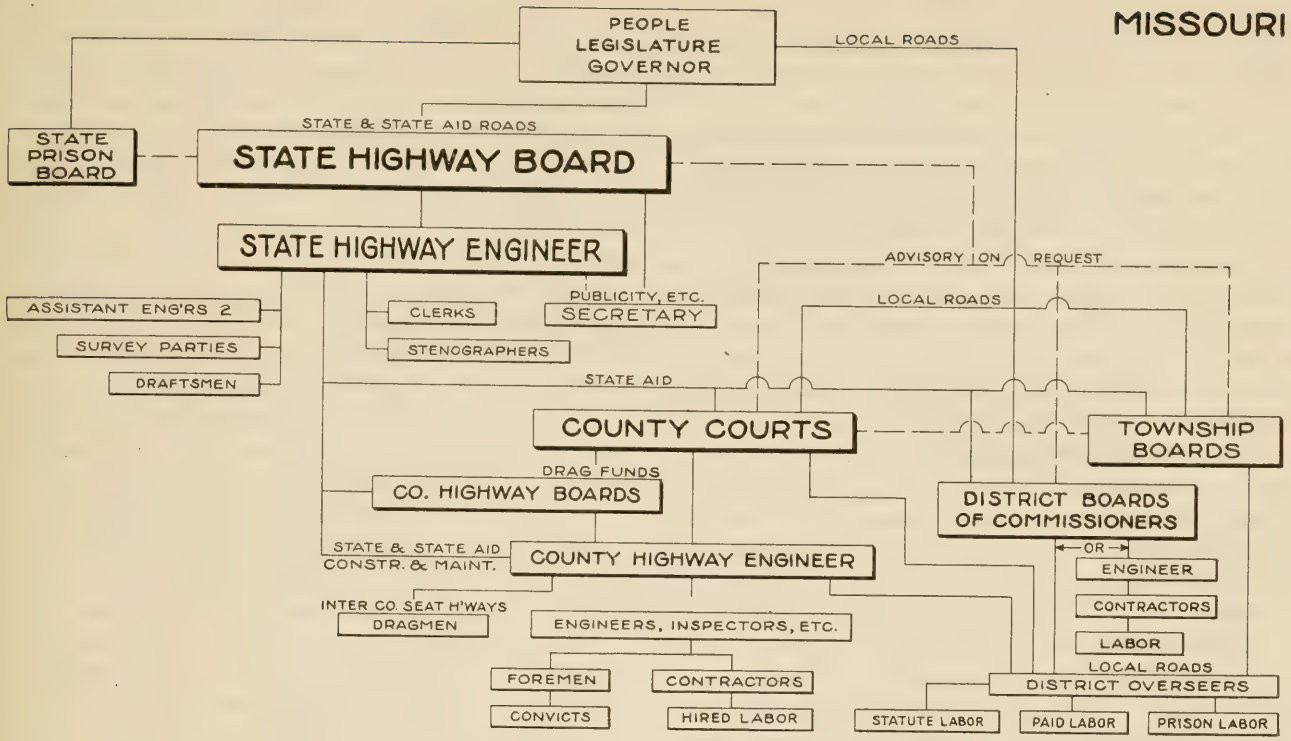
Two assistant engineers and such other employees as may be required are appointed by the State highway engineer with the approval of the board. The State highway department is required to cooperate with county courts, township and district boards, and with individuals and private associations organized for the improvement or construction, at joint expense, of roads selected by mutual agreement between the department and the individual board or body concerned.

County.—In 92 counties of the State road and bridge affairs are administered by county courts composed of a presiding judge elected for a four-year term and two associates judges elected for terms of two years. The county clerk and county treasurer, elective officials, are respectively clerk and fiscal agent of the court.

The court may appoint a county highway engineer or if the office has been abolished by a majority vote of the qualified voters of the county, the county surveyor, an elective official, becomes exofficio highway engineer and assumes the duties imposed by law on the county highway engineer.

The county highway engineer is required to be skilled in road and bridge building and general road work, and has general supervision of all road and bridge work in the county. He is required to render an annual report in such manner as may be prescribed to the State highway engineer. Each county is divided by the county court into road districts, each in charge of an overseer appointed by the court who serves under the direction of the county engineer.

The county highway board composed of three members is appointed by the county court for terms of two years. This board lets contracts for dragging the intercounty seat highways. The county highway engineer is ex officio a member of the board. Monthly payments for dragging are made out of the State drag fund by the State treasurer to the various



county highway boards on certificates executed by the boards and State highway engineer.

Townships.—Twenty-two counties of the State have, in addition to the regular county organization, a board of directors and other elective officials for each township in the county. The county courts of counties of this group are required to appoint a county highway engineer who has general supervision over all township road work. Road overseers in charge of the various districts of the township are appointed by the township boards. Township boards may not expend for bridge purposes more than $100 per bridge and all expenditures of $25 or over must be approved by the county highway engineer. Townships may cooperate with the State highway board for the improvement of State highways.

Districts.—The county courts of counties not under the township organization plan may authorize, when petitioned therefor, the formation of special road districts not exceeding 64 square miles in extent. The affairs of such districts are administered by a board selected by joint action of the county court and the municipal council of the town required to be included in each district so organized. Such boards may levy taxes, issue bonds, enter into contracts, etc. Counties having township organization may by order of the township boards be subdivided into special assessment districts of not less than 1 square mile in extent. Roads in such districts may be improved and the cost assessed against the land included in the district when a majority of the owners of the land affected so petition.

Improvements on State roads financed by bond issues or special taxes must be executed in accordance with plans approved by the State Highway Engineer.

CLASSIFICATION, CONTROL, AND PROCEDURE.

The 96,041 miles of public road in Missouri are divided for the purpose of fixing responsibility for construction, control, and maintenance into three general groups, namely, State roads, intercounty-seat highways, and county roads.

State roads.—These comprise a system of 7,500 miles selected by the State highway department and distributed among the various counties in proportion to their area, population, and mileage of public roads. Initiative for improvement or reconstruction is taken by the local body having jurisdiction which makes application to the State highway engineer for State aid and guarantees to pay not less than 50 per cent of the total cost of the improvement. If deemed feasible and advisable by the State highway engineer, and if State or Federal funds are available, plans, specifications, and estimates are prepared by the local body and submitted to the State highway engineer for approval.

The work may be done by day labor, by convicts detailed from the State penitentiary with the approval of the State prison board and the State highway board if request is made therefor by the county court; or the work may be done by contract let by the local body having jurisdiction. The work during progress is under the charge and supervision of the State highway engineer and on completion is in-

spected and accepted by him. Payments to the contractor are made by the local board and on final acceptance of the work the local body is refunded 50 per cent of the total cost by the State highway department, but if found desirable partial payments may be made by the State as the work progresses.

Federal and State aid contributed may not exceed 50 per cent of the total cost of the work. Roads of this group when completed are maintained by the county with county funds. The State highway engineer is required to inspect or cause to be inspected all roads completed under this procedure, and to compel the county to maintain them in a condition satisfactory to the State highway department.

Intercounty-seat highways.—The 11,350 miles of road connecting the county seats of the State are allotted State funds to the amount of $15 per mile per annum to be expended under the supervision of the county highway board for the purpose of dragging or otherwise improving them.

County roads comprise all other public roads of the State, They are constructed and maintained by the county, township, or district boards with local funds. They may, however, receive an allotment of State funds equal in amount to the amount provided locally for the construction of permanent improvements. The State allotment to any county for any one year for this purpose may not exceed 3 per cent of the $200,000 annual appropriation made by the State legislature for distribution to all counties of the State.

REVENUES.

State.—The State road fund is composed of revenues raised, (1) by the imposition of a motor vehicle registration fee, (2) from the sale of option stamps, (3) from fees charged for registration of corporations. Amounts raised from each of these sources of revenue are not known, but the legislature has appropriated from this fund for road improvement for the biennial period January 1, 1917, to December 31, 1918, the following amounts:

1. Support of the State highway department	$150,000
2. To meet Federal aid funds	1,020,000
3. Dragging fund	400,000
4. For permanent improvements and allotments	400,000
Total	1,970,000

1. The fund for the support of the State highway department is disbursed on order of the State highway board.

2. The fund for Federal aid is disbursed by the State highway board for projects approved and granted funds by the United States Secretary of Agriculture, the disbursements being in the ratio of $1 State funds and $1 United States funds for each $2 of local funds provided.

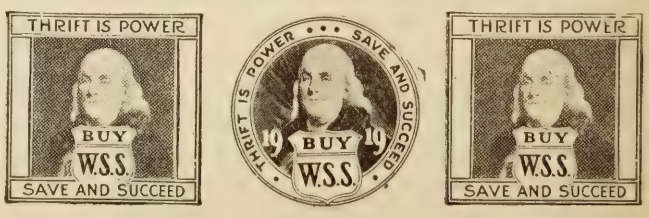
3. The drag fund is disbursed by the State highway engineer to the county highway boards to defray the expense of dragging or otherwise improving intercounty seat roads. Fifteen dollars per mile is the maximum expenditure allowed by the State.

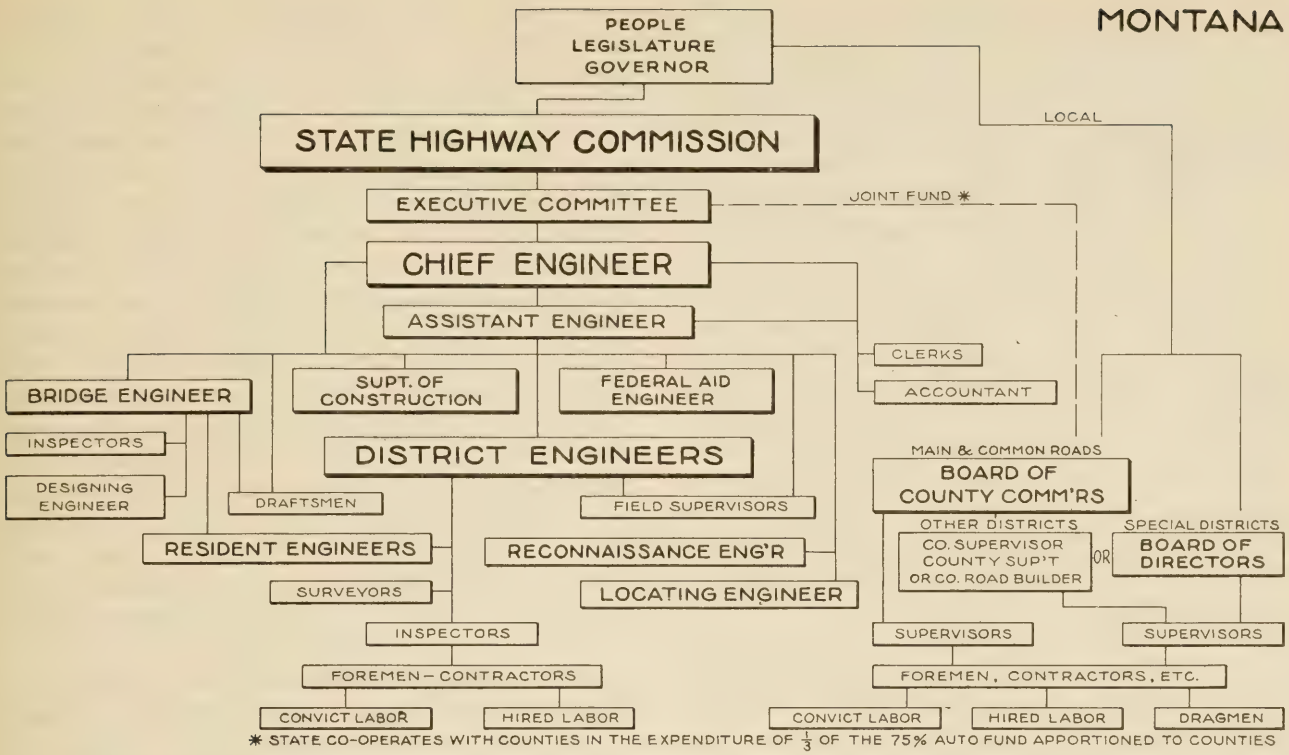
4. The permanent improvement allotments are distributed by the State highway engineer among the several counties, townships, or districts of the State in amounts equal to the amount raised locally for specific improvements of roads or bridges, provided that the amounts so allotted be in proportion to the assessed valuation of the various counties, and no county may receive more than 3 per cent of the total fund. All improvements financed with the joint fund thus provided are required to be executed in accordance with plans and specifications approved by or acceptable to the State highway engineer.

Local.—All county courts are required to levy for road and bridge purposes a tax at a rate not less than 10 cents nor more than 20 cents on each $100 of assessed valuation of all real and personal property made taxable by law. This tax is placed to the credit of the county road and bridge fund. In counties not under township organization, a special road and bridge tax not exceeding 25 cents on $100 may be levied, and the proceeds of this tax are expended in the district in which collected. Dramshop licenses fees of $250 to $400 for each license for a six months' term are added to the special road and bridge fund. Townships may levy a road and bridge tax at a rate not less than 10 cents nor more than 20 cents on each $100 valuation. A poll tax at a rate of $4, payable in cash or labor, may be levied by the county court or township board.

BONDS.

Bonds in an amount not exceeding 10 per cent of the assessed valuation of the county and 5 per cent of the assessed valuation of the township or district may be issued by the counties, townships, or special districts for road and bridge purposes. County bonds require the approval of two-thirds of the qualified voters of the county. Such bonds are limited to 20-year terms, subject to call, however, at any time, and may bear not to exceed 5 per cent interest, payable semiannually. Township bonds, when authorized by two-thirds of the voters of the township, may be issued, to bear not to exceed 6 per cent interest, become due in 15 annual installments,





the first of which shall become due not later than two years from the date of the bonds.

Special district bonds may be issued by the special boards of commissioners. Such bonds are of a type and are issued in a manner similar to that described under township bonds.

On January 1, 1915, there was outstanding a total of $522,500 of bonds issued by the counties of Missouri for road and bridge purposes. These bonds bore interest at the rates of 5 and 6 per cent, and were issued for terms varying from 10 to 15 years.

MONTANA.

DEVELOPMENT.

State participation in road improvement in Montana is of recent origin, limited in scope, and consists of a small amount of money aid derived from automobile registrations applied to a system of State highways administered by a State highway commission.

State interest in road improvement was first manifested in 1913, when there was established a State highway commission consisting of three members and a State highway fund for the improvement of a system of State roads. The commission consisted of two ex officio members and a secretary-engineer, who was virtually the State highway engineer of the department. From 1913 to 1917 State activity was limited to the use of State convicts on road work and to the furnishing of plans, specifications, and supervision of bridges.

In 1917 this commission was abolished and a new commission, consisting of 12 appointive members, was provided for. The fund at the disposal of the commission for administration and for construction and maintenance of State highways consists of 50 per cent of the net automobile registration fees, which amounted to approximately $131,500 in 1917. The local expenditures during 1916 amounted to approximately $3,500,000. The money over which the State exercises complete control, therefore, represents approximately 3.5 per cent of the total.

ORGANIZATION.

The organization of the State highway department and the relation between the State and local forces is shown in the accompanying diagram and is briefly described as follows:

State.—The State highway commission consists of 12 nonsalaried members appointed by the governor, one from each of the 12 districts into which the State is divided for this purpose. Three are appointed each year for a term of four years and no more than six members are to be of the same political party. They elect biennially from their membership three members to act as an executive com-

mittee, one of whom is designated as president of the commission and chairman of the committee. This would appear to be a rather cumbersome organization, but it is evidently the intent of the law to have the commission handle questions of policy while the committee is to act for the commission in an executive capacity. This committee meets each month to let contracts and transact other business. It employs all engineering and clerical assistants. No State highway engineer is provided for by law, but a chief engineer at a salary of $3,600 and a bridge engineer at a salary of $3,500 and other engineers at salaries ranging from $2,400 to $3,000 per annum have been appointed by the executive committee.

The commission may have State highways constructed and maintained by its own engineers, or it may have the work done by local authorities under State supervision, and in accordance with rules and regulations issued by the commission.

Local.—The board of county commissioners is vested with general supervision over all roads except those designated as State highways and even State highways may remain under county control if the State authorities so elect. The county boards are composed of three members, one being elected biennially for a term of six years. They may employ a competent road builder to supervise all county work or they may direct the county surveyor to do this, and may divide the county into districts and appoint supervisors in charge of each.

Special districts may be established in a county and a board of directors consisting of three members may be elected for each district. The directors appoint a supervisor under whose immediate control all roads in the district are constructed or repaired. The boards of county commissioners continue to exercise the power to lay out and construct new roads in such districts and may appoint a county road superintendent with whom the district supervisors must cooperate.

Assessment districts may also be organized for the improvement of main highways. The work in such districts is handled by the county surveyor and the supervisors in whose district they are located.

CLASSIFICATION, CONTROL, AND PROCEDURE.

The public roads of Montana, comprising approximately 39,200 miles, are for the purpose of fixing responsibility for construction, control, and maintenance divided into three groups, namely, State highways, main highways, and common highways. About 800 miles or 2 per cent of the total have been surfaced.

State highways.—These are designated by the State highway commission and are improved and maintained under its direction with State, Federal, and local funds. The commission has designated 2,400 miles as constituting this system, but so far no improvements have been made under the new commission. Between 1913 and 1916 about 180 miles of earth and gravel roads were improved under the old commission, largely by the use of convicts.

The procedure as to the making of surveys, the preparation of plans, specifications, and estimates, and the supervision of construction and maintenance of State highways has not as yet been definitely worked out under the new commission. This work may be done by the State forces or by local forces under State supervision. All contracts, however, must be let by the executive committee of the State highway commission and if the work costs over $1,000 it must be by competitive bidding. There is nothing in the State highway law to indicate how the maintenance of State highways will be handled or how the cost of maintenance will be paid.

Main highways and common highways.—These constitute all roads in the State not included in the State system. Main highways are improved at the joint expense of the county and assessment districts. The district must pay not less than 35 per cent and may pay as much as 75 per cent of the cost, the county paying not to exceed 65 per cent of the cost. All land within 2½ miles of a main highway may upon petition of two-thirds of the land owners abutting on it constitute an improvement district and the cost aside from the county's share may be assessed by zones. Zone 1 embraces all land within one-half mile of the road on both sides and ends, zone 2 embraces all land 1 mile in width outside of zone 1, and zone 3 embraces all land 1 mile wide outside of zone 2. Of the district's share, 45 per cent is assessed against property in zone 1, 35 per cent to zone 2, and 20 per cent to zone 3. Surveys and estimates are made by the county surveyor and contracts are let or the work done by the supervisors in whose supervisory district the roads are located.

Common highways.—These are constructed and maintained under the general direction of the county commissioners and boards of directors in special districts. The immediate supervision of the work may be handled in several different ways, depending upon whether the roads are in regular or special districts. Ordinarily the work is handled by the road supervisor.

REVENUES.

State.—Seventy-five per cent of the net receipts from the licensing of automobiles constitutes the State highway fund, 25 per cent being returned to the counties or origin to be deposited in the general road fund of the county. Two-thirds of the State highway fund is expended by the executive committee of the State highway commission for the support of the State highway department and for the construction and repair and maintenance of State highways and to meet the Federal aid fund. All State funds and Federal funds must be expended on the system of State highways. One-third of the State highway fund is apportioned among the various counties by the commission in accordance with such rules as it may adopt, to be expended under the supervision of the State highway commission. It would seem, therefore, that if 25 per cent of the automobile money is in the first instance subtracted from the total fund and turned over to the counties and if one-third of the remainder is later turned over to the counties, it is apparent that the State has absolute jurisdiction over only 50 per cent of the automobile money. The total automobile fund for the year 1917 amounted to $263,032. If the fund was handled as above indicated, this would give the State jurisdiction over $131,516 for expenditure during 1918, exclusive of balance on hand, which amounted to about $27,000, or a total of about $160,000.

Local.—These revenues are derived from general county taxes and taxes on special and local assessment districts and from bond issues. The general county tax levied by the county commissioners must not be less than 2 mills and not more than 5 mills. There is also a $2 per capita tax on each male person between 21 and 50 years of age. These taxes apply to property and persons outside of cities in which a like tax is levied for streets.

The local fund applied to roads and bridges during 1916 amounted to approximately $3,500,000.

Of the forest reserve moneys received by the State under the act of Congress of May 23, 1908, 66⅔ per cent is apportioned to the various counties in which such forest reserves are situated in proportion to the acreage of such reserves. During 1917 the fund applied to roads amounted to $77,746.

BONDS.

The county commissioners may issue bonds for the improvement of State or main highways, but no indebtedness can be incurred in excess of $10,000 unless authorized by a majority vote of the electors. The indebtedness of a county is limited to 5 per cent of the assessed valuation. Bonds issued for a road improvement district must be paid in 10 years from the date of issue. The total road and bridge bonds outstanding on January 1, 1915, amounted to $2,224,000.

NEBRASKA.

DEVELOPMENT.

State participation in road building in Nebraska is limited to a small amount of State aid to roads and bridges administered by the State board of irrigation, highways, and drainage. The State contributes about 10 per cent of all road and bridge expenditures and exercises supervisory control over nearly 20 per cent of all road and bridge funds, exclusive of Federal aid.

The policy of aiding in the construction of large bridges originated in 1911 when a State-wide tax of one-fifth mill was levied for the purpose of creating a State-aid bridge fund. This tax has been levied each year since that time, and with the proceeds the State has been paying one-half of the cost of construction and maintenance of bridges over 175 feet in length.

The State-aid policy was further enlarged and strengthened in 1917 by providing a 65/100 mill State-wide levy, the proceeds from which will be used for State aid to roads, to be expended, together with Federal aid and local funds, under the direction of the State board of irrigation, highways, and drainage.

The total expenditures by all road forces of the State during the year 1917 amounted to approximately $4,603,400.

ORGANIZATION.

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

State.—The State board of irrigation, highways, and drainage is vested with control over State aid to counties and with supervisory powers over the construction of Federal aid projects. The State board is composed of the governor, the attorney general, and the commissioner of public lands and buildings.

The State engineer, appointed for a two-year term by the board, is their secretary and chief executive official. His salary is $2,500 per annum. The State board may also appoint three persons well versed in road building, who are to act without salary in an advisory capacity and who constitute the advisory board. The State board may also appoint an

engineer who shall be a civil engineer and practical road builder who shall act as secretary to the advisory board and be known as the State highway engineer. The State engineer has been appointed to this position and, therefore, occupies the quadruple position of State engineer, State highway engineer, and secretary to the State board and to the advisory board. Assistants to the State highway engineer are employed by the State board.

Local organization.—County boards are organized either under the county board of commissioners plan or under the county board of supervisors plan. Counties which have a township organization have county boards of supervisors; others have county commissioners. In both classes of counties the general control of all roads under the authority and direction of the county board is vested in a county highway commissioner appointed by the county board. Each county not under township organization is divided into from three to five districts and one commissioner is nominated from each and elected by the voters of the entire county, one being elected biennially. The county commissioners so elected constitute the county board of commissioners and has general supervision over roads and bridges in the county. They divide the county into districts, for each of which an overseer is elected. The road overseers are responsible to the county highway commissioner. Road dragging districts may be established and a superintendent of dragging may be appointed for each district.

The counties under township organization are divided into seven supervisor districts, each district electing a supervisor, the seven constituting the county board of supervisors. This board divides the county into townships. Each supervisor has charge of the expenditure of county funds apportioned out of the county treasury for his district.

Counties under township organization may vote to have township supervisors, in which event one supervisor is elected for each township and the supervisors thus elected constitute the county board of supervisors. The governing body of the township known as the township board, consists of a town clerk, an assessor, and a justice of the peace. Each year the township board selects one of its number as township highway superintendent, to have charge of all township road and bridge work.

CLASSIFICATION, CONTROL, AND PROCEDURE.

The public roads of Nebraska comprise about 80,300 miles, of which about 1,300 miles, or 1.7 per cent have been surfaced. For the purpose of fixing responsibility for construction, control, and maintenance these roads may be divided into three classes, namely, State-aid roads, county roads, and township roads.

State-aid roads.—The designated system of State-aid roads, on which State and Federal funds will be applied, together with local funds, includes about 4,000 miles. After improvement these roads will be maintained by the counties under State supervision.

The State board is authorized to furnish all bridge plans for structures costing over $500 each and to advise with county boards in regard to the building of roads and bridges, and upon request of the county boards to assist in the preparation of plans and in the supervision of work of construction and maintenance. Roads and bridges built or maintained with the aid of State or Federal aid funds must be constructed under the supervision of the State board. The State board has no authority to designate on its own initiative the roads to be constructed with State or Federal aid funds, such power being vested specifically in the county boards. Construction contracts on State-aid roads and bridges are let by the county and State acting jointly.

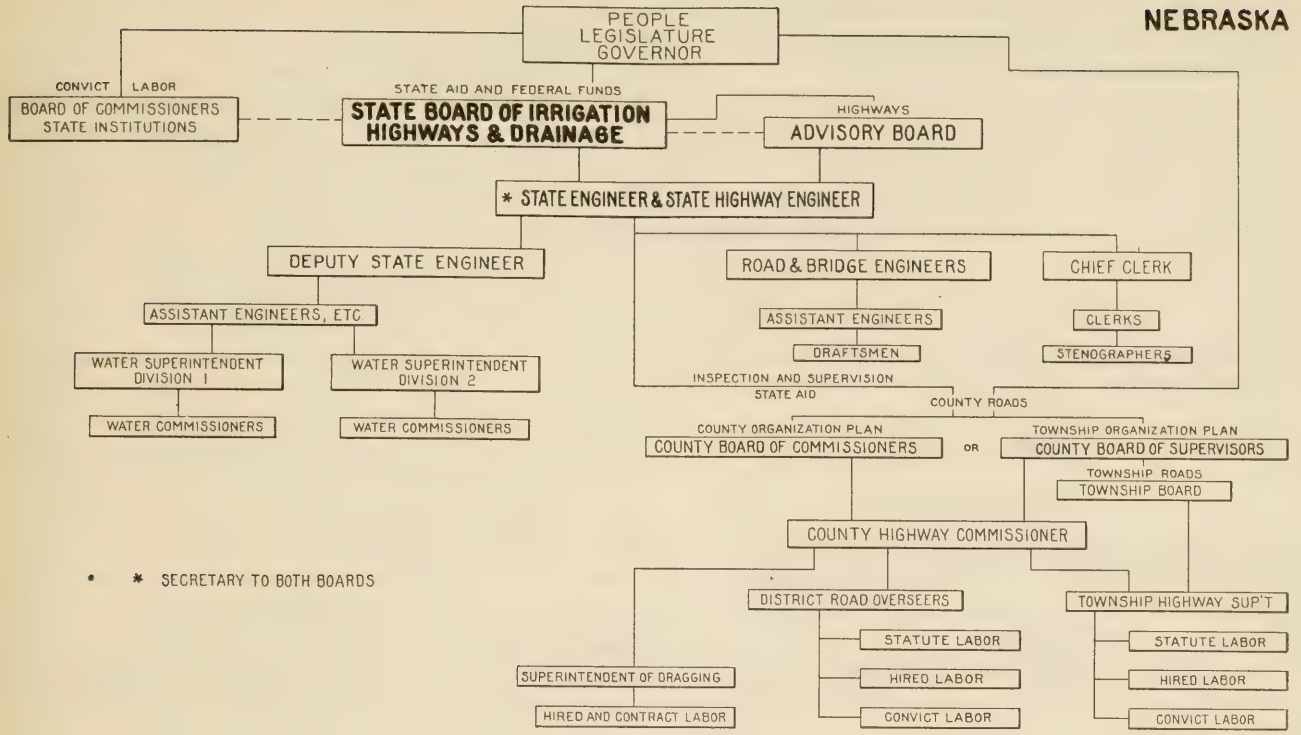
Applications for State-aid on bridges are initiated by county authorities. The State pays one-half of the cost of construction and one-half of the cost of maintenance exceeding $100 per annum on State-aid bridges 175 feet in length and over. The proportion of the cost of construction of State-aid roads to be borne by the State and the counties is not definitely fixed.

County roads.—All roads in counties not under township organization and not included in the State-aid system and to which county funds are contributed, and all roads in counties under township organization to which county funds are contributed may be considered county roads.

Township roads.—All roads in counties under township organization except those to which county or State funds are contributed may be considered township roads.

REVENUES.

State.—A State tax of one-fifth of a mill is levied annually, the proceeds from which are used to aid the counties in constructing and maintaining bridges of 175-foot span and over. A State tax of $\frac{65}{100}$ of a mill is also levied, the proceeds from which are used to aid the counties in constructing roads. Of the one-fifth mill tax which produces about $110,000, approximately $105,000 or 95 per cent of the total raised is available for expenditure. There has been appropriated by the legislature



$320,000 for State aid to roads for each of the years 1917 and 1918. The $\frac{6.5}{100}$ mill tax is expected to raise about $327,500 a year, but any balance over $320,000 a year appropriated by the legislature will accumulate in the State treasury pending further legislative action.

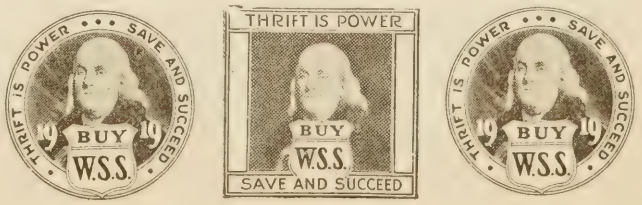
State-aid funds for State-aid roads and bridges, therefore, amount at present to about $425,000 a year. State-aid road money together with the Federal-aid road money is apportioned to the various counties on the basis of area, mileage of post roads, and population, each having a weight of one-third. Project districts each containing not over five counties have been established and all State and Federal funds in each district will be considered as a unit for such district and will be available for expenditure on a single project each year. By this arrangement it will not be necessary to build a road in each county each year, but it is planned to build a road in each county during the five-year period.

Local revenues.—Road and bridge taxes are levied by the county commissioners or the boards of supervisors. The road tax shall not exceed 5 mills and the bridge tax not to exceed 4 mills. The proceeds from inheritance taxes and net receipts from the registration and licensing of automobiles are used for road construction and maintenance. In counties not under township organization, one-half of all the money collected constitutes a county road fund, and is divided equally among the commissioner districts. The other half is apportioned to the districts for expenditure under the direction of road overseers. In counties under township organization, one-half of the road money collected from taxation constitutes the district road fund and one-half constitutes the town road fund.

On petition of a majority of resident freeholders of any road district or township, the county board may levy a tax from not less than 5 nor more than 25 mills on the taxable property of the districts, the proceeds to become a part of the road fund of the district or township. All road taxes must be paid in cash. Any available county funds may be used in the construction or maintenance of State-aid roads, or a special levy of not to exceed 5 mills may be made by the county for this purpose. The local expenditure from all sources during 1916 is estimated at about $4,300,000.

BONDS.

County precincts and townships or cities may issue bonds for the construction of bridges upon three-fifths vote of the electors. When bonds are issued a special tax shall be levied by the county commissioners or boards of supervisors on the county, district, or township as the case may be, the proceeds of which are to be used for the payment of interest on the bonds which must not exceed 7



per cent, and for the creation of a sinking fund with which to redeem the bonds at maturity. Townships and precincts may issue bonds in amounts not to exceed 10 per cent of the taxable valuation for roads and bridges when authorized by a two-thirds vote. In counties having a population of over 20,000 bonds may be issued for the improvement of special roads on petition of property owners and the money to pay the interest and principal on the bonds may be assessed against the lands lying within 2 miles of the road improved. So far as can be ascertained no county, township, or district bonds have been issued.

NEVADA.

DEVELOPMENT.

State participation in road improvement was first manifested in Nevada in 1911 by the appropriation of $20,000 to equip convict camps used under the supervision of the State engineer in the construction of trail roads. The State legislature from time to time designated certain roads as State roads, but placed the burden of construction and maintenance on the counties in which they were located.

State funds were not again made available for road improvement purposes until 1917, at which time the State highway department was organized. A system of State highways was selected and a fund was provided for its improvement under the supervision of the State highway department.

Highway improvement prior to 1917 was almost entirely under the charge of the local officials, and due to the limited travel, soil, and climatic conditions graded and drained earth roads comprised the principal type of construction. However, on January 1, 1917, 320 miles, or 2.6 per cent, of the total road mileage of the State had been surfaced, while 1,800 miles, or 14.8 per cent, had been graded and drained.

During the year 1916 local expenditures for road and bridge purposes amounted to $275,000, no State funds being available for use during this period.

During the year 1917 a total expenditure of $336,796 was made by all road forces of the State for highway purposes. Of this amount $36,796, or 10.7 per cent, was contributed by the State.

ORGANIZATION.

The organization of the road forces of the State and their relation is shown on the diagram.

State.—The department of highways is composed of the board of three highway directors appointed by the governor for terms of three years, and the State highway engineer appointed by the board. Such assistant engineers, clerks, and other assistants as may be required are employed by the State highway engineer at rates of compensation fixed by the board.

The State highway engineer as executive official of the department has full charge of all work in the State road system, general supervision over the expenditure of State funds allotted to the counties for aid in the construction of important local roads, is required to establish standards of construction best adapted to the sections of the State and to advise with and require reports from the various local officials throughout the State.

County.—The county board of commissioners, consisting of three members and in counties with more than 4,000 voters of five members, elected for terms of two and four years, with the county assessor and district attorney, comprise the board of county highway commissioners, vested with jurisdiction over the construction and repair of all county roads. This board may appoint a county road supervisor as its executive official, or on petition of the interested residents the board may appoint a board consisting of one or three road commissioners for each district created by the board. The commissioners thus appointed may subsequently be elected if desired by the residents of the district.

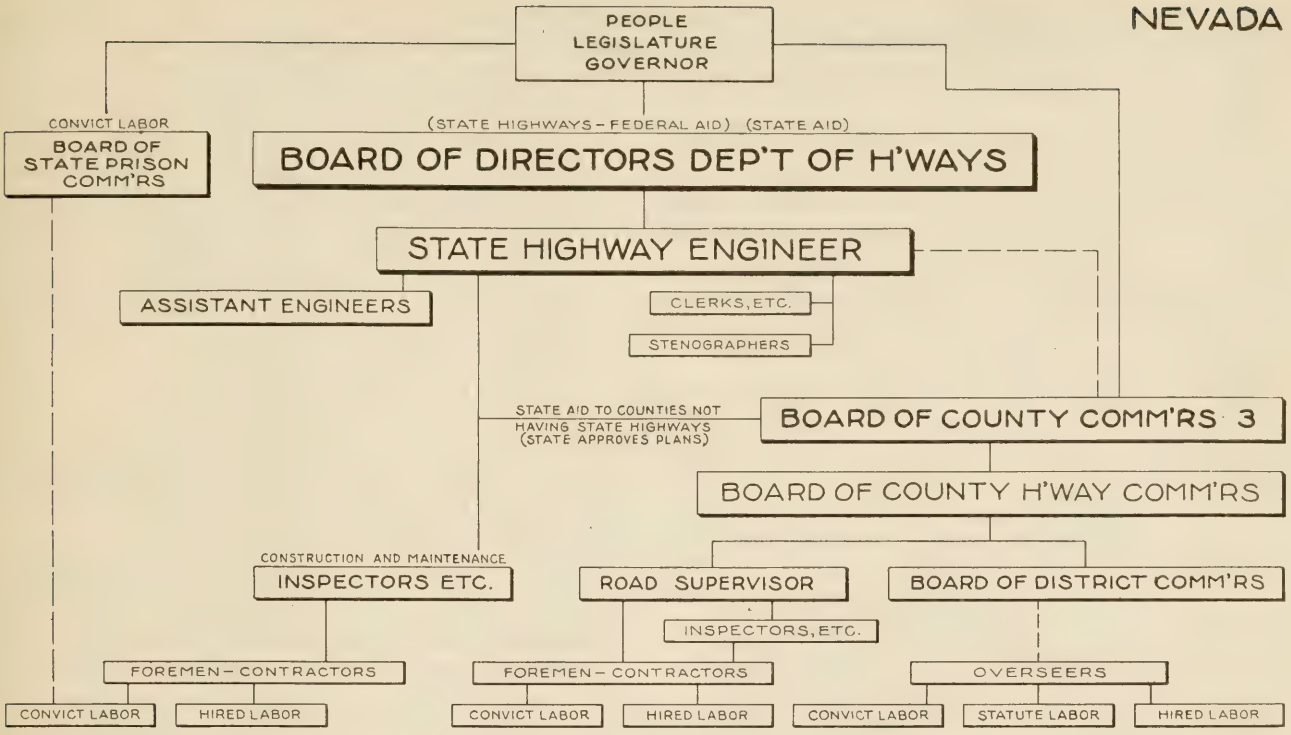
CLASSIFICATION, CONTROL, AND PROCEDURE.

The 12,182 miles of public road in Nevada are, for the purpose of fixing responsibility for control, construction, and maintenance, divided into two groups, viz, State highways and county roads.

The State highways.—These comprise 1,400 miles of road selected by the State legislature for improvement under the supervision of the department of highways with Federal and State funds. All surveys, plans, specifications, etc., are made by the department and approved by the United States Secretary of Agriculture, if the use of Federal funds is contemplated. Construction may be executed by convict labor under the supervision of the department, or the work may be let through contract by the department. During progress the work is under the supervision of the inspector assigned by the State highway engineer.

Monthly payments covering 85 per cent of the completed work may be authorized by the State highway engineer, the claim for which, however, must be approved by the State board of examiners.

Final payment covering all remaining balances is made in a similar manner when the completed



work has been accepted by the State highway engineer or his representative.

Completed roads of this group are administered and maintained by the department of highways at State expense.

County roads.—All other public roads of the State are classed as county roads and are further subdivided into main county roads and general county roads, according to the amount of travel thereon. When a road of either classification is improved, it is known as a standard county road. It is intended to improve the roads of each county in the order of the amount of travel sustained. Improvements are made under the order and direction of the county board of highway commissioners. However, when State-aid funds are utilized, the department of highways prescribes standards of construction to be followed. Plans and specifications are required for all improvements costing $500 or more, and the use of perishable materials for bridge and culvert construction, while not entirely forbidden by law, is restricted to temporary or emergency repairs.

Whenever the estimated cost of improvement is $500 or more, the county board of highway commissioners is required to advertise for bids. The bids may be rejected and the work done by day labor, or the contract may be let.

The State highway engineer may, on request of the county board, take charge of and supervise any county work.

Completed roads of this group are maintained by county officials at county expense.

REVENUES.

The State highway fund for the year 1917 was composed of an appropriation of $40,000 made by the legislature; the proceeds of the $\frac{7}{10}$-mill State-wide tax, which produced $128,509.63; the net proceeds of the motor-vehicle tax collected in counties in which sections of the State highway are located amounted to $25,000; one-sixth of the net proceeds received by the State racing commission from the sale of parimutuels, which amounted to $11,365.16; making a total of $207,728.14. Also from the automobile road fund there was the sum of $12,853.35 collected in previous years from automobile licenses.

In addition thereto about $117,331.14, which comprised the county State highway fund, was raised by a $\frac{7}{10}$-mill tax levied by the counties in which were located sections of State highways. This fund, combined with Federal or State funds, is expended by the department of highways on the State highway system and can be used for no other purpose.

The State highway fund is available for the support of the department of highways, the construction of highways and their maintenance, and for allotment of State aid to counties not having State highways in their borders. The State aid thus allotted to counties consists of the amount contributed to the State highway fund by reason of the $\frac{7}{10}$-mill State-wide tax less the proportionate share of the overhead of the department of highways, and an additional sum equal to the county's share of the Federal aid allotted to the State.

County.—The counties in which no State highways are located are entitled to a refund of the net

motor-vehicle license fees paid by the residents of the county. Such fees are credited to the auto road-repair fund available for expenditure by the county board.

A general county road tax at a rate not exceeding one-fourth of 1 per cent may be levied by the county board and expended in the various districts in which collected. A special tax at a rate not exceeding 30 cents on $100 valuation may, on petition of a majority of the property owners of the district, be levied on all taxable property in the district. This tax may be paid in labor.

A poll tax at the rate of $3 is levied on all male inhabitants between the ages of 21 and 60. The proceeds of this tax are expended in the districts in which collected.

BONDS.

Counties may, when authorized by a majority vote of the electors of the county, issue serial-type bonds for a term not exceeding 40 years in amounts not exceeding 3 per cent of the assessed valuation of the county. The rate of interest is fixed by the county board, but shall not exceed 6 per cent.

There was outstanding on January 1, 1915, a total of approximately $38,000 road and bridge bonds issued by counties.

NEW HAMPSHIRE.

DEVELOPMENT.

State interest and participation in road construction and maintenance has been a permanent policy since 1903, is extended to a system of State highways, trunk-line highways, and to State-aid roads, and is administered by a State highway department.

State participation began in 1903 with the appropriation of funds for special projects. However, in 1905 steps were taken to designate and assist in the construction of a system of State roads, and since that date State assistance has been granted each year.

In addition to the construction of roads which are, in general, of State importance, provision has been made for State aid in the construction of important local roads.

On January 1, 1917, 1,900 miles, or 13.5 per cent of the total road mileage of the State, had been surfaced. Sixty-seven and five-tenths per cent, or 1,280 miles, of this improved mileage had been constructed under the State highway or State-aid plan.

During the year 1916, $414,669 of State funds and $430,742 of local funds were expended by or under the supervision of the State highway commission. The total expenditures during the year by all forces, State and local, reached $2,045,410. The State thus contributed 21.4 per cent and exercised supervision over 41.3 per cent of all expenditures.

During the year 1917 the total expenditure by all forces reached $2,240,000.

ORGANIZATION.

The organization of the State for highway control, the State highway department, the local units, and the relation between State and local officials is shown in the chart given.

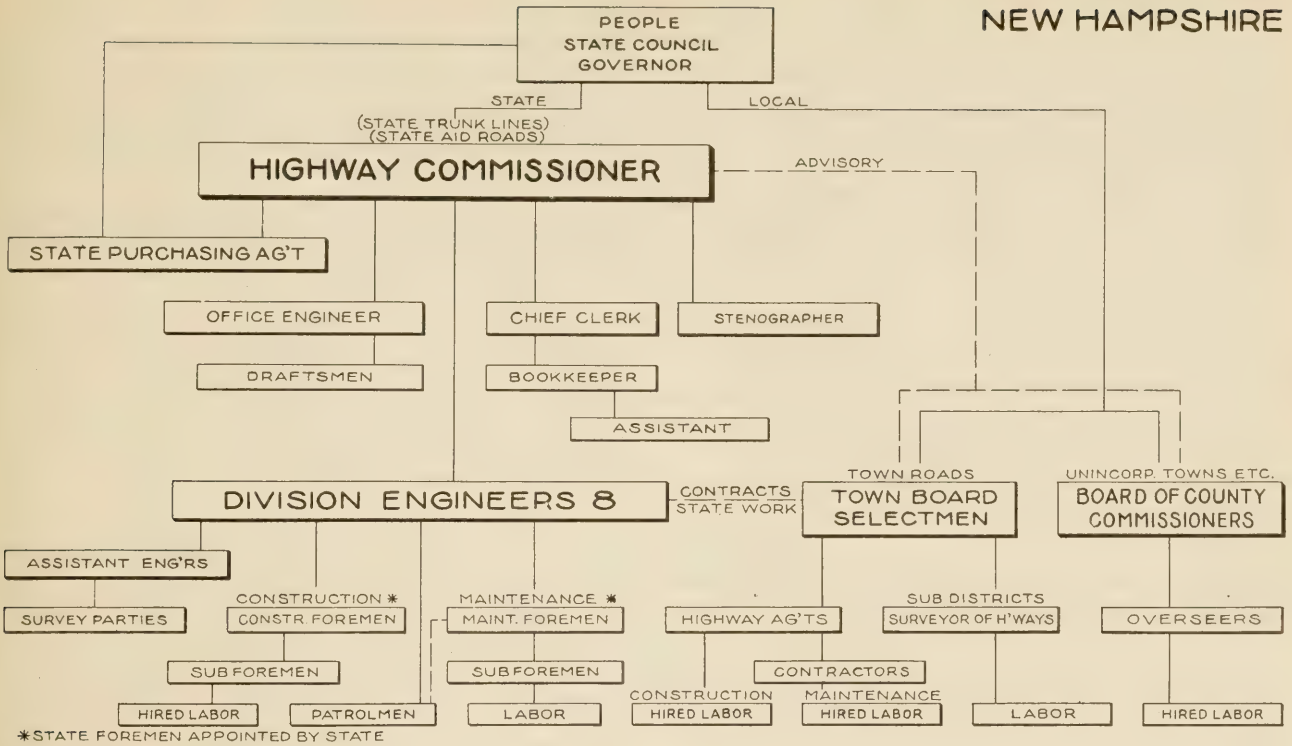
State.—In charge of State work on either the State trunk lines or State-aid roads is a State highway commissioner appointed by the governor for a term of five years. He is required to be a competent road builder and is executive head of the department and technical head of the engineering forces. The staff consists of technical and clerical help outlined in the chart. For purposes of control he has divided the State into eight divisions with a division engineer in charge of each. Each division engineer is assisted by the necessary surveyors and inspectors, and he appoints construction and maintenance foremen, with the approval of the commissioner for trunk-line and State-aid work. Most of the work is done by force account or day labor, although the work can be let on a contract basis according to law. Foremen are usually paid annual salaries to keep them available for continuous service.

Town.—Authority over road and bridge affairs in organized towns is vested in a board of selectmen elected annually at the town meeting. The board selects from one to three highway agents who supervise and execute construction and maintenance of town roads, or the town may be divided into districts each under the charge of a surveyor of highways appointed by the board. The affairs of towns not organized are administered by the county board of commissioners.

CLASSIFICATION, CONTROL, AND PROCEDURE.

The 14,020 miles of public roads in New Hampshire are divided for the purpose of fixing responsibility for control, construction, and maintenance into four groups, namely, State highways, trunk-line or cross-State highways, State-aid highways, and town roads.

State highways.—These comprise 135 miles of highway selected by the legislature to be constructed



and maintained at State expense under the direction of the State highway commissioner.

Trunk-line or cross-State highways.—These comprise about 584 miles of road selected in a general way by the State legislature, the details of location being left to the State highway commissioner. Such roads are constructed by the State highway department at State and town expense, the towns contributing in general 50 per cent of the cost, although the poorer towns may be permitted by the commissioner to contribute a lesser percentage. Roads of this group are maintained by patrolmen under the supervision of the State highway department, and are paid with local funds and State funds derived from the registration of motor vehicles. All construction work on State highways and trunk-line or cross-State highways is under the charge of the State highway commissioner. Contracts are let for work involving the expenditure of $1,000 or more, while force account labor is used on work of lesser amount.

State-aid highways.—These comprise 671 miles of important local roads selected by joint agreement between the State highway commissioner and the county or town boards. Such roads are improved by the towns under State inspection and supervision, the cost of the work being borne as follows: One-sixth to three-fourths of the total cost is paid by the State, the percentage being dependent on, and inverse to, the assessed valuation of the towns affected. State aid may not be expended on local roads until the existing mileage of trunk-line or cross-State highways in the towns concerned has been improved.

Improved roads of this group are maintained in a manner similar to that described under trunk-line and cross-State highways.

Town roads.—These comprise all other roads of the State. They are constructed and maintained by town forces at town expense.

REVENUES.

State funds.—The State funds for highway improvement are provided by legislative appropriation and for the year ending August 31, 1918, the following amounts are available:

1. For the support of the State highway department, maintenance of State highways, maintenance of trunk-line and cross-State and State-aid highways, $450,000. Of this amount $350,000 will be collected from motor-vehicle licenses and will be disbursed as follows: Thirty-five per cent to the State-aid roads, 65 per cent to trunk-line and cross-State highways.

2. For construction of trunk-line and cross-State highways and to meet Federal-aid funds, $200,000.

State funds for State-aid purposes, either trunk-line or cross-State highways, and State-aid highways are apportioned among the towns as follows:

1. To towns of $100,000 or less assessed valuation, $3 for each dollar appropriated by the town.

2. To towns of more than $100,000 and less than $250,000 assessed valuation, $1.25 for each dollar appropriated.

3. To towns of more than $250,000 and less than $1,000,000 assessed valuation, $0.60 for each dollar appropriated.

4. To towns of more than $1,000,000 and less than $3,000,000 of assessed valuation, $0.25 for each dollar appropriated.

5. To towns of more than $3,000,000 assessed valuation, $0.20 for each dollar appropriated.

The towns are required to contribute to this fund in the following ratios:

1. Towns with an assessed valuation of less than $2,000,000, $1 for each $1,000 of valuation.

2. To towns of more than $2,000,000 and less than $3,000,000 assessed valuation, $0.75 for each $1,000.

3. Towns of more than $3,000,000 and less than $5,000,000 assessed valuation, $0.50 for each $1,000.

4. Towns of more than $5,000,000 and less than $15,000,000 valuation, $0.33⅓ for each $1,000.

5. Towns of more than $15,000,000 valuation, $0.25 for each $1,000.

Town.—In addition to the contribution to the State-aid fund town funds are raised by a tax levied by the town board. This tax may not be less than one-fourth of 1 per cent of the assessed valuation and may not produce a fund in excess of $50 per mile of road in the town.

BONDS.

On September 1, 1914, there was outstanding a total of $675,000 of State highway bonds. These are of the deferred serial type, fall due between 1915 and 1924, and bear interest at 3 and 3½ per cent.

NEW JERSEY.

DEVELOPMENT.

From the standpoint of State participation in road work New Jersey was the pioneer in point of time. It deserves the distinction of being the first State to adopt the principle of State aid, but it was not until 1917 that a State highway system was established. At present the State has absolute control over approximately 4.5 per cent and supervisory control over the maintenance of 21 per cent of the total road mileage of the State. The first actual appropriation for State aid was made in 1892, and amounted to $75,000, but during the fiscal year, November 1, 1917, to October 31, 1918, the State funds available for construction and maintenance of State and State-aid roads amounted to over $5,500,000.

When the State-aid plan was first adopted the initiative for State-aid work was vested with local authorities. Contracts were let by local authorities while the general inspection and supervision was vested in State authorities. In general this plan still obtains so far as State-aid work is concerned. At present about 2,100 miles have been constructed through the aid of the State. The contributions from State funds have amounted to about $9,500,000. The first State-aid law provided that abutting property owners pay 10 per cent of the cost, the State one-third and the county the balance. In 1902 the law was so changed as to provide that no part of the cost was to be assessed against the abutting property except in the form of regular taxation.

The urgent need for a connected system of State highways over which the State could exercise absolute control was met by the establishment in 1917 of a State highway system to be improved and maintained entirely at State expense. During 1916 the highway department expended $1,167,843 of State funds for construction, maintenance, administration, and engineering on State-aid roads, while $2,616,511 was expended by local authorities for the same purpose. In addition to this the local authorities expended about $2,000,000 for local road purposes.

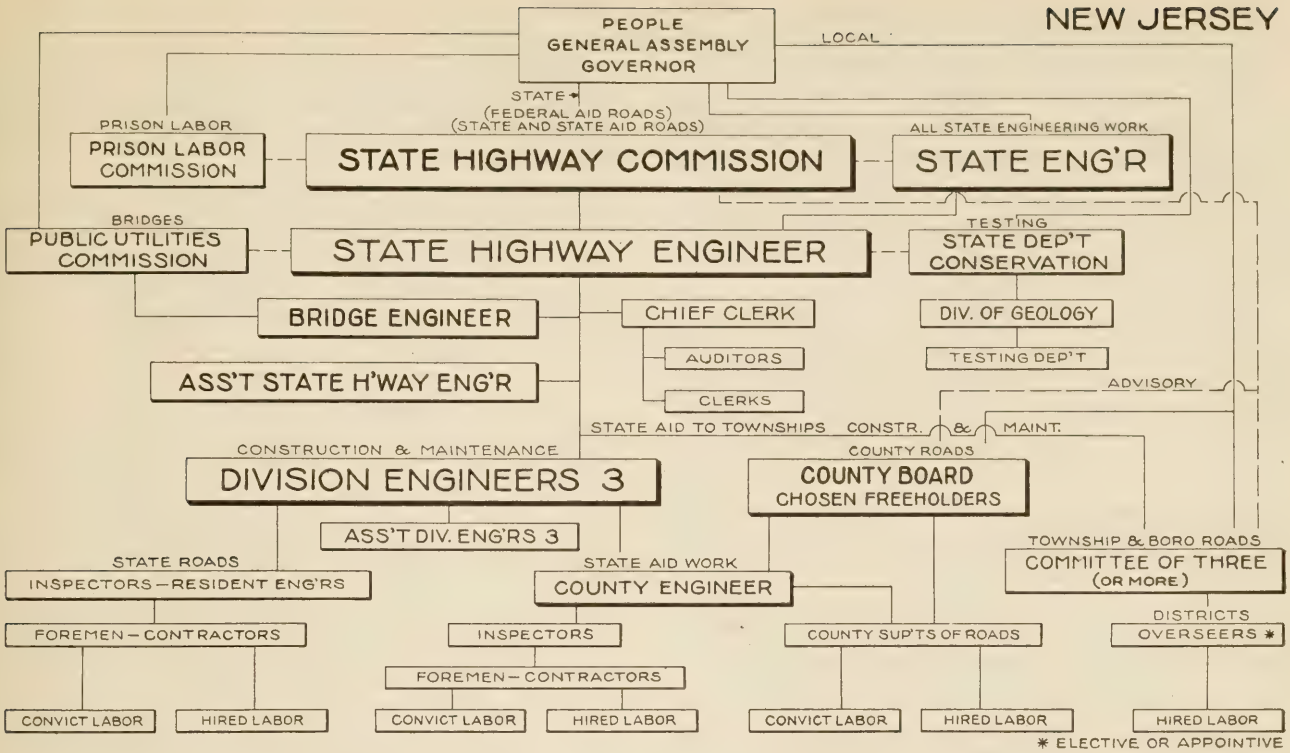
During 1917 the total expenditures by all forces reached $6,280,000.

ORGANIZATION.

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

State.—The State highway department is controlled by a board known as the State highway commission. It is composed of the governor, ex officio member, and eight members appointed by the governor. Two of the commissioners must be civil engineers and all serve without salary. It is a continuous body, two members being appointed each year for terms of four years. The State engineer, appointed by the governor and whose salary is fixed by the State house commission, acts in an advisory and supervisory capacity to the highway department.

The chief executive officer of the department is the State highway engineer, who must be a qualified and competent engineer, skilled and experienced in road construction and maintenance. He is elected by the commission for a term of five years, and his compensation is fixed by the commission. The commission also elects and fixes the compensation of an assistant State highway engineer, whose qualifications and term of office are the same as the State highway engineer. The commission or the State highway engineer, or the assistant State highway



engineer, subject to the approval of the commission, appoints and fixes the compensation of such other assistants and employees as may be necessary. Such assistants and employees are appointed and hold office in accordance with civil service procedure.

Under the State highway engineer there are three division engineers. Resident engineers and inspectors handle the State road work, while county engineers handle the State-aid work. These officials report to the State highway engineer through the division engineers.

The commission has full control and direction of construction and maintenance of State highways and the elimination of grade crossings thereon. It may acquire rights of way by condemnation, purchase, or donation. It may acquire toll roads or bridges. It provides standards to which all State-aid roads must conform. It has general supervisory powers over State-aid construction and maintenance. All State and State-aid bridge work is under the general supervision of the bridge engineer of the public utilities commission, who, in addition to his duties with this commission is the head of the bridge division of the State highway department.

Local.—The boards of chosen freeholders have charge of the construction and maintenance of county roads and cooperate with the State highways department in the construction and maintenance of State-aid roads. The members are elected by the people for terms of three years and draw a per-diem allowance for the time actually employed. This body is responsible for the levying of road taxes and for the payment of accounts incurred in the construction and maintenance of county roads and the counties share of State-aid roads. County engineers may be appointed by the boards of chosen freeholders usually for terms of 5 years. County engineers have charge of engineering, construction, and maintenance of county roads and cooperate with the division engineers of the State highway department in the construction and maintenance of State-aid roads in their respective counties. When engaged on State-aid work the salary of the county engineer is paid by the county and State jointly. The county supervisors of roads, appointed by the county board of chosen freeholders, have immediate charge under the county engineer of maintenance of county roads in their respective counties. The township's road work is carried on by an elective committee of three or more members and an overseer who is elected by the people, or appointed by the township committee for each district in each township.

CLASSIFICATION, CONTROL, AND PROCEDURE.

The public roads of New Jersey, comprising about 14,800 miles, are for the purpose of fixing responsibility for construction, control, and maintenance, divided into four groups; namely, State highways, State-aid roads, county roads, and township roads.

State highways.—A system of State highways, embracing 15 routes and including 660 miles, was designated by an act of the legislature approved March 13, 1917. These roads are to be laid out by the State highway commission, and are to be con-

structed by contract or with prison labor of granite, asphalt or wood blocks, asphalt or other durable material. The State will have absolute control of construction and maintenance and will pay the entire cost of construction from the 1 mill State-road tax. The maintenance costs will be paid from the automobile fees fund and from such other State funds as may be available. The State may take over any public road on the State highway system and pay the entire cost of maintenance.

State-aid roads.—These are roads constructed and maintained with joint funds provided by the State, counties, and townships. Petitions for State-aid originate with the county boards of chosen freeholders or with township committees. Petitions are passed upon by the State highway commission. Surveys are made by county engineers with State approval and at the joint expense of the State and counties. If petitions originate with townships, the surveys are made and paid for by the State. The final approval of plans, specifications, and estimates rests with the State highway commission. The contracts are awarded by the boards of chosen freeholders or township committees on approval of the State highway commission, or the work may be done by day labor. Immediate supervision of construction and maintenance rests with the county or township subject to general inspection and supervision by the State highway department.

Payments up to 80 per cent of work done are made by the State and counties on engineer estimates as the work progresses. When final payment is made, 5 per cent of the total estimate is withheld for one year from date of acceptance as a guarantee. The State pays 40 per cent of the cost of construction, but townships may contribute 10 per cent, in which event the county pays 50 per cent. If the petition for State-aid originates with the township, the State may pay 50 per cent of the cost and the township 50 per cent. The State pays 20 per cent of the cost of bridges, when constructed in conjunction with State-aid roads.

State-aid roads are maintained by the counties or the townships at joint expense, usually 50 per cent by the State and 50 per cent by the county or the township. The State may compel proper maintenance by withholding future allotment of State aid. Up to January 1, 1917, a total of 2,112 miles of State-aid road had been constructed, while 2,487 miles were classed under the State-aid system for the purpose of maintenance.

County roads.—These are constructed and maintained entirely at county expense. There are about 2,400 miles of county roads in the 21 counties of the State.

Township roads.—These roads are constructed and maintained by the townships and include all other roads in the State not included in the above groups, except roads in boroughs, villages, cities, and towns. There are also about 12 miles of toll roads in the State.

STATE REVENUES.

In March, 1917, the legislature provided a five-year State-road tax of 1 mill, the proceeds from which are to be used at the discretion of the State highway commission for the construction of State highways.

An annual appropriation is made for State aid and for the administration of the highway department, out of which the State pays 40 per cent of the cost of State-aid roads, the counties or townships paying the balance. This money is apportioned at the discretion of the State highway commission.

The net receipts from automobile fees fund are used principally for the maintenance of State-aid roads, the State ordinarily paying 50 per cent of the cost. These funds are apportioned at the discretion of the State highway commission, usually on the basis of mileage, traffic, population, and assessed valuation. Annually there is set aside $105,000 from the automobile money, $5,000 for each county for State aid in construction and maintenance of selected township roads.

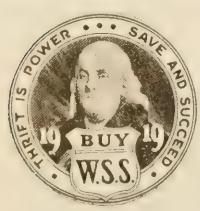
In 1917 the legislature made an appropriation for the maintenance of State prisoners used on State highways.

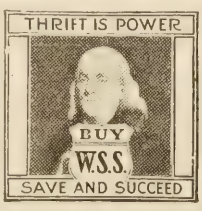
The State revenues available for the fiscal year November 1, 1917, to October 31, 1918, are estimated as follows:

State tax for construction of State highways	$3,000,000
Appropriation for administration and State aid	500,000
Automobile fees funds for maintenance and State aid to townships	2,000,000
Appropriation for maintenance of State prison labor	75,000
Total	5,575,000

LOCAL REVENUES.

It is impossible to say how much will be expended during the current fiscal year by counties or townships, but as the expenditures were approximately $4,600,000 during 1916, including $2,600,000 contributed to meet State aid, it is safe to say that the expenditures during 1918 will at least equal that amount.





BONDS.

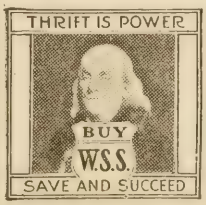
No State bonds have been issued for road improvement. Counties and townships are authorized to issue bonds for road and bridge construction. The limit of the indebtedness is 2 per cent of the assessed valuation for counties and 7 per cent for townships. For township bonds a referendum vote is provided for in case taxpayers representing 10 per cent of the assessed value of the property in the townships sign a petition for them. County boards of chosen freeholders may issue bonds without a referendum vote. The terms of all bonds are limited to the probable life of the improvement for which the bonds are issued as follows: For stone, concrete, and iron bridges, 30 years; for roads built of concrete 6 inches thick or of blocks of any material, or sheet asphalt laid on concrete foundation, 20 years; for bituminous concrete construction, 15 years; for water-bound macadam surfaced with bitumen, 10 years; and for gravel, 5 years. The law also provides that all bonds be paid off by the deferred serial method, the first payment commencing not more than two years from the date of issue. County and township bonds outstanding November 30, 1914, amounted to $14,011,000.

NEW MEXICO.

DEVELOPMENT.

State aid to road construction in New Mexico is extended by the terms of new legislation enacted in 1917 to a system of State roads to be constructed with Federal or State funds combined with local funds, and is administered by a State highway commission. State aid in New Mexico antedates statehood, as for a period of several years the Territorial legislature provided funds at irregular intervals for aid to various local road projects. In 1909 a Territorial highway commission was authorized, and additional legislation affecting the powers and duties of this body was enacted in 1912, in 1915, and again in 1917.

A system of State roads comprising a total mileage of 6,250, or 52.5 per cent, of the total mileage of public roads in the State, has been selected for improvement under the direction of the State highway commission. Funds for the State's share of the cost of this work are provided by means of a Statewide tax and a portion of the motor-vehicle revenues.



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On January 1, 1917, 550 miles, or 4.6 per cent, of the total road mileage of the State were reported as surfaced, and a total of 846 miles, or 7.1 per cent, was reported as improved, the improvements having been carried out mainly under State supervision.

The total expenditures during the year 1916 for road and bridge purposes reached $828,952. Of this amount, $385,685 of State funds and $43,267 of local funds were expended by or under the supervision of the State highway commission. Thus the State contributed 46.5 per cent and supervised the expenditure of 52 per cent of the total.

During the year 1917 a total of $846,000 was expended by all forces.

ORGANIZATION.

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

State.—The State highway commission, a bipartisan continuous body composed of three members appointed by the governor for terms of six years, is at the head of the highway improvement work of the State. The State highway engineer appointed by the commission is the administrative and executive official in charge of all work instituted under the direction of the commission. He is required to advise with county officials relative to local improvements and to require reports and statistics from such officials. The State engineer has been appointed State highway engineer and receives in addition to his regular salary as State engineer $1,000 per year as additional compensation. The State highway engineer, subject to the approval of the State highway commission, is required to select the roads upon which State and Federal funds may be expended, and in cooperation with the county boards he may let contracts for such improvements. The State highway commission is required to appoint a county highway superintendent for each county in the State, or, in the discretion of the commission, a superintendent may be appointed for two or more counties. The State highway engineer with the approval of the commission appoints such assistants, clerks, etc., as may be required.

The State highway commission and the State highway engineer have, in general, the power to select the location of and to initiate improvements and to supervise the maintenance thereof when completed.

County.—Road and bridge affairs are administered by county boards of commissioners consisting of three members elected for terms of two years each. The county clerk and county treasurer are, respectively, clerk and fiscal agent of the board. The county highway superintendent selected by the

State highway commission serves as the executive official of the board in all road and bridge construction and maintenance instituted under its direction. Such foremen, assistants, etc., as may be required are employed by the superintendent with the approval of the county board. Thus the road forces of the county are under the complete control of the county superintendent of highways, who in turn is responsible to the State highway commission. All purchases involving amounts of $50 or more made by the county superintendent for supplies or materials require prior authorization therefor by the county board.

CLASSIFICATION, CONTROL, AND PROCEDURE.

The 11,873 miles of public road in New Mexico are divided for the purpose of fixing responsibility for control, construction, and maintenance into two general groups, namely, State roads and county roads.

State roads.—These comprise about 6,250 miles of road selected by the State legislature for improvement under the direction of the State highway commission. This system may be modified or extended at the discretion of the commission.

Improvement of sections of this system may be initiated by the State highway commission or by the county board. Surveys are executed, plans and specifications are prepared by the State highway engineer, and submitted to the State highway commission for approval. If the estimated cost of the work is less than $1,000, the work may be done by the county or by the State highway engineer by force account or by convict or prison labor. If the estimated cost exceeds $1,000, bids are requested by the State highway engineer and contract may be let by him with the approval of the State highway commission, and the county board concerned, or the bids may be rejected and the work completed by force account or convict labor. All work on roads of this group is executed under the supervision and inspection of the State highway engineer. Monthly payments covering 85 per cent of the completed work as evidenced by the engineer in charge of the work may be made on order of the State highway engineer. Final payment is made when the completed work has been accepted by the State highway engineer. The cost of the work may be paid from Federal and State funds, or from Federal or State funds and local funds. The local contribution in no case may exceed 50 per cent of the total cost of the work, and the State highway commission has no authority to compel any county to participate in such construction.

Maintenance of the completed roads of this group is executed by the State highway commission at State and county expense, the cost being shared equally.

County roads.—All other public roads of the State are classed as county roads and are improved and maintained at county expense by the county board. However, county boards may enter into agreement with the United States Secretary of Agriculture for the improvement of roads and trails within or near the boundaries of Federal Forest Reserves.

REVENUES.

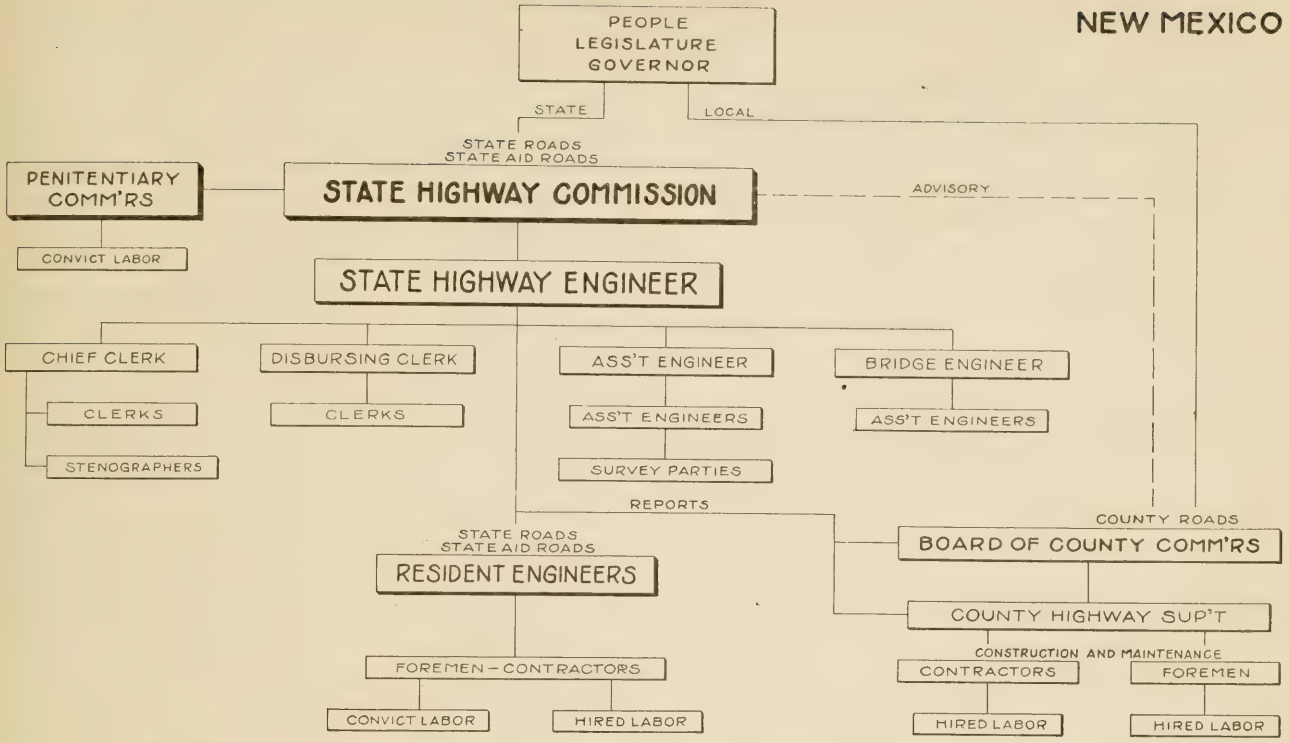
State.—State-road fund is composed of the proceeds of the State-wide one-mill tax estimated at $280,720 for 1917, and one-half of the net revenues of the motor vehicle license fund estimated at $54,970, or a total for the year of $335,690.

From this fund an amount sufficient to provide for the needs of the State highway department is deducted. From the remainder a further deduction of not less than 20 per cent of the original fund is set aside for maintenance of State roads. The amount then remaining suffers a further deduction of an amount equal to the Federal aid fund allotted the State. A further deduction is set aside to pay the interest and principal of any certificates of indebtedness issued in anticipation of the collection of the State-road fund and 75 per cent of the remainder is allotted to the various counties of the State in proportion to the assessed valuation of the property therein exclusive of the property within the limits of towns containing 2,000 or more inhabitants, as shown by the latest Federal census. Funds thus allotted and not applied for by the counties become available the succeeding year for reallotment. Money thus allotted to the county must be met by an equal amount of local funds, the combined sum to be expended on the State roads of the county.

County.—The boards of county commissioners may levy for State-aid purposes a tax at a rate not exceeding 2 mills on each dollar of assessed valuation. They may levy for bridge purposes a tax at the rate of 1 mill and for general county purposes a tax at a rate not exceeding 3 mills. Several counties of the State have been directed by the legislature to levy special taxes in order to raise funds for the construction of State roads lying within their boundaries.

BONDS.

State bonds in the amount of $500,000 have been issued for highway and bridge purposes. These bonds bear interest at 4 per cent, are of the deferred



serial type, and must be redeemed by July 1, 1942. Payment of the principal of this issue began on January 1, 1919.

Counties may, when authorized by a majority of the voters thereof, issue sinking-fund bonds in such amount which when combined with other outstanding indebtedness will not exceed 4 per cent of the assessed valuation of the county. The interest rate may not exceed 5 per cent and the term of the bonds may not exceed 30 years.

On January 1, 1915, there was outstanding $157,000 of county bonds.

NEW YORK.

DEVELOPMENT.

New York was the fifth State to adopt the principle of State participation, the original State-aid law having been adopted in 1898. The first State appropriation amounted to only $50,000, and the control exercised by the State was relatively meager. Since 1898 the control of the State has been gradually extended. The State organization has been strengthened and enlarged and the State appropriations increased to such an extent that New York now has a powerful centralized State highway department exercising complete control over the construction and maintenance of a State system of highways embracing about 18 per cent of the total road mileage and supervisory control over all other public highways in the State.

Prior to 1898 all roads were built and maintained by the rural tax payers, about 20 per cent of the total population, representing less than 10 per cent of the assessed valuation of the State. At present the whole population and wealth of the State is drawn upon to build and care for the highways.

The Higbie-Armstrong law, passed in 1898, provided that the cost of roads selected by the county and approved by the State should be paid as follows—50 per cent by the State, 35 per cent by the county, and 15 per cent by the abutting property owners, or by the town. The State appropriation for the first year, as above indicated, was $50,000. From this small beginning has grown the present State and county system of highways for which the State appropriated upward of $10,000,000 for construction and nearly half a million dollars for maintenance during the year 1916.

In 1898 there was also adopted what is known as the Fuller-Plank Act, or the money tax law, by which the State agreed to pay one-fourth of the cost of maintaining town roads in towns maintaining a cash system of taxation instead of the previous labor tax system. In 1899 the first State aid distributed to towns under this law amounted to $34,518. This plan of aiding the towns has been gradually broadened and now embraces a certain amount of State supervision and control over all local expenditures, and a graduated system of State aid to towns whereby the State extends a greater amount of aid to the poorer towns than to the richer ones. As a result, practically all town road taxes are now paid in cash and the State fund required to meet the town funds amounts to upwards of $2,000,000 a year.

The New York State highway department has suffered many vicissitudes during its 20 years of existence. These changes have for the most part resulted from political changes in the State administration. The first attempt at systematic care of highways under State supervision occurred when the State engineer and surveyor was placed in charge of the expenditure of all State highway moneys. He continued to direct the work until 1909, when a bipartisan State highway commission was established consisting of three commissioners appointed by the governor. The law of 1909 also provided for the appointment of six division engineers.

In 1911, the organization was again changed by providing for a commission consisting of a State superintendent of highways and two ex officio members, namely, the State engineer and the superintendent of public works. This commission was to serve during the pleasure of the governor and the organization was strengthened by providing for the appointment of two deputies, one to have charge of construction and maintenance of State and county highways, and one to have charge of State aid to towns and bridge work on the highways.

The department was again reorganized in 1913, and the work was placed under the direction of a single commissioner known as the commissioner of highways. The organization has not been materially changed since that date and is described as it exists at present in the chapter on organization.

During 1916, there was expended in New York for roads and bridges $20,901,490, of which $11,400,230 was appropriated by the State. Thus the State paid during that year approximately 54 per cent of the cost of road construction and maintenance of all roads in the State.

ORGANIZATION.

The accompanying diagram shows the organization of the highway department.

State.—At the head of the highway department is a single commissioner assisted by three deputy commissioners, a secretary, and an auditor.

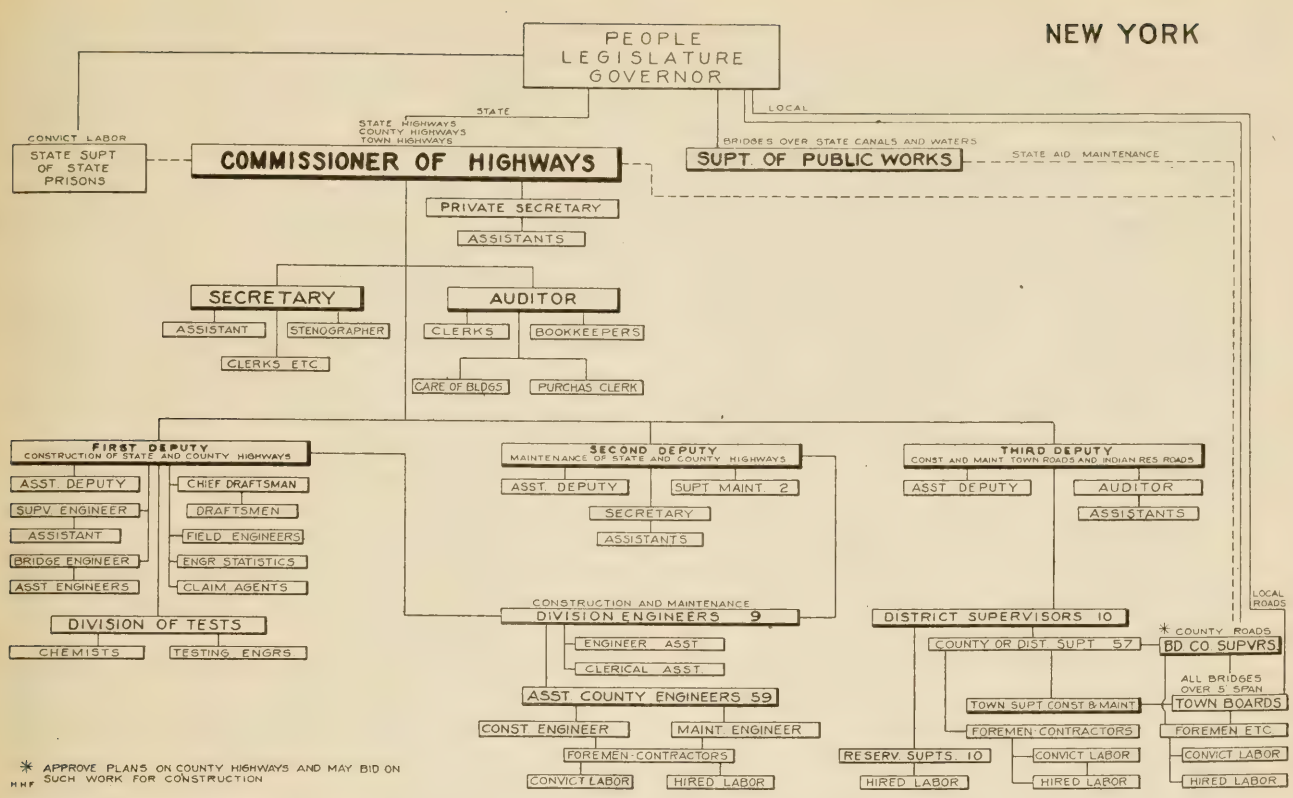
The commissioner is appointed by the governor with the advice and consent of the senate for a term of five years. His salary is $10,000 per annum. He has administrative control over all road and bridge work in the State, constructed and maintained wholly or in part with State funds. He prescribes the rules and regulations fixing the duties of the division engineers, resident engineers, district, county, and town superintendents, and compels all highway officials to comply with the same and carry them into effect. He is virtually, therefore, in control of all highway activities of the State. He selects and appoints the deputy commissioners, the secretary, the auditor, and division engineers. All subordinate officials and employees are selected from the register of eligibles of the civil service commission. The commissioner fixes the percentage which shall be credited by the civil service commission for experience and he fixes the salaries of all officials and employees whose salaries are not fixed by statute. The commissioner works through the heads of bureaus and the division engineers who are immediately responsible to him for results.

The first deputy shares with the commissioner the executive duties of the department, but is essentially the chief engineer in charge of construction of State and county highways. He receives a salary of $6,000 a year and is required by law to be a civil engineer experienced in road building. In the central office under the first deputy there is a resident engineer who assists on general supervision, a supervising engineer who acts as general inspector of construction work, and a supervisor of construction on special work, a bridge engineer and assistants in charge of bridge designs, a chief draftsman, and assistants, field engineers and claim agents. The division of tests which has charge of the physical and chemical testing work of the department is also under the first deputy.

The State is divided into nine divisions, each in charge of a division engineer, who has direct supervision over county assistant engineers relative to construction and maintenance of State and county highways. There are 59 county assistant engineers who report to the division engineers in their respective districts. The county assistants are responsible for both construction and maintenance in their counties, but they are assisted by engineers who are responsible for construction and maintenance, respectively. In addition to the county assistant engineers there are assigned to the division engineers one or more resident engineers who act as assistants to the division engineers, and they may be assigned to special pieces of work.

The division engineers report to the State highway commissioner through the first deputy on construction matters and through the second deputy on maintenance matters. The division engineers have charge of making all surveys, plans, specifications, and estimates in their respective divisions and certify to monthly and final estimates.

Each division engineer is provided with suitable office rooms and the necessary organization properly to carry on the work. Subdivisions of divisional offices are usually about as follows: Surveys, clerical,



construction, drafting, inspection, maintenance, and estimates.

The second deputy has charge of maintenance work on State and county highways. He receives a salary of $5,000 per annum, and is assisted by two superintendents of maintenance—one for divisions 1, 2, 4, and 5, and one for divisions 3, 6, 7, 8, and 9. The divisional work under the second deputy is handled as indicated above.

The third deputy has general supervision over the construction and repair of all town roads, highways in Indian reservations, and all bridge work. He is also required to see that towns conform to the State law and keep uniform financial records and to conduct meetings in the different counties to educate the people on highway subjects. He receives a salary of $5,000 per annum and is assisted by a deputy, who has general charge of office and field forces and the work of district supervisors; also an auditor, who has charge of town highway accounts.

For town highway purposes the State is divided into 10 districts, each of which is controlled by a district supervisor. They are traveling representatives of the third deputy, and audit town highway accounts, inspect work, investigate and report on complaints, and exercise general supervision over county and town superintendents and reserve superintendents. There are also seven superintendents who have charge of road maintenance in Indian reservations.

The secretary of the commission is the chief administrative officer under the commissioner. He receives a salary of $5,000 per annum. The secretary has charge of the divisions of estimates, contracts and permits, filing, correspondence and records, and civil service, and transmits general orders throughout the department.

The auditor has supervision over all financial transactions, purchases, supplies, and the care of office buildings.

County organization.—In each county there is a board of supervisors whose members are elected by a majority vote of the people. They levy taxes and have general supervision of county roads where such roads exist, and of intercounty and intertown bridges, and under certain conditions may take charge of town roads. A county superintendent is appointed in each county by the board of supervisors for a term of four years. If the county supervisors fail to act, the State highway commissioner may make the appointment from the civil service eligible list of the county and fix the salary. The county superintendents may be removed by the State highway commissioner. The county superintendent represents the county in all State and county highway matters in his county and is required to aid the town superintendents on town road work. Their salaries are paid by the counties, but they report to the third deputy of the State highway department through the district supervisors.

Town organization.—There is in each of the 932 towns in the State a town board consisting of at least three members. They are elected each year

at the annual town meeting. Town boards are responsible for the proper construction and maintenance of town roads and bridges and for the removal of snow from State and county highways. In each town there is also a town superintendent, either appointed by the town board or elected by the town for a term of two years. He is in direct charge of the maintenance of all town roads and bridges and is subject to the rules and regulations of the State highway department. The town superintendents receive from $2 to $5 per day for time actually employed, and during 1914 the pay roll of such superintendents amounted to $745,000. They report to the third deputy through the county superintendents and district supervisors.

CLASSIFICATION, CONTROL, AND PROCEDURE.

The public roads of New York, comprising approximately 80,000 miles are, for the purpose of fixing responsibility for construction, control, and maintenance divided into four groups, namely, State highways, county highways, county roads, and town highways. The State and county highways together constitute the State system and the town highways belong to that class of local roads which are aided and supervised by the State. In county roads the interest of the State is slight.

State highways.—These are roads over which the State has absolute jurisdiction and for which it pays the entire cost of construction and maintenance, except that the towns are taxed $50 per mile per annum and villages 1½ cents per square yard for portions of such highways located within their respective corporate limits. The system consists of 3,772 miles and includes 46 routes prescribed by the legislature. Up to the close of the calendar year 1917 there had been completed or under contract 2,621 miles of State highways.

In designating these routes the legislature fixed the termini, the intermediate points, and in some cases the exact location, but in most cases the exact location was left to the State highway commissioner. Bridges and culverts over 5-foot span are not included as a part of the highways and must be provided by the towns. Rights of way must be furnished by the counties.

The highway department is required to arrange for an equal amount of work in each county each year, taking into consideration the mileage of State and county highways already completed, and the mileage which remains to be completed. State convicts may be used by the superintendent of State prisons upon requisition of the State highway commissioner on State and county highways, and, if so used, the State highway commissioner shall compensate the prison department for the use of such convicts at a rate based on the value of the labor performed.

County highways.—These are roads which are constructed by the State at the joint expense of the State and county. The county highway system is designated by the State highway commissioner. At present there are 8,515 miles in the system, of which 5,362 miles were surfaced or contracted for at the close of the calendar year 1917. Although this system has been designated by the State highway commissioner, the initiative for construction lies with the county boards of supervisors. Bridges, culverts, and rights of way must be provided in the same manner as on State highways.

All surveys, plans, specifications, and estimates are prepared by the State, and contracts are let by the State after plans and estimates are approved by the board of county supervisors, but contracts may be let to towns.

The counties pay variable proportions of the total cost of county highways, arrived at as follows: (1) The total assessed valuation is divided by the total mileage of all roads outside of cities and incorporated villages which gives the assessed valuation per mile; (2) the assessment for county highways is 2 per cent of such assessed valuation per mile, provided that the amount paid by the county in any case shall not exceed 35 per cent of the total cost. Thus the county pays from 8 to 35 per cent of the cost, while the State pays the balance. If the boards of supervisors agree, however, the county may pay 50 per cent of the cost. The costs of surveys and engineering are apportioned and paid in the same manner as for construction. Upon completion the roads are maintained by the State, the maintenance cost being paid in the same manner as for State highways.

County roads.—These roads are built at the sole expense of the counties usually from bond issues, and are subject to the jurisdiction of the county board of supervisors. Approximately 1,000 miles of county roads have been constructed. They are maintained by the county, with local funds provided for the purpose.

Town highways.—The town highways comprise all the roads which are outside the limits of incorporated villages and cities and which do not belong to the State and county highway systems or are county roads. The total length of town highways including roads in Indian reservations is 67,125; of this mileage it is estimated that approximately 12,000 miles have been surfaced up to January 1.

1918. Town highways are constructed and maintained at the joint expense of the State and towns, but no State aid is given on bridges and culverts of over 5-foot span.

All construction work costing over $500 may be let under contract awarded by the town superintendent, in accordance with plans, specifications, and estimates furnished by the district superintendent or the county superintendent. All such work is done under the direction of the district or county superintendent. The improvement and repair of town highways, whatever the cost, may be done without letting the work to contract.

REVENUES.

State.—Appropriations are made annually by the legislature for State and county highways and for aid to the towns on town highways, as well as for the maintenance and support of the State highway department. The funds appropriated for the construction of State highways and for the State's share of county highways are derived from State bond issues. Theoretically, one-half of the funds derived from the registration and licensing of automobiles are used for the construction and maintenance of State and county highways, but as a matter of fact the funds are deposited in the State treasury and thereby lose their identity before being appropriated by the legislature. Furthermore, the amounts annually appropriated for maintenance are usually larger than the amounts derived from the automobile registration fees fund.

On March 30, 1917, there was appropriated and made immediately available $4,525,000 for maintenance, repair, and reconstruction of improved State and county highways, of which $4,075,000 was deposited with the various counties and $450,000 as a contingent fund deposited in the State treasury subject to the requisition of the State highway commissioner.

An appropriation was also passed by the legislature and became a law on April 19, 1917, for the following purposes:

For State aid to towns to be distributed on the basis of taxes levied by the towns for repair and improvement of town highways, etc	$1,980,000
For contributions to counties containing Indian reservations to be apportioned on basis of not less than $30 per mile of road	50,000
For construction and improvement of county roads in Franklin County	20,000
Total	2,050,000

In order to receive State aid from the above appropriation, it is necessary for the town to levy a tax to be paid in cash of such amount that when it is added to the contribution by the State it will equal $30 per mile for all roads outside the limits of all incorporated villages and cities. For towns having a valuation of less than $3,750 per mile there has been established a lower requirement, which is $4 per thousand of assessed valuation.

The amount which a town may receive from the State is regulated both by the appropriation of the town for roads outside of incorporated cities and villages, exclusive of bridges and culverts over 5-foot span, and its wealth per mile of road, and is determined by adding to the town appropriation a percentage which decreases with the increase in the valuation. If the valuation of the town is less than $5,000 per mile the State will pay 100 per cent of the taxes so raised; if it is between $5,000 and $7,000 the State pays 90 per cent; if between $7,000 and $9,000 the State will pay 80 per cent; if between $9,000 and $11,000 the State pays 70 per cent; if between $11,000 and $13,000 the State pays 60 per cent; and if over $13,000 the State will pay 50 per cent.

In other words, the aid from the State varies from one-third to one-half the expenditure by the town inversely with valuation per mile of roads outside the limits of incorporated cities and villages. Thus the State extends a greater amount of aid to the poorer towns than to the richer ones. There is a further limitation in the law which provides that no allowance by the State shall exceed $25 per mile except where the valuation per mile is greater than $25,000, when one-tenth of 1 per cent of that valuation may be allowed.

An appropriation was made by the legislature and became a law April 27, 1917, providing $300,000 with which to meet the Federal aid apportionment for the fiscal year ending June 30, 1917. An additional appropriation was also made of $100,000, which constitutes a revolving fund to be repaid by the Federal Government out of Federal aid appropriations for the State. This will enable the State to pay the entire cost of its Federal aid projects as the work progresses and to be reimbursed by the Federal Government to the extent of 50 per cent of the total cost when the contracts have been completed and accepted.

A reappropriation of unexpended balances for the construction of State and county highways was made during 1917, amounting to $7,126,947.63. This appropriation was originally made from the proceeds of the second bond issue, amounting to $50,000,000, authorized in 1912.

On June 5, 1917, an emergency appropriation of $100,000 was made by the legislature for repair and maintenance of improved State and county highways on principal routes between New York and Albany. A special appropriation was also made for State routes in Green County and for other work on State and county highways, amounting to $346,636.69.

The funds appropriated during the early part of 1917 may be briefly summarized as follows:

For maintenance, repair, and construction of State and county highways, and for administrative and field expenses on the same	$4,575,000.00
For State aid to towns and Indian reservations, etc.	2,050,000.00
For State's share to meet Federal aid	400,000.00
Reappropriation for construction of State and county highways	7,126,947.63
Special appropriation for construction of State and county highways	346,636.69
For repair and maintenance of State and county highways between New York and Albany	100,000.00
For State highway department, central office, fiscal year beginning July 1, 1917	294,683.00
For construction of highways under superintendent of State prisons	50,000.00
Total	14,943,267 32

Local revenues.—Taxes for town roads to which State aid is extended and for bridges over 5-foot span, to which no State aid is extended, and for other town-road purposes are levied by the board of county supervisors on the recommendation of town boards. The funds so raised by the towns, exclusive of funds received from local bond issues and from State-aid appropriations, amount to approximately $6,000,000 per annum.

To pay the county's share of the cost of county highways the boards of county supervisors are authorized to levy and collect a tax apportioned between the county at large and the town or towns in which such highways are constructed. The money so raised may also be used to pay interest and principal on county highway bonds.

BONDS.

State.—The construction of State and county highways has been financed largely by State bonds, of which $50,000,000 were authorized in 1906 and $50,000,000 in 1912. The funds derived from the sale of bonds are deposited in the State treasury and are appropriated out as needed. All of the first issue and $30,000,000 from the second issue have been sold and the proceeds appropriated. All of the bonds are of the sinking-fund variety, and run for 50 years. They bear rates of interest varying from 3 to 4½ per cent.

Each year the legislature levies a State-wide tax, the proceeds from which are deposited in the State treasury for the payment of interest and for the creation of a sinking fund to retire the bonds at maturity. Out of the sinking fund thus created the legislature appropriates each year the amount required to pay interest on the bonds outstanding. For 1917 there was appropriated for this purpose $3,320,000.

Local bonds.—Towns may borrow money in anticipation of taxes, or the county boards of supervisors may authorize towns to issue bonds for highway or bridge purposes, provided the proposition has been agreed to by a majority vote of the town meeting. The county board of supervisors fix and levy on the towns which have issued bonds a tax sufficient to pay interest and to retire the bonds when they become due. It appears to be discretionary with the town and county boards to fix the term, interest rates, amounts, and character of bonds to be issued.

The county boards of supervisors may by resolution authorize the issuance and sale of town and county bonds in amounts not to exceed 35 per cent of the cost of county highways. The term of such bonds is limited to 30 years, and a tax is levied upon the whole county or upon the various towns benefited for the payment of interest and principal.

NORTH CAROLINA.

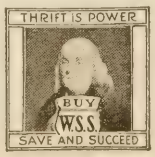
DEVELOPMENT.

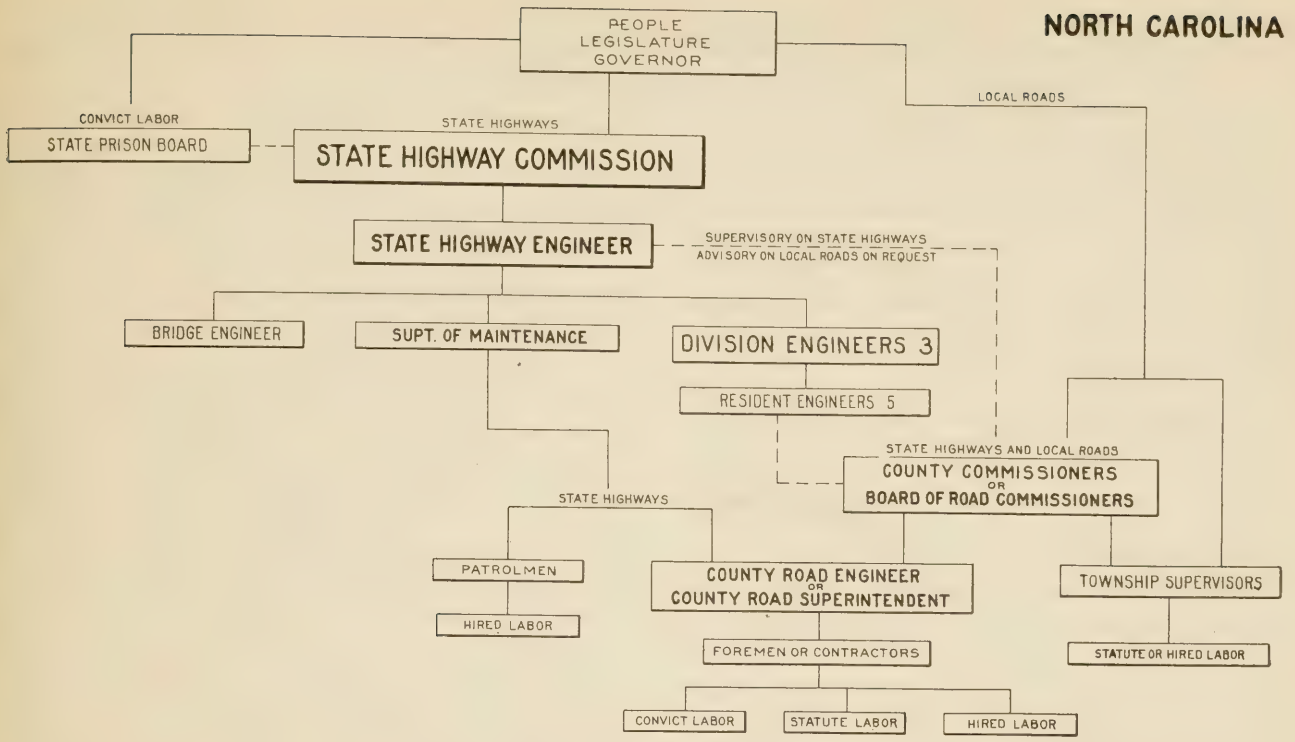
State participation in road work in North Carolina is limited to educational, advisory, and supervisory work, and money aid to counties for the maintenance of roads included in the State system of highways administered by a State highway commission. The State extends advice and supervision to counties and townships on request, and has superintendence and control over the maintenance of State highways.

The State controls, through the distribution of the automobile fund, about 4.3 per cent of all expenditures and has authority over maintenance of the State system, which includes about 6.6 per cent of the total road mileage of the State.

In 1909 the legislature appropriated $5,000 per annum to enable the economic and geological survey to conduct road investigations, make experiments, and furnish advice to local officials on road problems. This work was continued by the geological survey until 1915, when the State highway commission was created and provision was made for the designation of the tentative State highway system connecting county seats and principal cities of the State. In 1917 the legislature provided that all net receipts from automobile registration be expended for maintenance of the State system under the direction of the State highway commission.

Of the 50,758 miles of road in the State, it is estimated that on January 1, 1915, 6,750 miles, or 13 per cent, were surfaced, principally with sand-clay. The total expenditures for all road and bridge pur-





poses were estimated to be about $5,500,000 for the year 1916. During 1917 there was expended by all forces of the State for highway purposes $5,520,000.

ORGANIZATION.

The road forces of the State and the relation existing between them is shown on the diagram herewith.

State.—The State highway commission consists of seven nonsalaried members, three appointive and four ex officio. The appointive members are appointed by the governor for terms of four years, one from eastern, one from central, and one from the western part of the State, and one of whom shall belong to the minority political party of the State. The ex officio members consist of the governor, State geologist, a professor of civil engineering in the University of North Carolina, and a professor in the North Carolina Agricultural and Mechanical College, the professors being designated by the governor. The State highway commission appoints and fixes the salary of a State highway engineer and such other employees as may be needed. The commission also acts in a consulting capacity to the State highway engineer on all engineering problems confronting him and may call meetings to be held in various parts of the State to be conducted by the State highway engineer.

The State highway engineer who is the administrative head of the work of the State highway commission must be well versed in the science of road building and maintenance. He is appointed for a term of six years. The State engineer is assisted in the discharge of his duties by three division engineers, a bridge engineer, the superintendent of maintenance, and other assistants.

County.—Each county is governed by a board of county commissioners of from three to seven members elected usually for a period of two years. Thirty-seven counties have five commissioners, one county has six commissioners, one has seven, and one county elects its commissioners for four-year terms. The county clerks and treasurers are the clerical and fiscal agents of the county boards, and the sheriff is the tax collector. Except in special cases the county board has charge of the layout, altering, construction, and maintenance of all roads and bridges and the raising of money therefor.

In carrying out road work in the different counties there is considerable variation in organization and procedure. Many counties in which bonds have been issued have boards of county road commissioners who are given power to employ engineers, superintendents, to make contracts, and to buy machinery. In some counties the work is done under the direction of county engineers, in others by county superintendents, while in others the work is done by township supervisors. The township supervisors are elected for two-year terms and have charge of the maintenance of roads and bridges in their respective townships.

There are 25 counties that have county engineers. Such engineers are usually employed by those counties in which extensive improvements are under way, and when the work is being done by contract. In such cases the engineer makes all surveys, pre-

pares plans, specifications, and estimates, acts as inspector, and prepares and approves monthly estimates which are submitted to the county board for payment. County engineers are usually appointed by the county commissioners on the recommendation of the State highway engineer. The county superintendents are usually practical road builders employed in counties where the work is done by force account or with convict gangs. Generally, they are not civil engineers and, therefore, incapable of making surveys, preparing plans, specifications, and estimates.

CLASSIFICATION, CONTROL, AND PROCEDURE.

The 50,758 miles of public road are divided for the purpose of fixing responsibility for control, construction, and maintenance into two groups, viz, State highways and county roads.

State highways.—The legislature from time to time has designated certain interstate roads as State highways, viz, the central highway extending from Beaufort Harbor on the Atlantic coast to the Tennessee line, Charlotte-Wilmington highway, the Hickory Nut Gap highway, and the Asheville-Murphy scenic highway. In addition to these the State highway engineer in consultation with the State highway commission is given general authority to designate, lay out, survey, etc., a system of State highways. The tentative system of State highways thus selected, including those specially designated by the legislature, comprises 3,356 miles.

The State provides no money with which to construct these roads, but by special authority of the legislature State convicts have been used in the construction of the central highway and the Asheville-Murphy highway. The net receipts from the registration of automobiles is apportioned to be used in the various counties for the maintenance of roads of this group, such work being done by and under the direction of the State highway engineer. The construction work on State highways is carried on by the counties, except when the State highway engineer is requested to take charge. However, all plans, specifications, and estimates are prepared and paid for by the State, but if the roads are not built in accordance with such plans and specifications, the cost of the surveys, plans, etc., is paid by the counties.

County roads.—These include all roads in the State not included in the State system. They are built and maintained by county and township authorities with county or township funds. The State has no jurisdiction over roads of this group except on request of local authorities. The State highway engineer will, on request, prepare plans, specifications, and estimates, but if the roads are not built in accordance with such plans, the cost of such work is paid for by the county. County prisoners may be used in the construction and maintenance of roads of this group.

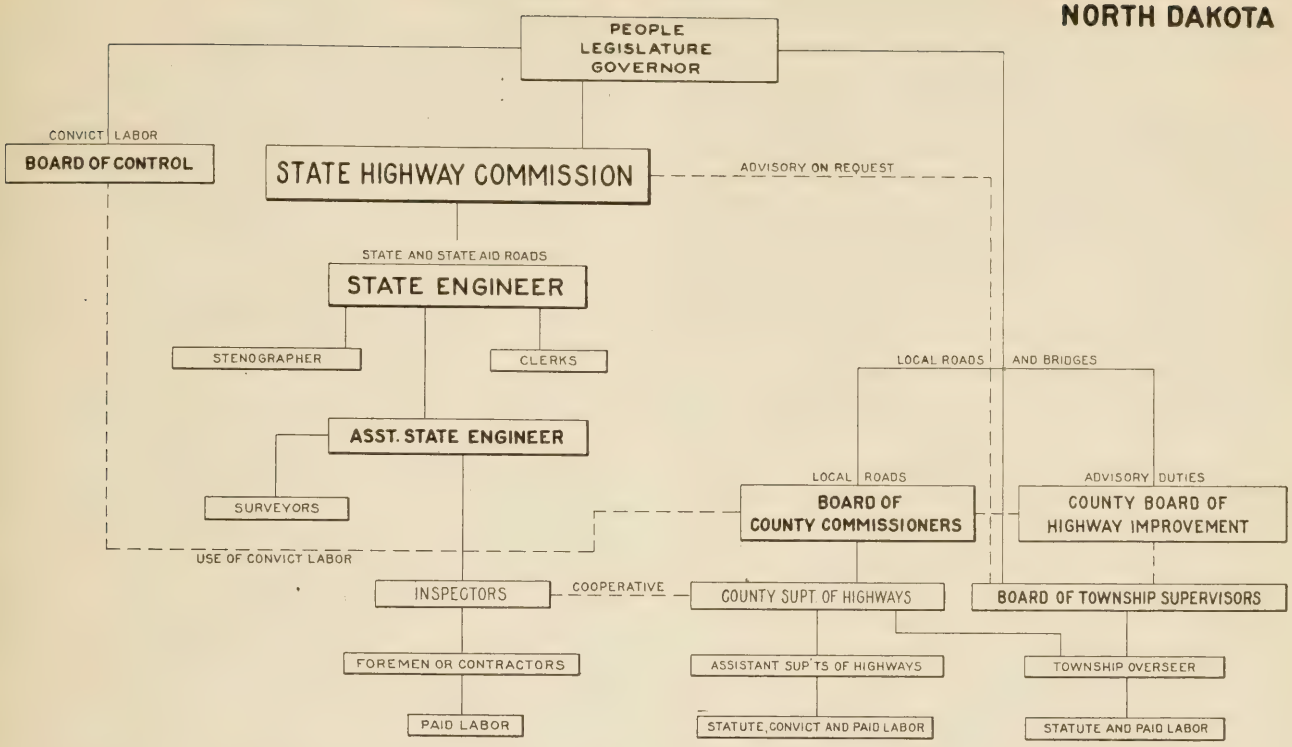
REVENUES.

State funds for the support of the State highway commission are derived from an appropriation of $20,000 per annum. The gross receipts, less not to exceed 12½ per cent for collection, derived from the registration of automobiles are expended for the maintenance of State highways and bridges. Of the net receipts 17½ per cent may be expended at the discretion of the State highway commission and 70 per cent is apportioned to the counties from which collected, but must be expended within one year on the maintenance of State highways by and under the direction of the State highway commission. The amount available for this fund for the fiscal year ending June 30, 1918, is estimated at $275,000.

County.—Road and bridge taxes in the counties vary from 5 to 50 cents per $100 of valuation and from 45 cents to $1 per poll. Some counties also retain the statute labor system. It is estimated that during 1916 there was expended from local funds a total of $5,500,000.

BONDS.

State.—The legislature of 1917 provided that the State treasurer should issue State bonds in amounts not to exceed $800,000 a year during the next 41 years, the proceeds to be used as a loan fund to the counties for permanent road improvement. The bonds are to bear 4 per cent interest. The counties benefiting by the act are to annually pay the interest plus 1 per cent of the amount borrowed. The additional 1 per cent is to be used by the State for creating a fund with which to retire the bonds in 41 years from the date of issue. Counties desiring to borrow a portion of the State bond fund are required to submit the question to a popular vote. If a majority decides in favor of making use of the State money, a special tax is levied by the county which must be sufficient to pay the interest on the bonds at 5 per cent plus 4 per cent of the bonds so used for the first four years from the date of issue, 8 per cent for the subsequent four years, and 10 per cent thereafter so long as the bonds remain unpaid to the State. The additional 4. 8, and 10 per cent referred to are levied for the purpose of maintaining the roads so constructed. County officials failing to levy or collect such taxes shall be guilty of a misdemeanor. State loans to any county when added to the existing indebtedness shall not exceed 6 per cent of the assessed valuation of the county. No State supervision or inspection of the roads constructed from these funds is provided for, and so far none of the bonds have been issued.



Counties and townships may issue bonds for road or bridge improvement in amounts not to exceed 10 per cent of the taxable valuation of the property. Before such bonds are issued the question must be submitted to the qualified voters of the county or township and a favorable vote returned by a majority of the voters, but before such election can be held the State highway engineer must certify that the proposed issue will be sufficient for the purposes set forth in the petition for the election. The term, character and interest rate of the bonds are left to the discretion of the authorities issuing them. In case the bonds are issued, special taxes must be levied in sufficient amounts to pay interest and principal and to maintain the roads so constructed. The tax for maintenance shall not be less than 1 per cent nor more than 4 per cent of the bonds issued. The total of county and township bonds outstanding on January 1, 1915, was $8,955,300. A large mileage of the improved roads of North Carolina has thus been financed from bond issues.

NORTH DAKOTA.

DEVELOPMENT.

State participation in road and bridge work in North Dakota is of recent origin, limited in amount, of State-wide distribution, and is administered by a State highway commission.

State interest in and aid to road and bridge work began in 1909 with the establishment of a good roads experiment station for the purpose of constructing experimental roads. Due to a lack of sufficient funds the desired work was not fully accomplished. Beginning in 1911 the net automobile revenues were returned to the various counties for use by the county authorities in maintaining the main traveled roads of the State, and this policy was continued until 1917.

In 1913 a State highway commission was organized and accomplished during the next three years considerable educational work along the lines of road and bridge improvement. No funds were provided during this period to enable the State to take part in construction or maintenance, although the commission furnished at the expense of the counties applying therefor engineers to execute surveys of and prepare plans, specifications, and estimates of cost for a number of road and bridge projects.

In 1916 the State highway commission was reorganized to meet the requirements of the Federal aid road act, and provision was made for the designation of a system of State roads comprising about 4,000 miles or 5.8 of the total road mileage of the State to be constructed at State and local expense under the supervision of the State highway commission.

On January 1, 1917, 1,100 miles, or 1.6 per cent, of the total road mileage of the State was reported surfaced. During the year 1916, $2,711,295 was expended by local officials for road and bridge purposes. The State highway commission, being possessed at this time of educational and advisory powers only, did not supervise any part of this expenditure.

During 1917 there was expended by all forces for highway purposes a total of $2,868,000.

ORGANIZATION.

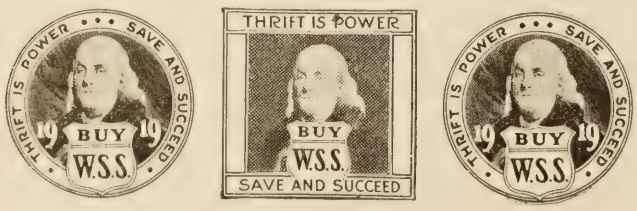
The organization of the highway forces of the State and the relation existing between them is shown on the diagram.

State.—The State highway commission, composed of the governor of the State as chairman, the State engineer, the commissioner of agriculture and labor, and two members appointed by the governor, has charge of the location, construction, and maintenance of all projects financed wholly or in part with Federal or State funds. The State engineer as secretary and engineer of the commission is the executive officer of the commission in all matters relating to construction and supervision of maintenance of State projects and is required to furnish advice to local road and bridge officials when requested by them. He is provided with assistant engineers, stenographer, and three inspectors.

County.—The road and bridge affairs are administered by a board of county commissioners consisting of three or five members elected for terms of four years. The county auditor and county treasurer are respectively clerk and fiscal agent of the board. County boards may appoint a county superintendent of highways skilled in road and bridge building who serves as their executive official. Counties not organized into townships are divided into districts with an assistant superintendent of highways or district overseer in charge of each district.

Township.—Road and bridge affairs in organized townships are administered by a board of three supervisors elected for terms of one year. The township overseer appointed by the board is their executive official in charge of all township road and bridge work.

Board of highway improvements.—In each county of the State a board consisting of a member from each road district in the county is required to meet on the second Monday of March in each year at the county seat and to adopt rules and regulations governing the uniform construction and maintenance of local highways throughout the county. The instructions of this board are binding on the township supervisors and road overseers unless otherwise ordered by any township supervisor.



CLASSIFICATION, CONTROL, AND PROCEDURE.

The 68,796 miles of public road of North Dakota are, for the purpose of fixing responsibility for control, construction, and maintenance, divided into two groups, viz, State roads and county roads.

State roads.—These comprise about 4,000 miles of main traveled roads selected by the various county boards, with the approval of the State highway commission for improvement at their joint expense. This system may be increased by agreement between the county board having jurisdiction over the road concerned and the State highway commission.

Initiative for construction or improvement of a road of this group is taken by the county board by making application to the State highway commission for aid in carrying out the proposed improvement. When favorably considered by the State highway commission, surveys are executed and plans, specifications, and estimates of cost are prepared by the State engineer. Proposed improvements costing less than $3,000 may at the discretion of the commission be executed by force account by the State engineer or by the county board, or may be let by contract. Work costing more than $3,000 is required to be advertised for bids. The bids may be rejected and the work done by force account under the direction of the State engineer or contract may be awarded by the State engineer with the approval of the county board concerned.

The work during progress is under the supervision of the State engineer. Monthly payments for the work completed are made by the State and county officials, the payments being based on an estimate prepared by the representative of the State engineer in charge of this work. Fifty per cent of the cost is paid by the State when the estimate has been approved by the State engineer and the secretary of the State highway commission. The county's share of the cost is paid by the county board when the estimate has been approved by the State engineer and the county superintendent of highways if such official has been appointed by the county board.

Final payments are made in a similar manner when the completed work has been accepted by the State engineer.

Completed roads of this group are maintained by the counties at the joint expense of the State and county subject to the inspection and supervision of the State engineer.

County roads.—These comprise all other roads of the State. They are constructed and maintained by county or ownship officials with local funds. A large measure of control is given to these boards over tax rates and location and construction of new roads.

REVENUES.

State.—For the year 1917 the legislature has provided an appropriation of $8,000 as emergency funds for the partial support of the State highway department. The State highway fund composed of two-thirds of the net receipts of the motor vehicle fund is available for expenditure by the State highway department as follows:

(*a*) For the support of the State highway department.

(*b*) For contributions to the maintenance of roads improved under the State-aid plan.

(*c*) For expenditures for road and bridge purposes in the various counties of the State, Of this latter amount 10 per cent of the funds may be expended at the discretion of the State highway department. The remaining 90 per cent is expended in the counties in the ratio in which the tax is paid. A total fund accruing from motor vehicle licenses available for expenditure by the department during 1917 amounted to $105,707.82. This will be increased to about $186,000 by an increase in the rate.

County.—One-third of the net motor revenues amounting to $72,162.14 was returned to the counties in which they are collected and credited to the funds for repair and dragging of highways within the county. County taxes are levied at the following rates:

Poll tax, $1.50 a year, or in lieu thereof one day's labor on the roads is required from each male inhabitant between the ages of 21 and 50.

A bridge tax at a rate not exceeding 4 mills on the dollar, and a road tax at a rate not exceeding 4 mills on a dollar to be paid in money or labor at the rate of $1.50 per day and an emergency tax at a rate not exceeding 2 mills on the dollar may be levied by the county board.

Township.—Township boards may levy a tax for road and bridge purposes at a rate not exceeding $1 on each $100 of assessed valuation. A portion of this tax levied for road purposes may be worked out by the taxpayers at the rate of $1.50 a day.

BONDS.

No bonds have been issued by the State or counties for road and bridge purposes.

OHIO.

DEVELOPMENT.

State participation in road improvement in Ohio consists of money aid in the construction and maintenance of a State-wide system of intercounty highways and main market roads known after improvement as State roads, administered by the State highway department. The system of intercounty highways includes 9,875 miles, of which 2,775 miles are main market roads. State control extends to about 11 per cent of the total road mileage of the State and the State contributes approximately 28.5 per cent of all road expenditures.

The first State-aid law enacted in 1904 provided for a State highway department and for State aid to roads, but no appropriation was made. The cost of State-aid roads was to be borne as follows: 25 per cent by the State, 50 per cent by the county, 15 per cent by the township, and 10 per cent by the abutting property. In 1905 the first appropriation of $10,000 for State aid and $7,400 for the highway department was made. The State-aid money was to be equally apportioned among the 88 counties. The fund was so small when so apportioned that no applications were made for aid during the first year.

The State-aid appropriation was increased to $150,000 in 1906 and 1907, to $440,000 in 1908, to $486,577 in 1909, and $558,654 in 1910. In 1911 the highway department was reorganized. Three deputies and other employees were provided, the State's share of the cost of State-aid roads was increased to 50 per cent, provision was made to have the State pay 25 per cent of the cost of maintenance of roads built under State aid, and a system of intercounty highways was provided for. No material changes have since been made except as follows: A State-wide tax has been provided and moneys derived from automobile registration and licenses are used to pay the whole cost of maintenance of such intercounty highways and main market roads as have been constructed or taken over by the State. In 1912 an attempt was made to amend the State constitution by providing for a bond issue of $50,000,000 for road improvement, but this failed by 2,018 votes out of a total of 547,146 votes cast.

Of the 86,354 miles of public road in the State, it is estimated that 31,500 miles or 36.5 per cent were surfaced on January 1, 1917, and that during the year 1916 approximately $2,800,000 was expended by the State and $10,000,000 by the counties and townships including their contributions to meet State aid.

During 1917 there was expended by all forces of the State for highway purposes a total of $12,000,000.

ORGANIZATION.

State.—At the head of the State highway department is a State highway commissioner appointed by the governor, with the advice and consent of the senate, for a term of four years. He receives a salary of $4,000 per annum.

There is a nonsalaried bipartisan advisory board consisting of four members appointed by the governor for terms of four years, one being appointed

each year. All official acts of the State highway commissioner in connection with the designation of intercounty highways or main market roads, the granting of aid, the letting of contracts, the purchase of materials, tools, and equipment, the entering into agreement with the Federal Government on post-road projects, and the designation of engineers other than county surveyors to take charge of road and bridge work within any county under control of the State, must first have the approval of the advisory board. The State highway commissioner is ex officio secretary of the advisory board.

The State highway commissioner has general supervision over the construction and maintenance of intercounty highways and main market roads and must approve plans and specifications for all bridges on other roads if the cost exceeds $10,000. He causes to be prepared plans, specifications, and estimates for any road, culvert, or bridge on request. He may conduct investigations, propaganda work, and make experiments.

The engineering work of the department is conducted under the direction of three deputies appointed by the commissioner. One of these deputies is designated as chief highway engineer and has charge of all matters relating to the design and construction of roads. One is designated as the maintenance deputy and has charge of all maintenance and repair work, while a third is designated as bridge deputy and has charge of all matters pertaining to the design, construction, and maintenance of bridges. Each deputy receives a salary of $3,000 per annum. The construction deputy exercises general supervision over the bridge and maintenance deputies and acts for the highway commissioner in his absence.

Acting under the three deputies there are nine division engineers appointed by the commissioner from the civil-service eligible list. They have their headquarters at the central office in Columbus, but most of them live in their own districts. They have charge of design, construction, and maintenance of roads and bridges in their respective divisions.

The county surveyors of the various counties are by virtue of their positions resident engineers of the State highway department. If such county surveyor fails to comply with the requests of the State highway commissioner, he may be removed as the representative of the State. The State pays one-fifth of his salary as long as he represents the State as resident engineer.

Correspondence, records, and accounts at the central office are handled by the chief clerk appointed by the commissioner. Civil-service and legal matters are handled by the secretary to the commissioner, who is an attorney. The physical and chemical testing work of the department is handled by a testing engineer, a chemist, and assistants.

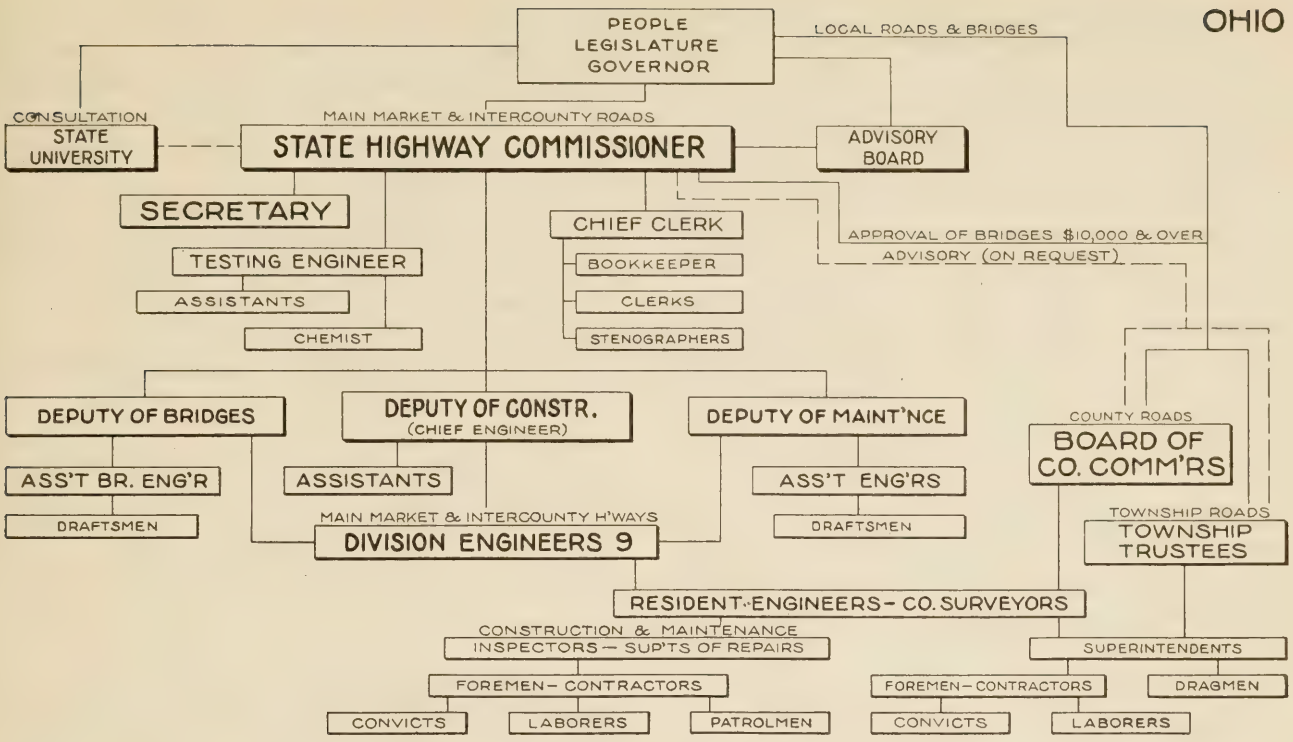
County organization.—Highway matters in the various counties are handled by a board of county commissioners consisting of three members, elected biennially for a term of two years. The county auditor is the clerk of the board except in the larger counties, and the county treasurer is the custodian of the funds. Under the direction of the county commissioners, the county surveyor has charge of the design, construction, and maintenance of all county roads. As indicated above, he may also represent the State as resident engineer. His salary is paid one-fifth by the State if he acts for the State, and four-fifths by the county on a basis of road mileage and population, the maximum being $6,000 per annum.

Township.—Highway matters are handled by the township trustees, of which there are three in each township elected biennially for a term of two years. They divide their townships into three districts, each having charge of his district, or they may appoint one of their own members or a person not on the board as highway superintendent for the township. The township trustees of any township may order the county surveyor to prepare plans, specifications, and estimates for roads to be constructed or resurfaced, or the county surveyor may on his own motion prepare such alternate plans, specifications, and estimates, and when the same have been approved by the township trustees, the work may be let by contract by the trustees on the lump-sum or unit-price basis. Such contract work is done under the general direction of the county surveyor.

CLASSIFICATION, CONTROL, AND PROCEDURE.

The public roads of Ohio comprising 86,354 miles are for the purpose of fixing responsibility for construction, control, and maintenance divided into three groups, namely, State roads, county roads, and township roads.

State roads.—These are such portions of intercounty highways and main market roads as have been constructed by the State with State money, or which have been taken over by the State. There are 492 intercounty highways embracing 9,880 miles, forming a continuous system throughout the State. These roads were selected by the State highway department, and were legally adopted by the governor's approval in December, 1912. From the system of intercounty highways, the legislature in 1913



designated 12 main market roads. This number has since been increased by the State highway commissioner with the approval of the governor to 22, and includes 2,775 miles of the intercounty highway system.

Applications for State aid on intercounty highways originate with the county commissioners or township trustees. Plans, specifications, and estimates are prepared by the county surveyor or resident engineer, checked and approved by the division engineer, and forwarded to the State highway commissioner for approval. If approved, he forwards the same to the county or township and when approved by the county or township, the same is returned with statement showing that the necessary financial arrangements have been completed, and that necessary rights of way, gravel pits, stone and quarries, have been secured by condemnation or purchase. Contracts are let by the State highway department in the name of the State and approved by the county or township. Work proceeds under the direction of the county surveyor or resident engineer, and inspectors appointed by the county surveyor who must be State civil service eligibles approved by the State highway commissioner. The work is inspected at frequent intervals by the division engineer. Payments are made on monthly estimates deducting 15 per cent until final completion and acceptance.

The above procedure is followed in the construction of intercounty highways and main market roads, when the counties or townships cooperate. When they do not cooperate, the State highway commissioner may proceed with the work without local initiative.

When the State is cooperating with the county in the building of a State road ordinarily the percentages paid by the State, county, township, and property owners are as follows: State not to exceed 50 per cent, county 25 per cent, township 15 per cent, and property owners 10 per cent. If the State does not pay 50 per cent the balance is usually made up by the county. When the tax duplicate (assessed valuation) of a county is less than $30,000,000, but not over $20,000,000 the State may pay not to exceed 60 per cent. When the tax duplicate is less than $20,000,000 the State may pay not to exceed 75 per cent. The county may assume the township's share, or the township may assume the county's share. When the State is cooperating with the township in the building of a State road, the State may pay not to exceed 75 per cent of the cost.

Under all conditions the property owners are required to pay not less than 10 per cent of the total cost, but they may be assessed in any amount above this at the will of the county commissioners. The assessment of property owners may be made on the front footage of abutting property or by unanimous vote of the county commissioners on property within one-half or 1 mile of the road. No part of the cost of bridges and culverts is assessed against the township or property owners. The cost of culverts and bridges is paid by the State and county in the same ratio as for construction of the road. If the State acts independently of the county and township, the State pays the entire cost less the amount

contributed by the property owners, which must in no case be less than 10 per cent.

On January 1, 1918, 2,029.61 miles of intercounty highways and main market roads had been surfaced or contracted for by the State, and 144.33 miles of county and township roads had been taken over by the State making a total of 2,173.94 miles of State roads.

These roads when completed are turned over to the maintenance deputy and are maintained by the State at State expense, but a portion of the cost of maintenance may be paid by a county or township. The State may take over an intercounty highway or main market road previously constructed by a county or township and thereafter pay the cost of maintenance. The maintenance work is carried on under the immediate direction of the county surveyor. Weekly reports are made to the maintenance deputy by the superintendents, patrolmen, and foremen. The patrol or gang system of maintenance is employed, a general tendency being to use the gang system.

State convicts may be used by the highway department through requisition on the State prison authorities in improving intercounty or main market roads, or in preparing materials therefor. The cost of transportation, guarding, clothing, and other expenses incident to such work may be paid by the State highway department from funds available for the construction of State roads.

County roads.—The county roads may be said to include all roads that are not State roads, but which have been or may be surfaced with hard materials to a standard fixed by the county commissioners. All such roads are maintained by the county commissioners.

Township roads.—These include all highways except those above indicated and are under the jurisdiction of the township trustees.

REVENUES.

State.—A State-wide tax of three-tenths of a mill is levied annually from the proceeds of which 75 per cent is used for the support of the State highway department and for the construction of intercounty highways, and 25 per cent is used for the construction of main market roads. After deducting from the 75 per cent fund enough to support the State highway department, the balance is apportioned equally among the 88 counties. The 25 per cent fund is apportioned at the discretion of the State highway commissioner in such a way as to distribute equitably and as far as practicable the benefits from such expenditures to the different sections and counties of the State.

The net receipts from the registration of automobiles is used for the maintenance of State roads. The receipts from the State tax and the automobile fund are deposited in the State treasury and are appropriated out as needed.

Appropriations for the fiscal year ended June 30, 1918, are as follows:

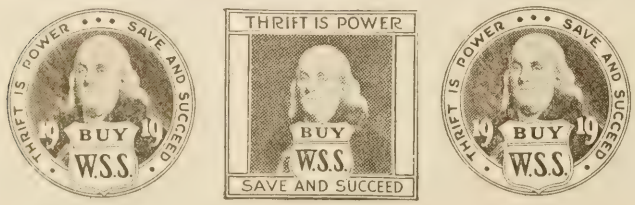
State highway department	$113,960
Construction of intercounty highways	[1] 1,563,270
Construction of main market roads	[1] 537,400
Reappropriation of surplus	900,000
Maintenance and repair of intercounty highways, and main market roads	1,749,960
Total	4,864,590

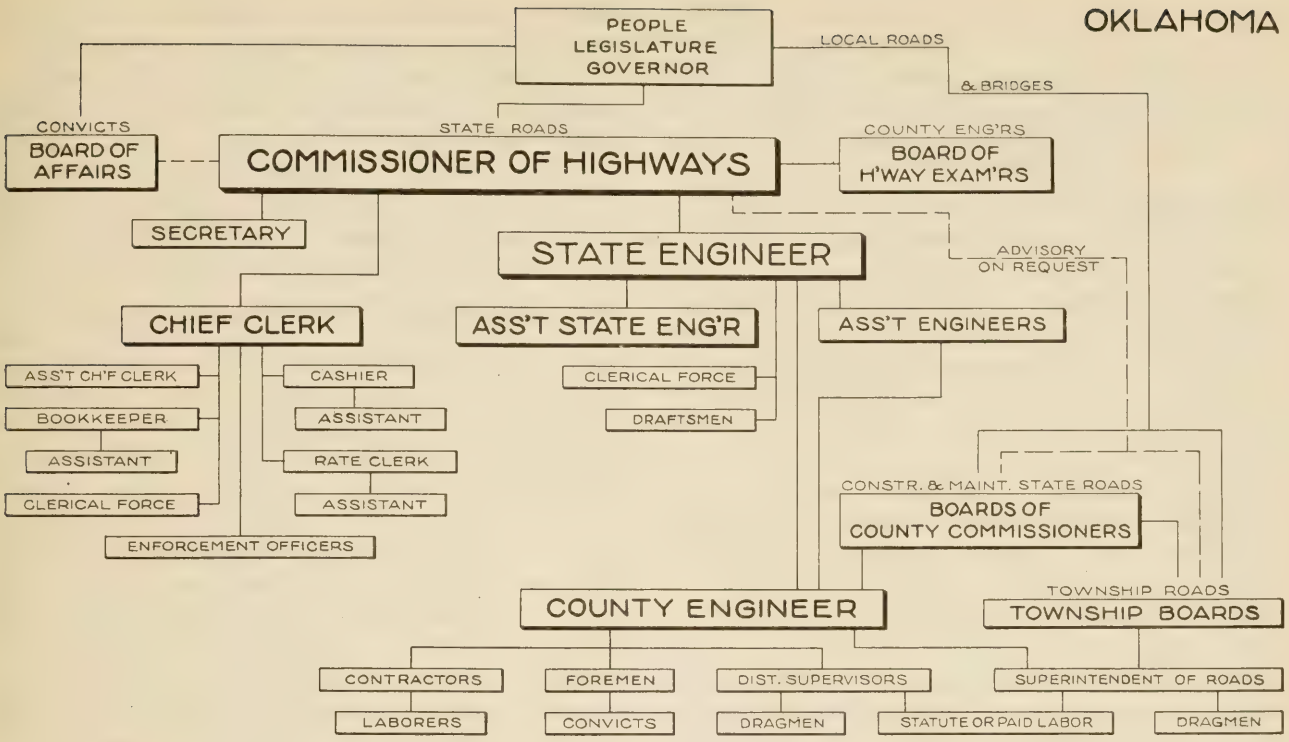
Local revenues.—For highway construction the county commissioners may levy not to exceed 2 mills on all property, including cities, and villages, for maintenance of roads and bridges. The county commissioners must levy a tax which will produce at least $20 for each mile of county roads. For the county's share of the cost of State roads, the counties may levy a tax of not to exceed 1 mill. County roads may also be improved under the local assessment plan on petition of 51 per cent of abutting landowners, and the whole or a portion of the cost may be assessed by the county commissioners against the abutting landowners within one-half to 2 miles of the road, in proportion to benefits received, or a portion of the cost not to exceed 50 per cent may be paid by the county and township. In order to meet the township's portion of such cost, the county commissioners may levy a tax of not to exceed 3 mills on the township or townships.

Township.—The township road funds are derived from a tax of not to exceed 3 mills levied by the township trustees, but an additional levy of 2 mills may be made for meeting the township's share of State roads. Township roads may also be improved on the local assessment plan on petition of owners of real estate. If petitions are granted by the township trustees from 25 to 50 per cent of the cost may be assessed against the abutting property owners within one-half or 1 mile of either side and termini of the road.

It is estimated that counties and townships expended from local revenues approximately $7,000,000 during 1916, exclusive of about $3,000,000 for the construction of State roads.

[1] One-half of the amonnt appropriated for two years.





BONDS.

In anticipation of the collection of taxes or assessments to meet the county's or township's share of State roads or county roads built under local assessment plan, the county commissioner may issue sinking-fund bonds maturing in not to exceed 10 years and bearing not to exceed 5 per cent interest. The aggregate amount of such bonds for State roads shall not exceed 1 per cent of the tax duplicate (assessed valuation).

For the construction of township roads, the township trustees may issue bonds maturing in not more than 10 years and bearing not to exceed 6 per cent interest, provided the same is agreed to by a majority of the electors; the amount to be issued is left to the judgment of the township trustees.

For many years counties and townships have indulged rather freely in bond issues, and on January 1, 1915, there was a total of upward of $31,000,000 of such bonds outstanding, and during the year 1914 there was expended from bond issues $6,000,000, while there was retired about $2,700,000.

OKLAHOMA.

DEVELOPMENT.

With the appointment of a State highway commissioner in 1911 with educational and advisory duties, State interest in road and bridge work was first manifested, and during the period 1911 to 1915 considerable data relative to road improvement, road finances, etc., was collected and published at State expense by the commissioner.

In 1915 a State department of highways was organized. By the terms of legislation passed in 1916 its powers and duties were increased. A system of State roads selected by the boards of commissioners of the various counties of the State was authorized by the legislature at this time and in 1917 supervisory control over the location and plans for all improvements made on this system was vested in the department of highways.

The system of State roads is required to comprise not less than 10 nor more than 15 per cent of the total road mileage of each county and is selected to insure connection between the principal towns of the State.

A one-fourth mill State tax levy was made in 1916 on all property in the State and the proceeds thereof were returned to each county in the ratio of tax paid, provided that the county levied a similar tax and that the joint fund was expended in accordance with plans approved by the department of highways.

During 1916, 1,900 miles of road were improved under State supervision. It would appear, however, that a large portion of the work accomplished consisted of grading earth roads, as at the close of this period only 300 miles were reported as surfaced.

The expenditure of $300,000 of State funds and of $1,825,000 of local funds by or under the supervision of the department of highways comprised 58.5 per cent of the total expenditure, $3,625,000, made by all

road and bridge forces of the State during the year 1916.

During 1917 there was expended by all road forces of the State for highway purposes a total of $3,722,000.

ORGANIZATION.

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

State.—Supervision of highway construction and maintenance is vested in a department of highways in charge of a commissioner of highways, who is appointed by and who serves at the pleasure of the governor and is required to be a practical road builder.

The commissioner of highways has supervision over all matters relating to State roads, is required to determine and establish standards best adapted to the various sections of the State, and to furnish without cost plans and specifications for road and bridge work presented by local officials.

The State engineer and the assistant State engineer are appointed by the commissioner with the consent and the approval of the governor. Other employees necessary for the conduct of the business of the department may be employed by the commissioner.

The commissioner of highways, with the approval of the governor, appoints three civil engineers of established reputation and ability to constitute a board of highway examiners. This board conducts examinations of applicants for the position of county engineer. Certificates of competency are issued by the commissioner to those candidates recommended by the board. These certificates may be revoked by the commissioner for neglect of duty or other just cause.

County.—Administration of roads and bridges is vested in a board of three commissioners elected for terms of two years by a majority vote of the residents of the county. The county clerk and county treasurer are, respectively, clerk and fiscal agent of the board.

The county engineer, required to possess a certificate of competency from the commissioner of highways, is appointed by the board to serve, during its term of office, as the executive official of the board in all road and bridge affairs instituted under its direction and he is required to render such reports to the commissioner of highways as may be required. The engineer has supervisory control as regards road repair and maintenance over all township supervisors appointed by the county board or township superintendents appointed by township boards.

Township.—Each county organized under the township organization plan is divided into townships, the affairs of which are administered by a board of directors composed of a township trustee, treasurer, and clerk, all elective officials. The members of this board are ex officio highway commissioners for the township, and are required to select a township superintendent as their executive official in road matters under their charge. The township clerk is required to make an annual report to the township board of directors of the work accomplished on the township system of roads, and to furnish a copy of the report to the county clerk.

CLASSIFICATION, CONTROL, AND PROCEDURE.

The 107,916 miles of public road in Oklahoma are, for the purpose of fixing responsibility for construction, control, and maintenance, divided into two groups, namely, State roads and township roads.

State roads.—These comprise between 10 and 15 per cent of the total mileage of each county selected for improvement by the county board at the joint expense of the State and county under the supervision of the commissioner of highways. These roads are selected so as to connect the county seats and the important cities of the State with roads leading to important centers in adjoining States. Initiative for construction is taken by the county board making application to the department of highways for financial aid in the construction of the road or roads specified in their application. When the project has been approved by the commissioner of highways, the laws of Oklahoma provide four forms of procedure by which State aid may be extended to the State road systems, namely:

1. By Federal and State aid combined with local funds in the ratio prescribed by the rules and regulations of the department of highways.
2. By State funds combined with local funds, the cost being borne equally.
3. By State convicts equipped for road building, loaned to the county.
4. By the proceeds of a one-fourth mill State tax combined with an equal amount of local funds.

Whenever the first or second method is followed, plans, specifications, and estimates of cost are prepared under the direction of the commissioner of highways. The letting of contracts involving Federal or State aid, supervision of the work during progress, and final inspection and acceptance of the work when completed is vested in the commissioner of highways.

The work of construction may be let by contract and paid for with Federal or State and local funds, or State convicts may, with the consent of the State

board of public affairs, and the approval of the department of highways, be furnished to county boards on their request and at their expense as regards extra expense due to the guarding of convicts while away from the State institution. The necessary tools, machinery, etc., required to equip these convict camps are furnished by the State.

Roads of this group may be constructed by the counties with State funds provided by the one-fourth mill tax levy and an equal amount of county funds, provided that plans and specifications approved by the department of highways are followed in this work.

Completed roads of this group are maintained by county boards at county expense subject to the inspection and instructions of the department of highways.

Township roads.—These are constructed and maintained by township boards with township funds under the general supervisory administration of the county engineer. All roads and bridges of this group constructed with the proceeds of township bond issues and all bridges on township roads of more than 20-foot span are required to be constructed in accordance with plans and specifications approved by the department of highways.

The township roads when constructed in accordance with plans and specifications approved by the State highway department may, when the State road system now authorized shall have been completed, be added to the State system by favorable action of the county board and the department of highways.

REVENUES.

State.—Funds are provided by a State-wide tax and by special appropriations by the legislature. The funds available for the year July 1, 1917, to June 30, 1918, and the purposes for which they may be used, are shown as follows:

1. An appropriation by the legislature of $20,000 for the support of the department of highways. Additional employees may be engaged and the State reimbursed by the counties benefiting from their services.

2. An appropriation by the legislature of $345,417 to meet Federal aid funds allotted to the State for the period ending June 30, 1918. This fund may be expended under the supervision of the department of highways with the approval of the United States Secretary of Agriculture on roads selected by the State department of highways.

3. An appropriation of $1,000,000 per annum, or as much thereof as may be available, is provided for the years ending 1918 and 1919, to be allotted to the various counties of the State for aid on State roads. One-half of this appropriation is allotted in the ratio of which the area of each county bears to the total area of the State, and one-half of the appropriation is allotted in the ratio which the population of each county bears to the total population of the State, the allotments being conditioned, however, on the county providing an equal amount.

4. An appropriation of $100,000 for the equipment of convict camps for road work.

5. A State-wide tax levy of one-fourth mill is returned in the ratio in which collected to each county providing a similar amount, provided that the combined sum be expended on State roads in accordance with the instructions of the department of highways. For the year ending June 30, 1918, it is estimated that $300,000 will be produced by this tax.

Thus the legislature provided a total of $1,765,417 for the fiscal year ending June 30, 1918.

County.—In addition to the one-fourth mill tax levy to meet the State tax levy funds, the county board may impose a general county tax at a rate not exceeding a total of $7\frac{3}{4}$ mills for county purposes and apply to the road and bridge fund any or all surplus moneys produced by this tax.

Ninety per cent of the motor-vehicle revenues, amounting to $768,300, is returned by the State to the counties in which they originated and is credited to the dragging fund for State and local roads. Any surplus in this fund may be applied to new construction.

A gross production tax is levied on certain products of the State and the proceeds thereof are returned to the counties in which they originate and are used for road and bridge purposes.

Township.—Every male person, able-bodied and not legally exempt, between the ages of 21 and 50, is required to render four days' labor each year on the public roads or to pay $5 in cash. A tax not exceeding 2 mills may be levied by the township board, the proceeds thereof to be expended for dragging the roads of the township.

BONDS.

Sinking-fund bonds in an amount not exceeding 5 per cent of the total assessed valuation of the county, bearing interest at a rate not exceeding 5 per cent per annum with terms not less than 5 years nor more than 25 years, may be issued by county boards for road and bridge purposes when authorized to do so by three-fifths of the voters of the county.

Sinking-fund or serial bonds in an amount not exceeding 5 per cent of the total assessed valuation of the township, bearing interest at a rate not exceeding 6 per cent, with terms not exceeding 25 years, may be issued by or on behalf of a township

whenever three-fifths of the voters of the township so authorize.

At the close of the year 1913 there was a total of county and township road and bridge bonds outstanding amounting to $1,440,000.

OREGON.

DEVELOPMENT.

State participation in highway improvement in Oregon is of recent origin, consists of money aid applied to a system of State highways, and to post roads constructed under State supervision at the joint expense of the Federal Government, State, and counties, and is financed with the proceeds of a one-fourth mill State-wide tax and by bond issues.

The State highway commission, established in 1913, was reorganized in 1917 and given jurisdiction over the expenditure of Federal funds allotted to the State and to all construction to which the State contributed 25 per cent of the total cost.

Of the total road mileage, 10.4 per cent, or 4,875 miles, had been surfaced at the close of the year 1916. Of this improved mileage 413 miles had been constructed under the State-aid plan.

The expenditures during 1916 comprised $165,662 of State funds and $290,000 of local funds, expended by or under the supervision of the State highway department, and $5,500,000 of local funds expended under local supervision. The State thus contributed 2.8 per cent and supervised the expenditure of 7.7 per cent of the total.

During 1917 there was expended a total of $5,700,000 by all forces for highway purposes.

ORGANIZATION.

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

State.—At the head of the State road work is the State highway commission composed of three members appointed by the governor for terms of three years, the term of one member expiring annually. The highway commission appoints a State highway engineer, who is required to be a competent civil engineer with experience in road construction and maintenance. He holds office at the pleasure of the commission, but for a period not to exceed four years without reappointment. The commission employs such clerks, officers, and assistants to the engineer at such salaries and for such terms as may appear necessary, provided, however, that the total cost of any one year shall not exceed 10 per cent of the total fund available to the commission for that year for its work. The State highway engineer is the chief executive of the department and has general supervision of all construction and maintenance of State highways, and of other roads to which Federal or specified amounts of State funds are contributed. He also acts in an advisory capacity in highway matters in the counties when so requested.

County.—Road and bridge affairs in the county are administered by a county court composed of a county judge and two commissioners, each elected for terms of four years. The court is required to divide the county into suitable districts and appoint for each district for a term of one year a road supervisor.

The county board may appoint for a term of one year a road-master who is required to devote his entire time to supervision of the road and bridge work of the county.

Two or more counties may create, join in, and constitute a road-building district for the purpose of locating and constructing public highways within the boundaries of such district. In such cases the combined county boards constitute the governing board of the districts. The proceedings of the board thus constituted are ratified by each board independently.

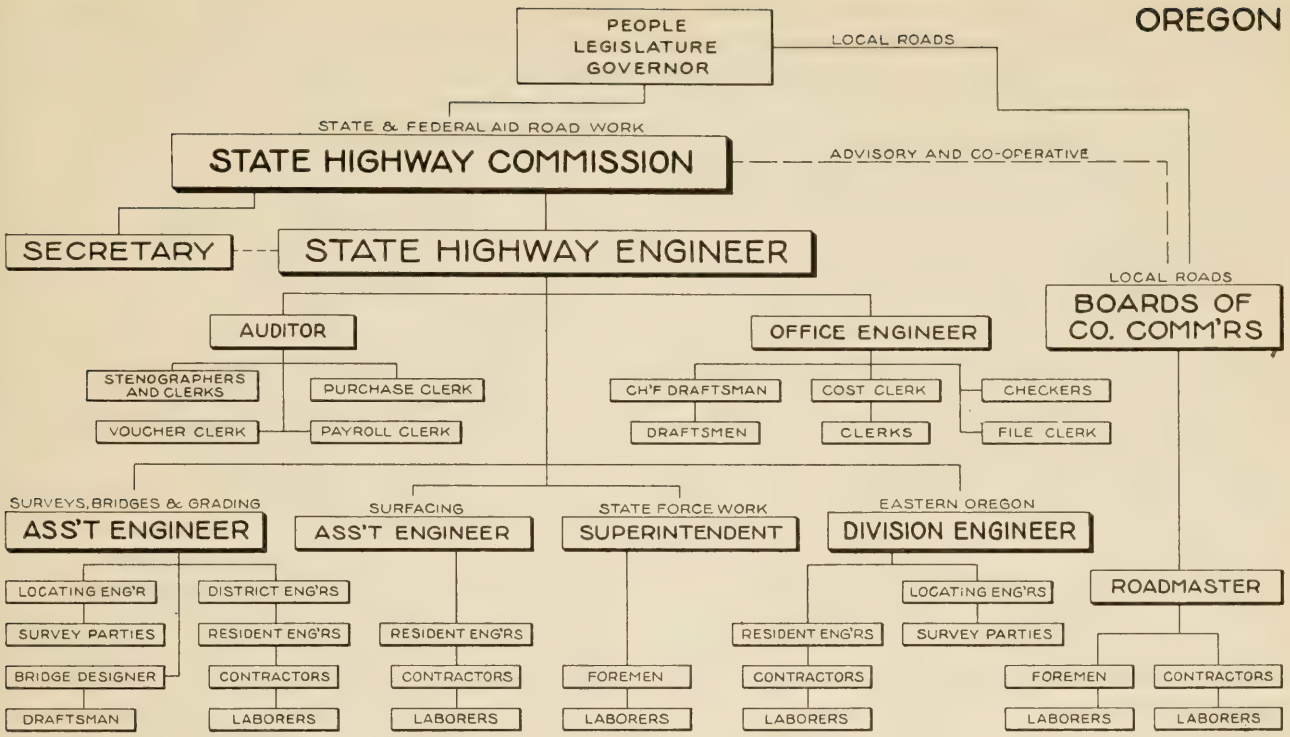
CLASSIFICATION, CONTROL, AND PROCEDURE.

The 47,000 miles of public road in Oregon are divided for the purpose of fixing responsibility for construction, control, and maintenance into five groups, namely, State highways, hard-surfaced highways, post roads, forest roads, and county roads.

State highways.—These comprise approximately 3,800 miles of highways, selected by the State highway commission for improvement under State supervision at State and local expense. Federal funds may also be used for the construction of this system.

Initiative for construction of these roads is taken by the State highway commission, which enters into agreements with the interested county board as to the type of construction and the portion of cost to be borne locally. Construction is carried out under State control and supervision. Maintenance is executed by the county under State supervision, the cost therefor being shared equally.

Hard-surfaced highways.—These comprise a system of roads with a mileage of 483 designated by



the State legislature for improvement under State supervision at State and local expense and 522 miles which may be improved under similar terms. The local board having jurisdiction over the territory in which the road is located is required to prepare the roadbed and the State is required to provide the pavement. Maintenance is executed under State supervision in accordance with the terms of an agreement as to subdivision of cost entered into by the State highway commission and the county board concerned.

Post roads.—These comprise 1,380 miles of road selected by the legislature for improvement by the State highway department with Federal and State funds. All plans, specifications, etc., are prepared by the State highway department and submitted to the United States Secretary of Agriculture for his approval. Construction is carried out under the direction of the State highway department. Maintenance is executed in a manner similar to that described under hard-surfaced highways.

Forest roads.—These comprise 521 miles of road selected by the legislature for improvement in the same general manner as for post roads. These roads are located in or adjacent to national forest reservations. Maintenance is to be carried out under the supervision of the State highway department in accordance with the terms of the Federal aid act.

The State highway commission has the power to modify and to add to the systems designated by the legislature, and it is probable that portions of the State highway system selected by the State highway commission will be coincident with portions of the systems selected by the State legislature.

All work to which the State or Federal Government contributes 25 per cent or more of the total cost is under the administration of the State highway department. The work may be carried out by convict labor with the consent of the governor, by force account under the direction of the State highway engineer, or let by contract. If the county bears a portion of the cost, the county board is required to approve the contract so let.

Monthly payments covering 85 per cent of the completed work, as evidenced by the estimate of the engineer in charge, and which bears the approval of the State highway engineer, are paid on order of the State highway commission; if the county contributes to the total cost, monthly payments cover only 75 per cent of the completed work. Final payments are made in a similar manner.

County roads.—These comprise all other public roads of the State. They are opened, controlled, constructed, and maintained by county officials.

REVENUES.

State.—The State highway fund composed of the proceeds of a one-fourth-mill tax, was estimated to amount to $230,000 for the year 1917. This fund

is available for the support of the State highway department and for payment of the State's portion of the cost of the construction and maintenance of the State highway system.

State bonds to the amount of $1,819,280.55 may be issued as needed by the State board of control to provide funds to meet Federal aid allotted for construction of post and forest roads.

State bonds to the amount of $6,000,000 may be issued by the State highway commission to provide funds to defray the State's portion of the cost of constructing the system of hard-surfaced highways. The law provided that not more than $1,000,000 of bonds of this series could be issued in 1917 and not more than $2,000,000 of this series in 1918. The issue of bonds of this series was postponed indefinitely as a war measure.

The net revenues, $150,000 for 1917, accruing from the registration of motor vehicles and the fines and penalties accruing from the violation of the motor-vehicle law are used for the payment of interest on the bonded indebtedness incurred for road purposes. The remainder, if any, may be used by the State highway commission for highway purposes.

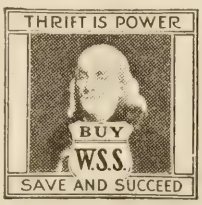
County.—County boards may levy a tax at a rate not exceeding 10 mills on each dollar of valuation. Three-fourths of the proceeds of this tax are expended in the district in which raised. The remaining one-fourth may be expended at the discretion of the county board. Special taxes at similar rates may be levied in the districts if the majority of the inhabitants so desire.

BONDS.

The State bonds above referred to are of different types. The bonds issued to meet Federal aid are limited to 20-year terms and bear interest at a rate not exceeding 4 per cent. The type of bond and manner of payment are fixed by the State board of control.

The State bonds to be issued for hard-surfaced highways are to be of the deferred serial type, bearing interest at 4 per cent, and may run not to exceed 20 years after 6 years from the date of issue.

Sinking-fund bonds in an amount not exceeding 2 per cent of the assessed valuation of the county may be issued by the county court when authorized by a majority of the voters of the county. The term of such bonds is stated in the proposal submitted to the voters. The interest on such bonds may not exceed 6 per cent. On January 1, 1915, there was outstanding $1,615,000 of county bonds issued for terms varying from 10 to 30 years, with interest at 5 and 6 per cent.



PENNSYLVANIA.

DEVELOPMENT.

State participation in road construction, improvement, and maintenance in Pennsylvania is of Statewide scope, was first evidenced in 1903, consists of actual construction and maintenance of a system of State roads with State funds, allotment of money aid to local roads of importance, and supervision of and allotments of money aid to the roads administered by townships of the second class, and is administered by a State highway department.

Road improvement in Pennsylvania had its beginning in private toll roads, which from their first establishment in 1792 were gradually extended throughout the State. However, as the railroads became the principal means of long-distance transportation, the toll roads were allowed to deteriorate, and many were abandoned or condemned and taken over by the local authorities as public roads. At present only a small mileage of the original system is administered by private ownership, and this mileage is decreased each year by purchase by the State.

Prior to 1895 road supervision and construction was executed by the township boards, but as this form of management did not prove satisfactory the county administration of roads was authorized by the legislature during that year. While county control was a step in the direction of centralized control of road matters, it was not until 1903 that the State highway department was organized, with the necessary funds to assist the counties in their road affairs.

From its beginning in 1903 the highway department has been modified from time to time until it, as now organized, has full control over the system of State roads comprising 11 per cent of the entire mileage of the State; supervisory control over the road system of the second-class townships which comprise about 85 per cent of the total mileage of the State, and extends money aid to counties, boroughs, or townships for the improvement of local roads which are of importance. Local roads improved with State aid comprise about 1 per cent of the total mileage of the State.

Approximately 11½ per cent of the road mileage of the State has been improved with funds supplied by State and local organizations. During the year 1916, $2,958,455.51 was expended by the State for maintenance of State roads and bridges.

The influence in the road and bridge work of the State exercised by the State highway department is evidenced by its control over the funds expended. During 1916 the State highway department expended $3,663,352 of State funds and $322,040 of local funds, and in addition thereto distributed to townships of the second class $712,501 of State funds. The total road and bridge expenditures within the State by both State and local forces for the period reached $10,985,392. Thus the State exercised supervision over the expenditure of about 43 per cent of all road expenditures.

During 1917 there was expended by all forces a total of $11,463,000 for highway purposes.

ORGANIZATION.

The organization of the State and local road forces and the relation existing between them is shown on the diagram herewith.

State.—The executive official of the State highway department is the State highway commissioner appointed by the governor for a term of four years. He provides rules and regulations governing the business of the department, appoints engineers, clerks, and such other employees as may be required, and prescribes their duties. He is assisted in the executive work of the department by a first deputy commissioner, a second deputy commissioner, a chief engineer, and an auditor, all of whom are appointed by the governor.

The department is divided for administrative purposes into five general divisions with specific powers and duties, namely:

1. The bureau of township highways is administered by the first deputy commissioner, who has general supervision of all road construction and maintenance administered by the local boards of townships of the second class.

A district engineer and such other assistants as may be needed is in charge of each of the five districts into which the State has been divided. He reports to the first deputy and represents him in carrying out the duties of the bureau, which in general are to prescribe and enforce rules and regulations not in conflict with State laws, fixing the duties of highway officials in townships of the second class; to approve all contracts let by such township officials for equipment, bridges, etc.; to supervise all townships of the second class road and bridge construction and maintenance, and to make an annual report to the commissioner of work accomplished and such statistics relative to roads and bridges of the State as may be at hand.

2. The division of maintenance is administered by the second deputy who allots funds available for maintenance and repair of State and State-aid roads. The allotment is made on recommendation of the assistant engineers of the division of construction who are in charge of the various districts into which the State has been divided for construction and maintenance purposes. The maintenance division employs as many as 10,000 or 12,000 men during the working season.

3. The division of construction is administered by the chief engineer who has charge of construction and maintenance of State and State-aid roads, and who is assisted by a central office force and a field force which for administrative convenience is divided into 15 district organizations, headed by district engineers, with such additional forces as may be needed from time to time.

4. The division of audits is administered by the auditor who examines all accounts against the department, and issues warrants for all payments made by the department.

5. The clerical and registration division is administered by the chief clerk, appointed by the commissioner, who has charge of the registration of motor vehicles, collection of fees therefor, and keeps records of all accounts and expenditures of the department. A comprehensive and effective cost-keeping system covering all expenditures of the department is administered by this division.

A statistician, appointed by and reporting directly to the commissioner, is in charge of the collection of data and information pertaining to the roads of the State. He edits bulletins and publications relative to the duties and accomplishments of the department.

County.—Authority over road affairs in the county is vested in a board of three commissioners elected for a term of four years. The county surveyor, an elective official, may be designated by the board, or the board may employ a county engineer to take charge of the road and bridge improvements under their control.

First-class townships.—Townships containing 300 or more inhabitants per square mile are designated first-class townships and are governed by a board of elective commissioners. They have full control over all township roads in their jurisdiction.

Second-class townships.—These comprise all other townships of the State. Authority over road and bridge matters is vested in a board of three elective supervisors. The board appoints a highway superintendent or road master and such other forces as may be required. Practically all operations of this board and its employees in road and bridge matters are subject to rules, regulations, and supervision of the State bureau of township highways.

CLASSIFICATION, CONTROL, AND PROCEDURE.

The 91,556 miles of public road in Pennsylvania are divided for the purpose of fixing responsibility for

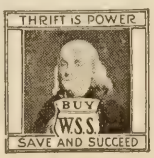
construction and maintenance into five groups, namely, State highways, State-aid highways, county roads, first-class township roads, and second-class township roads.

State highways.—These comprise 375 routes with a mileage of 10,235 designated in a general way by the State legislature, and are to be constructed and will be maintained by the State highway department with State funds. On January 1, 1918, approximately 2,000 miles of road of this group had been improved. Surveys, plans, specifications, and estimates are executed by the State highway department. Construction may be done by force account under the control of the department or let by contract. When by contract let by the State highway commissioner, inspection and supervision is exercised by the State highway department. Monthly payments may be made as the work progresses. They are based on an estimate prepared by the assistant engineer in charge of the work and are approved by the district engineer and State highway commissioner. Payment for 90 per cent of the amount of the estimate is made by the State treasurer on receipt of a warrant approved by the State auditor and the auditor of the State highway department.

State-aid highways.—These comprise about 1,050 miles of road improved by State and local funds, of which 459 miles are maintained by local forces. The remaining mileage, 591, located on State routes is maintained by and at the expense of the State.

New construction is instituted on the initiative of a county or township board. Application is made to the State highway commissioner for aid in constructing a designated road or section thereof, and if the project is deemed feasible by the State highway department and if the local board obligates itself to pay one-half the cost of construction and maintenance. Surveys, plans, specifications, and estimates are prepared by the district engineer and are approved by the State highway department and by the local board concerned.

Contracts are let by the State highway commissioner and construction is carried out under supervision of the State highway department. Payments are made by the county treasurer on warrants approved by the State highway commissioner until local funds appropriated for the project are exhausted; the remaining payments are then made from State funds by the State treasurer in the manner outlined under State highways.



County roads.—These are selected by the boards of county commissioners subject to the approval of the grand jury and the court of quarter sessions.

First-class township roads.—These comprise all roads of the townships not included in the three preceding systems. Roads of the third and fourth groups comprise a small percentage of the total road mileage of the State. They are constructed and maintained by their respective boards with local funds. The State highway department has no jurisdiction over roads of these groups unless they are improved by means of State-aid highway procedure.

Second-class township roads.—These comprise all other public roads of the State. They are administered by township boards under supervision of the State highway department. The State law provides that townships of this class which collect their road taxes in cash are entitled to an allotment from State funds equal to 50 per cent of the taxes collected. However, the allotments may not exceed $10 per mile of road. The legislature since 1911 has failed to provide funds sufficient in amount to pay the entire amounts due the townships.

All equipment, materials, etc., used by the State or local forces on State highways, State-aid highways, and second-class townships are purchased by contract let by or under the supervision of the State highway commissioner.

REVENUES.

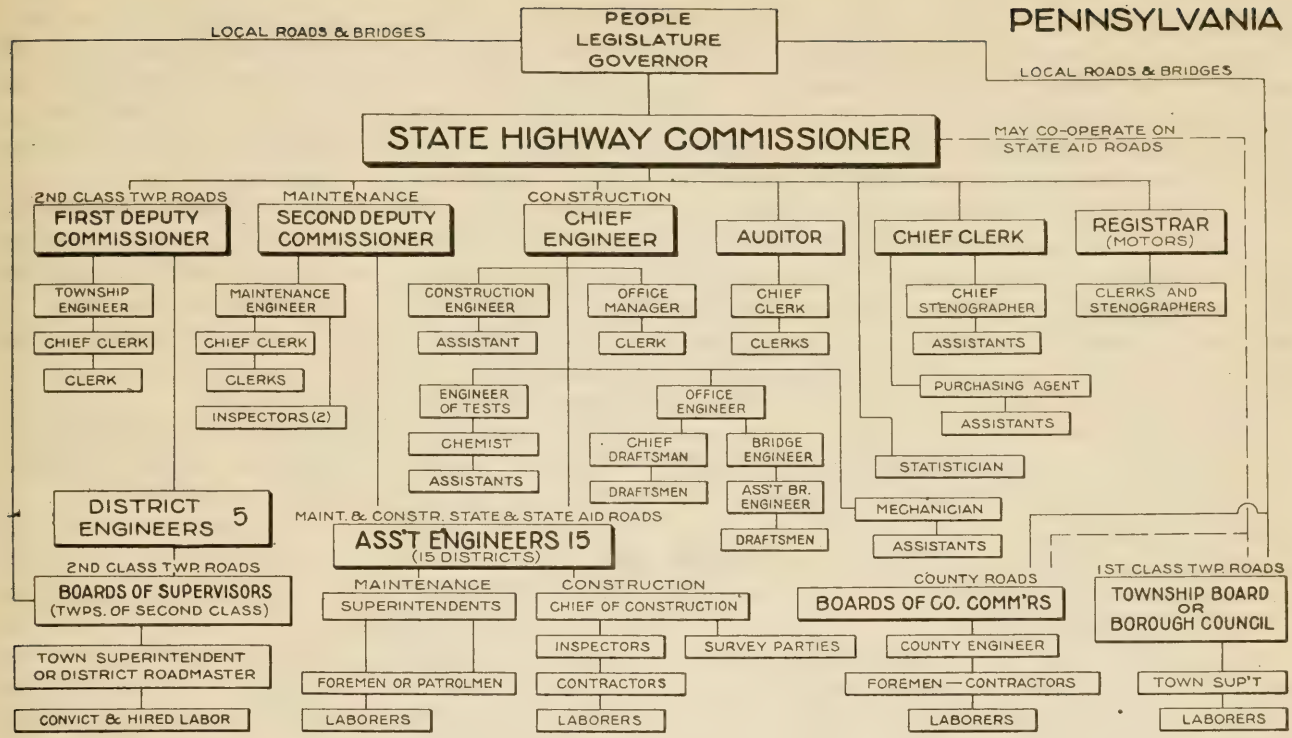
State.—For the two years June 1, 1917, to May 30, 1919, the State legislature has provided for each year the following amounts for the support of the State highway department and for State participation in road and bridge improvement.

For construction of State highways	$3,000,000
State aid to counties	750,000
Purchase of turnpikes	250,000
Cash bonus to townships of the second class	936,735
Maintenance of highway department	377,500
Total	5,314,235

In addition thereto the gross receipts of the motor-vehicle license fund, estimated at $3,268,026 per annum, are available for maintenance of State highways.

County.—The boards of county commissioners have authority to levy for road and bridge purposes an annual tax at a rate not exceeding 2 mills on each dollar of assessed valuation.

Township.—The boards of supervisors have authority to levy for road and bridge purposes an annual tax at a rate not exceeding 10 mills on each dollar of valuation, and may with the approval of the court of quarter sessions levy an additional tax at a rate not exceeding 10 mills on each dollar of valuation.



BONDS.

Bonds may be issued by counties and townships for road and bridge purposes at a rate of interest not exceeding 5 per cent and in amounts not exceeding 2 per cent of the assessed valuation of the county or township. The type and term of such bonds is not specified by law. On January 1, 1915, $27,547,659 of county and township bonds were outstanding.

RHODE ISLAND.

DEVELOPMENT.

State participation in road and bridge improvement in Rhode Island dates from 1896, is confined to a system of State roads although provision has been made for State aid to towns and is administered by a State board of public roads.

State interest in and control over road improvement began in 1896 with the appointment of a State highway commissioner, who, during the two succeeding years, constructed in several towns a total of 9½ miles of object-lesson roads. These roads consisted of half-mile sections of water-bound macadam, the cost being paid 75 per cent by the State and 25 per cent by the town. These roads served as a demonstration of the stability of roads constructed of proper materials under skilled supervision, and were no doubt useful in stimulating a demand for further road improvement. However, State interest in road improvements remained inactive until 1902, when the State board of public roads was first organized. At this time a system of State roads was designated by the State legislature for improvement with State funds.

The State road system as originally outlined has been augmented from time to time until it now comprises 37 per cent of the entire road mileage of the State. Three hundred twenty-four and five-tenths miles, or 40 per cent, of the State system has been surfaced, 207.7 miles being water-bound macadam and 116.8 miles being bituminous macadam. Thirty-four and five-tenths per cent of all roads of the State have been improved by surfacing.

The total expenditures for road and bridge purposes by all road forces of the State during 1916 reached $942,152. Fifty-seven and one-half per cent of this amount, or $543,162, was State funds expended by the State board of public roads.

During 1917 a total of $862,000 was expended by all forces in the State for highway purposes.

Since 1914, the work of the board has been confined to bridge construction, and bridge and road maintenance, funds for new road construction not being available. However, funds sufficient in amount to provide for the maintenance of the existing improvements were made available for 1917.

ORGANIZATION.

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

State.—Authority over road affairs is vested in the State board of public roads consisting of five members, one from each county of the State, appointed by the governor for terms of five years, one

term expiring annually. The executive official of the board is the chief engineer appointed by the board for an unlimited term. He is assisted in the central office by deputies who have charge of each of three divisions, namely, bridges, surveys, designs and estimates. Such other technical assistants and clerical force as may be required are provided for the central office. The State is divided into six divisions, each in charge of a division engineer who reports to the chief engineer and represents him in the work of construction, repair, reconstruction, and maintenance in the district. A field force of inspectors, field parties, and other help is provided in sufficient amount to carry out the work.

The collection of fees for motor vehicle and chauffeur licenses is carried out under the direction of the board.

County organization.—The counties in Rhode Island, as such separate organizations, take no part in road and bridge affairs.

Towns.—The town council composed of five or seven elective officials exercises, through executive officials appointed by the council or elected by the voters, control and maintenance of local roads and bridges under their jurisdiction.

CLASSIFICATION, CONTROL, AND PROCEDURE.

The 2,170 miles of public roads of Rhode Island are divided, for the purpose of fixing responsibility for construction and maintenance, into two groups, namely, State roads and town ways.

State roads.—These comprise 800 miles of the principal roads of the State designated by the State legislature. The roads of this group are improved and maintained by the State with State funds. The State law requires that the width of surfacing on tangents shall be not less than 14 feet nor more than 18 feet. The width on curves is fixed by order of the board and is generally wider. However, the width of roadway may be increased on request of and at the expense of the towns in which located.

All surveys, plans, and specifications for roads of this group are prepared by the State board of public roads. Construction and maintenance are carried out under the direction of the board by convict labor, by force account, or by contract.

When by convict labor, the convicts are furnished by the penal and charitable commission, on request of a majority of the board. The additional expense incurred in guarding and transporting the convicts is met from the fund provided for construction and maintenance purposes. Convicts detailed to road work are entitled to special privileges and may receive a small wage for their labor.

When by force account all steps of the work are supervised and administered by employees of the board.

When by contract let by the board after due publicity to a contractor who furnishes bond in 50 per cent of the contract price, the work is under the supervision of an inspector detailed to the work by the chief engineer, and the occasional inspection of the division engineer and of the chief engineer.

Monthly payments based on estimates covering 85 per cent of the completed work are made on order of the chief engineer to the contractor by the State treasurer with the approval of the State auditor.

Final payment is made in a similar manner when the completed work has been accepted by the division engineer and by the chief engineer.

Town ways.—These comprise all other roads of the State. They are controlled, constructed, and maintained by local officials with local funds.

The State law provides that whenever a town makes an annual appropriation, by a vote of the electors, for road and bridge purposes equal in amount to an assessment of 20 cents or more on each $100 of taxable property in the town, and requests the State board of public roads to supervise the expenditure of such appropriation, such town is entitled to State aid in the sum of one-fifth of the amount appropriated. Only one town has taken advantage of this provision of law.

REVENUES.

State.—The funds for the calendar year 1917 at the disposal of the State board of public roads are obtained from several sources, namely:

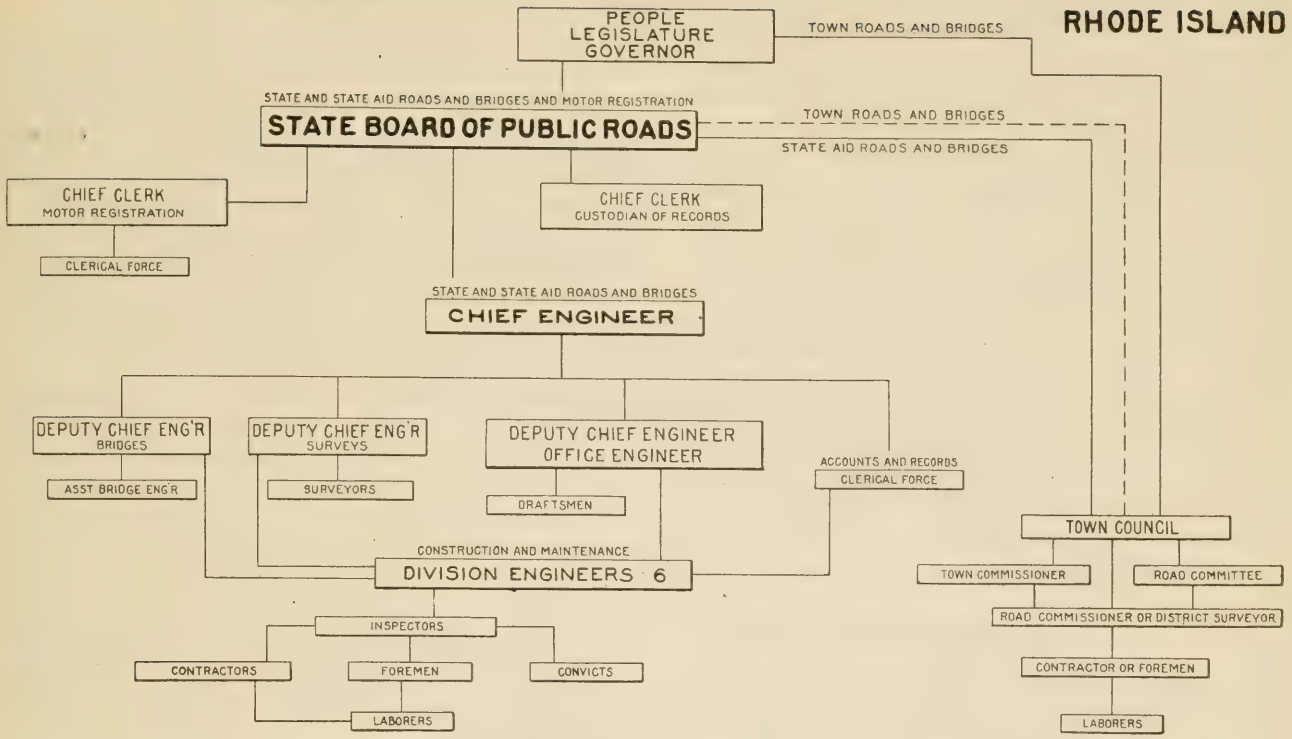
1. The fees collected from licenses of chauffeurs and motor vehicles and penalties collected for violation of the motor-vehicle law, amounting to $353,652, are available for expenditure by the State board of public roads in the following manner: A total of $2,500 is paid to members of the board as annual salary; not to exceed $12,500 for supplies for the motor-registration department; not to exceed $20,000 for clerical and contingent expense incident to enforcement of the motor-vehicle laws, and the remainder of the fund, $318,652, for the repair and maintenance of State roads.

2. By legislative appropriation of $2,500 for salaries of board, $5,000 for traveling expenses of board and for salaries and expenses of employees of the department, $175,000 for bridges on the State roads, and $34,997 to meet funds allotted by the United States Government.

3. The proceeds amounting to $224,423 of a State-wide tax of three-tenths of a mill levied on all taxable property in the State.

4. The refunds estimated to be $2,450 from towns and public-service corporations to the bridge construction fund.

Thus the total State funds available amounted to $798,022 exclusive of refunds.



Local.—Town funds are raised by local taxes. The amount of the fund for road and bridge purposes is fixed by a vote at the annual town meeting and the tax rates are fixed accordingly by the administrative officials of the town.

BONDS.

Town bonds may be issued for road improvement when specially authorized by the legislature, but apparently none have been issued.

State bonds may be issued on authority of the legislature. Such bonds may bear not to exceed 4 per cent interest and to be retired by the sinking fund method within 50 years. The total State bonds outstanding on January 1, 1918, amounted to $1,975,000. These bonds must be retired in 30 years and bear interest varying from 3 to 4 per cent.

SOUTH CAROLINA.

DEVELOPMENT.

State participation in road building is limited to educational, advisory, and supervisory assistance administered by a State highway commission established in 1917. No money aid is extended by the State, but 20 per cent of the automobile-registration fees is used for the support of the State highway department, while 80 per cent of such fees is refunded to the counties. The State exercises no control over the expenditure of these funds except on request of local authorities. For a number of years previous to 1917 the department of agriculture, commerce, and industries collected and disseminated information and statistics on road building, and issued road maps and route books.

During 1917 expenditures by all forces of the State for road purposes totaled $1,277,000.

ORGANIZATION.

The organization of the State highway department and its relation to the local road forces is shown on the diagram.

State.—The State highway commission is composed of two nonsalaried members appointed by the governor and three ex officio members as follows: The senior professors of civil engineering of the Military College of South Carolina, of the Clemson Agricultural College, and of the University of South Carolina.

A highway engineer appointed for an unlimited term by the commission, which appointment may be based upon an examination, must be skilled and experienced in the design, construction, and maintenance of roads and bridges. Upon the recommendation of the State highway commission the State highway engineer appoints two assistant engineers, which appointments may be based upon a civil-service examination. A clerk, who serves as secretary to the commission, is appointed by the commission.

The highway department is composed of two divisions, viz, engineering and automobile licensing and registration. The engineering division, administered by two assistants under the State highway engineer, has charge of the work, requested by local authorities of making surveys, preparing plans,

specifications, and estimates, and the supervision of road and bridge work on Federal-aid projects. The registration and licensing of automobiles is administered by a clerk who is secretary to the commission, and who reports to the State highway engineer.

County.—Except where special laws apply, the control over roads and bridges in the several counties is vested in a county board of commissioners composed of the county supervisor as chairman, elected by the people for a four-year term, and two commissioners appointed by the governor on the recommendation of the county delegation to the general assembly. Some counties have more than two commissioners and several counties operate under special laws. District overseers have immediate control over the roads in the various townships. These are appointed by the county board, or subject to its approval, or by the township board of commissioners in counties where such boards exist.

CLASSIFICATION, CONTROL, AND PROCEDURE.

The roads of South Carolina, comprising about 32,000 miles, are, for the purpose of fixing responsibility for construction, control, and maintenance, divided into two groups, viz: Proposed State highway system and county roads.

Proposed State highway system: In order to comply with the requirements of the Federal-aid road act, the State highway department has designated a tentative State highway system which it is proposed to improve with Federal aid and county funds during the five-year period 1917 to 1921. This system includes 2,550 miles, or 6.5 per cent of the total road mileage of the State, and connects the county seats and principal market centers. When local authorities request Federal aid, plans, specifications, and estimates will be prepared by and at the cost of the State. The work will be done by the counties by contract, force acccount, or prison labor, and under the inspection and supervision of the State highway department. When completed the roads will be maintained by the counties under State supervision. The cost of construction will be borne 50 per cent by the counties and 50 per cent by the Federal-aid fund. The counties will pay the entire cost of maintenance.

County roads.—All roads in the State including the proposed State system are county roads, built and maintained under the direction of county authorities with county and township funds. However, surveys, plans, specifications, and estimates may be prepared and construction and maintenance may be supervised by the State highway department on request of the local authorities.

REVENUES.

State.—Automobile license fees are collected by the State highway department. Of the amount collected, 20 per cent is retained to pay the expenses of collection and for the support of the State highway department, and 80 per cent is returned to the counties from which collected for the construction of roads and bridges therein. No supervision over the refunds to counties is provided for except on request of county authorities. During 1917 there was collected $113,556, of which $88,630 was refunded to the counties and $24,926 was retained by the State.

County.—Boards may annually levy a 1-mill tax, the proceeds to constitute a part of the county-road fund. They may also levy a similar tax on property in any township on written request of two-thirds of the property owners of the township. An additional levy of 2 mills may be assessed for two-year terms by the county board on any township if agreed to by a majority vote of the electors who own real and personal property subject to taxation. One-half of the taxes derived from the sale or manufacture of timber is used for the improvement of public roads.

Unless by law exempt, all male persons between certain ages, varying from 18 and 21 to 50 and 55, are required to work from 2 to 12 days on the public roads, or to commute the same in cash at the rate of from $1 to $3 per day. The conditions under which statute labor is applied vary under the special laws applying to the various counties.

It is estimated that the various counties and townships expended about $1,250,000 for road and bridge purposes during 1916.

BONDS.

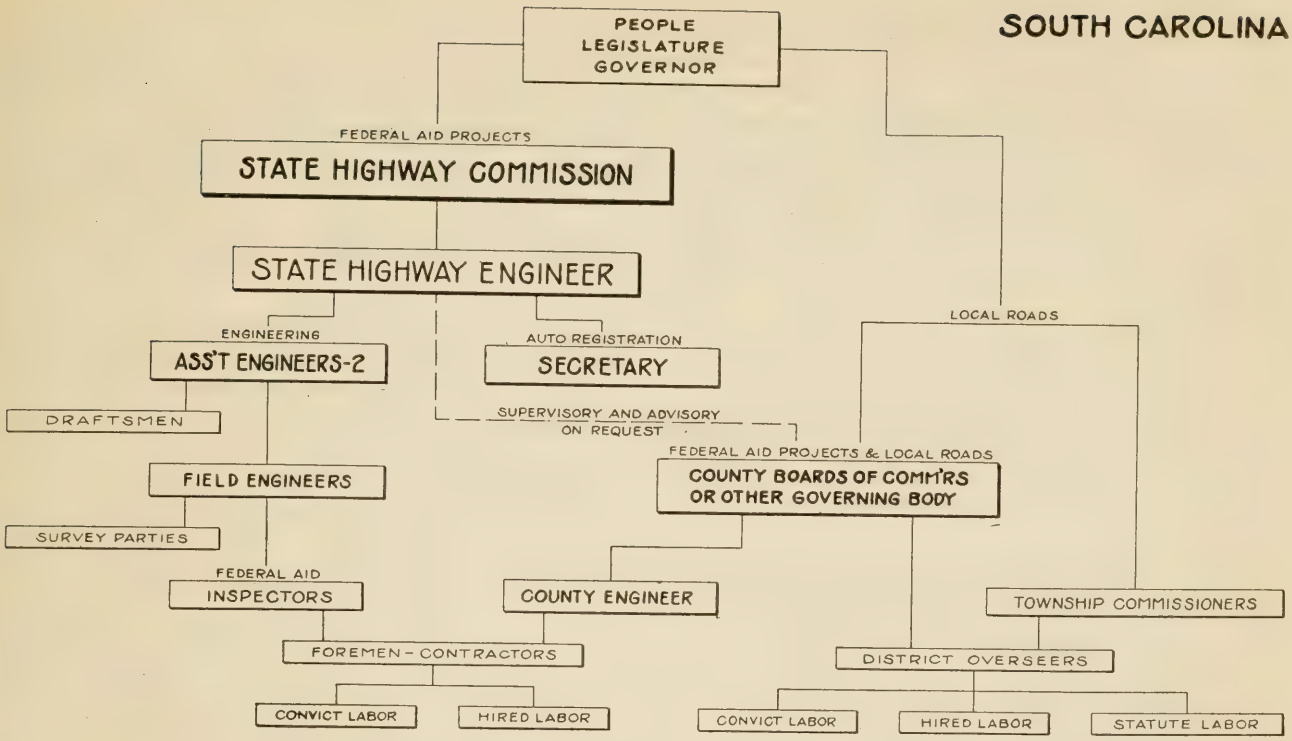
There is no general law authorizing the issuance of road and bridge bonds. Such bonds when authorized are by special acts of the legislature. It is estimated that $460,000 of county and township bonds were outstanding on January 1, 1915. Since that date approximately $1,675,000 county and township bonds have been authorized and sold.

SOUTH DAKOTA.

DEVELOPMENT.

State participation in road work in South Dakota is of recent origin, of limited amount, is dependent on local initiative, is financed by the proceeds of a State-wide tax, and is administered by a State highway department.

State interest in road improvement in South Dakota dates from the passage in 1913 of an act



creating a State highway commission with supervisory and advisory duties and the designation of a system of State highways to be constructed under State supervision at county expense.

Road improvement in this State is confined principally to the construction of bridges and culverts, and the grading of earth roads. During the years 1915 and 1916 the expenditures by local forces for bridge and culvert work exceeded the sum expended for road work.

On January 1, 1917, 750 miles, or 0.8 per cent, of the total road mileage were reported as surfaced, while on January 1, 1918, 1,500 miles, or 1.5 per cent, of the total mileage had been graded and drained.

Expenditures by local forces during the year 1916 reached $1,250,000. No State funds were expended other than for the support of the State highway commission, which was engaged in educational and advisory duties.

Centralized control over road work is now becoming established in accordance with the terms of the legislation enacted in 1917, and road and bridge improvement will proceed in accordance with standard plans and will be maintained when completed under State supervision.

Total expenditures during 1917 by all road forces reached $2,755,000.

ORGANIZATION.

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

State.—The State highway department is composed of the governor as chairman, the State engineer as secretary, both ex officio members, and a third member appointed by the governor. The appointive member is required to be an experienced road builder having the qualifications of a civil engineer. Such other assistants and clerical force as may be necessary are employed by the department.

The department so constituted supervises, controls, and directs the building of roads and bridges to which Federal or State aid is contributed and controls to a limited extent the construction or repair of local roads. Action in such local cases is not taken by the department until complaint has been filed against the local officials by five freeholders of the county in which the work is in progress. The department is required whenever a county employs a competent road builder for the purpose of supervising or controlling road building to authorize him to plan, supervise, and control the road building in said county.

County.—The road and bridge affairs are administered by a board composed of three or five commissioners elected for terms of four years. The county auditor and the county treasurer are respectively clerk and fiscal agent of the board.

Counties not organized into townships are divided by the board into districts and a road supervisor is appointed for each district. The county board may employ a suitable person to take charge of the county road work, and he may be designated the county engineer.

Township.—Road and bridge affairs in legally organized townships are administered by a board of three supervisors elected for terms of three years, one being elected each year. This board has jurisdiction over township roads which are generally the least important roads of the county. The township board may not expend to exceed $125 on a bridge or culvert without first securing authorization from the county board. Such road forces as may be required for township work are employed by the township board.

CLASSIFICATION, CONTROL, AND PROCEDURE.

The 96,306 miles of public road of South Dakota are divided for the purpose of fixing responsibility for control, construction, and maintenance into three groups, namely, State roads, county roads, and township roads.

State roads.—These comprise approximately 6,000 miles of public road selected by the county boards with the approval of the State highway department for improvement under the supervision of of the department with Federal or State and local funds. Initiative for construction is taken by the county board. On approval of the project by the department and the designation of the amount to be contributed by the county, surveys, plans, specifications, and estimates are prepared at the expense of the county and submitted to the State highway department for approval. Bids are requested by the State highway department and the contracts may be let or the work may be done by force account under the direction of the department. Partial and final payments are made on order of the State highway department. The county's portion of the cost is paid by the county board when ordered to do so by the State highway department. Improved roads of this group are maintained by county forces at county expense, subject to the supervision and inspection of the State highway department.

County roads.—In counties not organized into townships all roads other than State roads and the more important roads in organized townships are classed as county roads. They are improved and maintained by county forces at county expense. The State highway department exercises no supervision over these roads unless requested to do so by five or more freeholders of the county. All bridges constructed on these roads are required to be built in accordance with plans provided by the State engineer, or a competent assistant designated by him.

Township roads.—These comprise the minor roads of organized townships. They are opened, constructed, and maintained at township expense by township officials subject to limitations fixed by statute.

REVENUES.

State.—Revenues for road and bridge purposes are obtained from a tax levied at a rate not exceeding one-tenth of a mill. From the proceeds of this tax the legislature appropriated $100,000 for the fiscal year ending June 30, 1918, and $120,000 for the fiscal year ending June 30, 1919. These amounts are available for payment of the salaries and expenses of the State highway department and for the construction of State roads. Eighty per cent of this fund must be expended in the counties in which collected if application therefor is made by the county board within one year from the date of the tax levy.

County.—Eighty-five per cent of the motor vehicle license fees originating in each county are retained in the county motor vehicle road fund, and are used for gravelling and dragging the public roads outside the limits of cities. The county board may levy a 2-mill tax, and when authorized by a majority of the electors this tax may be increased to 5 mills for road and bridge purposes. A poll tax at a rate of $1.50 is levied on all male persons between the ages of 21 and 50. This tax may be paid in cash or a day's labor may be contributed in lieu thereof.

Township.—The electors of each township may at the annual town meeting in March appropriate such sums as they deem proper for road and bridge purposes and fix the tax rates to produce these amounts. However, the road tax may not exceed 50 cents on each $100 of assessed valuation.

BONDS.

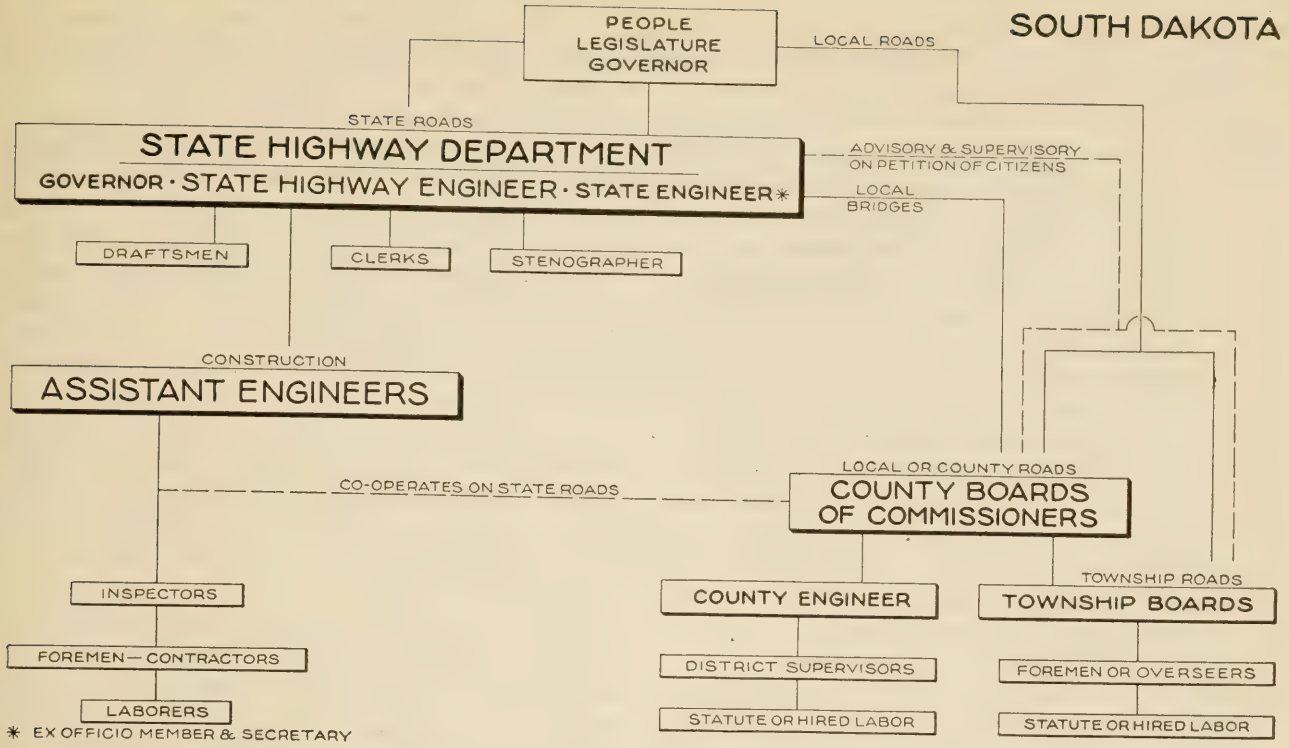
Sinking-fund bonds may be issued by county boards in amounts not exceeding 5 per cent of the total assessed valuation when authorized by three-fourths of the electors of the county. Such bonds if issued shall become due in not less than 5 nor more than 20 years from the date of issue, and they may bear interest at rates not exceeding 5 per cent.

Bonds may be issued by township boards in an amount not exceeding 5 per cent of the total assessed valuation of the township, and in no case to exceed $5,000. Such bonds may bear interest at a rate not exceeding 10 per cent, and may not run more than 20 years. No State, county, or township bonds are outstanding in South Dakota.

TENNESSEE.

DEVELOPMENT.

State participation in road and bridge improvement in Tennessee is of very recent origin, but is of State-wide extent. The State highway commission, organized in 1915, has supervision of construction and maintenance of the State highway system, com-



prising about 5 per cent of the total road mileage of the State. Little improvement has been done under the direction of the State highway commission, due to its recent organization and to the limited amount of funds placed at its disposal by the State legislature. However, during 1916, $200,000 of State funds and $400,000 of local funds were expended under the direction of the commission on the State highway system for maintenance, which, in many cases, amounted practically to reconstruction.

Beginning with 1917, a State-wide tax was levied on all assessable property in the State, and the proceeds thereof, together with Federal funds and auto-license revenues, constitute the fund at the disposal of the commission for construction and maintenance of the State highway system.

About 20 per cent of the road mileage of the State has been hard-surfaced, and a larger percentage of the mileage has been graded and drained by and at the expense of the various counties of the State. During 1916 about $4,000,000 was expended by the counties for road and bridge purposes. The State highway commission exercises control over projects involving the expenditure, either wholly or in part, of State funds and may advise county officials under certain circumstances relative to the expenditure of local funds.

The total expenditure during 1917 by all road forces reached $2,481,000.

The Legislature of Tennessee has provided many road laws applicable to the counties possessing certain qualifications, with the result that neither uniform organization nor methods of construction and repair are found in the various counties of the State. The State highway commission is engaged in the dissemination of information throughout the State relative to efficient methods of construction and repair by local officials, and improvement in the general condition of the roads of the State is to be expected.

The State is divided into three general divisions, namely, eastern, middle, and western Tennessee, which differ greatly in soil, topography, and amount and distribution of road-building materials. Therefore, the types of construction vary to a marked degree in the various localities, due to the availability and cost of road-building material.

ORGANIZATION.

The organization of the road forces of the State and their relation is shown on the diagram.

State.—The State highway commission is composed of six members, three ex officio, namely, the governor of the State, the State geologist, and the dean of engineering of the University of Tennessee, and three members appointed by the governor for terms of six years each, resident, respectively, in eastern, middle, and western Tennessee. No more than two of these appointees may be of the same political faith. The commission elects one of its members as chairman for a term of two years, and appoints a secretary for a like term. The secretary is required to be qualified in road building and maintenance.

The commission is required to hold such meetings as may be necessary for the conduct of the business

of the commission; to prepare a highway plan of the State showing the system of intercounty highways comprising the system of State highways; to establish standards for the construction and maintenance of highways in the various counties; to designate in each county the number of miles of traveled road which are deemed of sufficient importance to be classified as main traveled roads, and which may be entitled to State or Federal aid for their improvement (additional roads may be added to this system by the commission); to publish at stated periods such information and statistics as may have been compiled relative to the roads and bridges of the State; to advise county or district road officials in road and bridge matters brought to their attention; and to request information from such officials relative to the roads and bridges of their respective districts. The commission is also required to keep on file and furnish when requested by county or district road officials current prices of bridges, culverts, road materials, tools, implements, or machinery.

All licenses for motor vehicles are issued and the fees therefor are collected by the State highway commission.

The secretary is the executive and administrative head of the commission and is in charge of the office of the commission at Nashville, and his approval is required to all contracts and to all checks, vouchers, or warrants drawn against funds under the control of the highway commission. He is further required to assist county and district authorities in making the necessary financial arrangements for raising and floating bond issues for highway purposes.

The State highway engineer is required to be a civil engineer, experienced in highway construction. He is appointed by the State highway commission and may be removed for due cause. Such other engineering or other expert assistants employed by the commission are required before entering upon their duties, to pass a satisfactory examination conducted by a committee composed of the dean of engineering of the University of Tennessee, the State geologist, and the State highway engineer. The State highway engineer is in charge of all work where State or Federal funds are involved, and he is required to approve all vouchers, claims, and accounts paid out of the State highway fund or any joint fund where the work is financed in part by county or district and State funds. He may be requested by county officials to take charge of work financed wholly by county funds. He is the technical advisor of the State highway commission and is required to furnish advice to county officials on matters pertaining to the surveys, construction, and maintenance of roads and bridges when requested.

County organization.—The governing board of the county is known as the county court and is composed of the county judge, and two justices of the peace from each district of the county. The presiding officer, the county judge, of this court may be chosen from the members of the court, but in many counties he is elected by the people at the general biennial election. This court, known as quarterly court, is composed of the presiding officer and the justices, and meets in January, April, July, and October. The chairman, who constitutes another division of the court, is required to hold sessions at the first of each month, unless otherwise provided by legislation, applicable to counties possessing certain qualifications.

The quarterly court at its January term in odd years divides the county into road districts, and elects a road commissioner for each district for a term of two years. Such commissioners are the executive officers of the court in all road matters in their respective districts, and they may appoint overseers for sections of the road containing not less than 1 nor more than 5 miles. Certain counties of the State favored by legislation have a road commissioner or a board of road commissioners elected for terms varying between two and six years, depending upon the county and the legislation applicable. Certain counties are authorized to employ engineers skilled in road building. Due to the large amount of special legislation in force in Tennessee, no uniform organization can be laid down as applicable to all counties of the State.

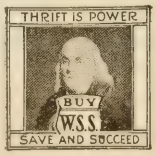
CLASSIFICATION, CONTROL, AND PROCEDURE.

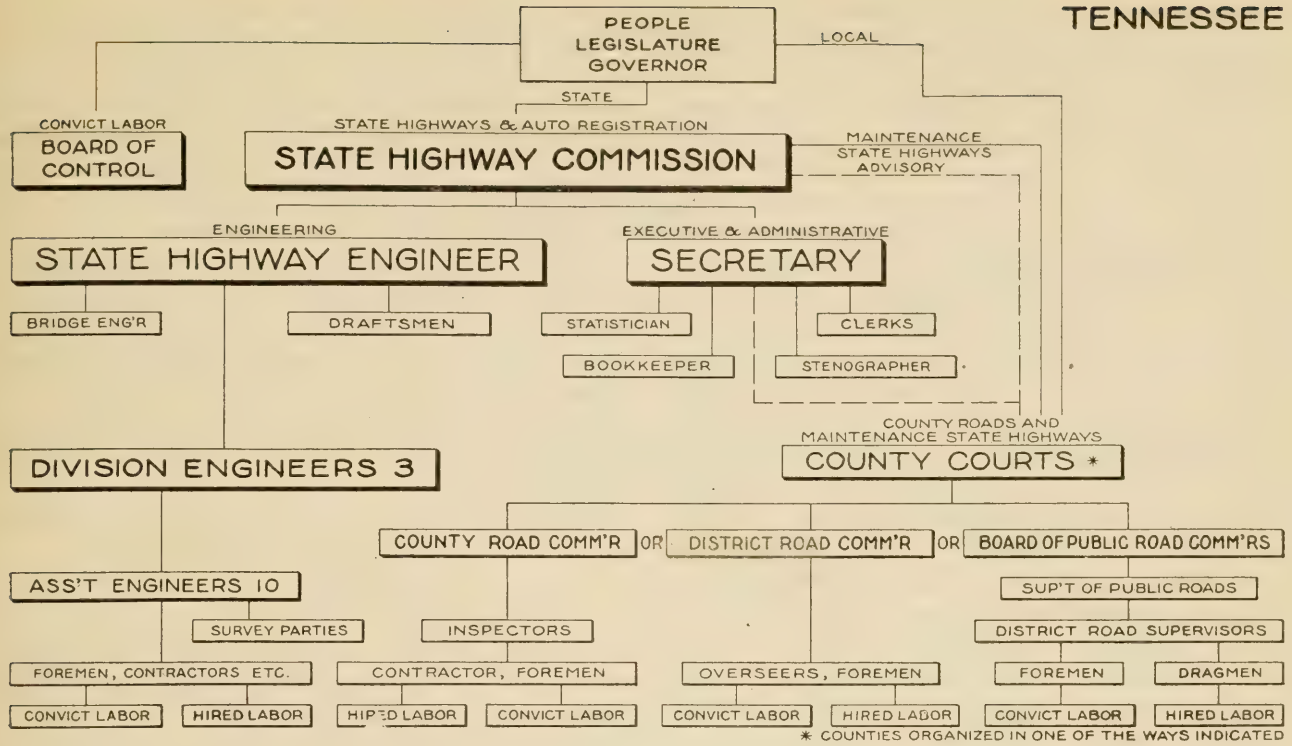
The roads of Tennessee are divided into three general classes:

State highway system.—These comprise the roads selected by the State highway commission as of sufficient importance to warrant the expenditure of State and Federal funds to improve and maintain them. Portions of the State highways may be improved under the State-aid plan, the State and counties providing a joint fund for their construction. In such cases, the State provides not less than one-fourth of the required amount while the counties are responsible for the maintenance of the roads when constructed.

County roads.—These comprise all other public roads of the State and are constructed and maintained by county officials with county funds.

Turnpikes.—These are public roads improved at private expense, the owners of the roads receiving reimbursement through tolls collected. The turn-





pike mileage of Tennessee is decreasing each year, and at the present time probably does not exceed 800 miles. Statutory control and supervision of turnpikes is exercised by the road officials of the counties in which the roads are located.

State highways may be improved in two ways, either by State and Federal funds, or by State or Federal funds in conjunction with local funds. The State highway commission has not definitely outlined its policy, but it is believed that the latter method will be almost universally followed. Under this plan the State highway commission and the local officials agree upon a road or section of road to be improved and joint funds are provided. The State is required to provide not less than one-fourth of the total cost of the work. All surveys for location and construction and supervision during construction are under the control of the State highway commission. When completed such roads are maintained by the county with county funds under State supervision. The State highway commission, however, has the right to take over the maintenance of such roads and any additional roads comprising the State highway system, if sufficient State funds are available for the maintenance thereof.

All construction dependent in whole or in part on Federal or State funds is under the complete control of the State highway department. Such work may be executed by State convicts, with approval of the Tennessee board of control, county or workhouse prisoners, by force account, or by contract. Contracts are let by the State highway commission and the State highway engineer assumes charge of the work and details a competent assistant to personally supervise it.

The State highways constructed with Federal or State funds are maintained by the State highway commission with State funds. The State highways constructed under the State-aid plan are maintained by the county with local funds, subject, however, to supervision and inspection by the State highway commission. Maintenance may be executed by contract, by force account, or by patrolmen. The patrol system has given satisfaction where adopted, and it is estimated that this system is in force in about 40 of the 96 counties. Detailed reports of the operation of the patrol system are furnished by the counties to the State highway commission at stated intervals. While county roads are constructed and maintained by county officials with county funds, State authorities may tender advice when requested to do so by the local officials.

REVENUES.

State.—The State highway commission is supported by funds obtained from 10 per cent of the gross revenues of the auto-license fund. The gross receipts from this source will amount to approximately $400,000 for the year 1918.

A State-wide tax of 1 mill on each dollar of valuation of all taxable property in the State is collected and constitutes the State-aid fund. This tax will yield approximately $700,000 in 1918. This fund is applied to the construction and maintenance of

State highways and during the period 1917 to 1921 must be so distributed that each county of the State shall have received at least $25,000 during the period.

Ninety per cent of the revenues from auto licenses are distributed among the counties in the ratio in which collected. This fund is expended by the county under supervision of the State highway commission for maintenance of State highways.

Local revenues.—Counties levy a tax on property and privileges for road purposes. The tax on property varies between 5 and 25 cents on a hundred-dollar valuation, a portion of which may be worked out. The tax on privileges shall not be less than one-fourth of the amount assessed for county purposes and not exceeding two-thirds of the amount of this tax may be paid in labor of the interested party at the prevailing wage. A labor tax of not less than 5 or more than 10 days of labor on the road is levied on each able-bodied male inhabitant between the ages of 21 and 50, and who is not exempt by law. This tax may be commuted at 75 cents to $1.25 per day. Counties may levy an additional tax for bridge purposes at a rate nor to exceed 20 cents on a hundred dollars. A few counties levy a turnpike tax of 10 cents on a hundred dollars. In a few counties of the State, a poll tax varying from $2 to $4, payable in cash, is levied instead of the labor tax above referred to. By special legislative authority some counties may require owners of wagons and teams to work them on the public roads the same number of days that statute labor is required.

BONDS.

Bonds may be issued by counties for road purposes for a period not exceeding 40 years and at a rate of interest not to exceed 6 per cent. The total of the bonds issued may not exceed 10 per cent of the total assessed valuation of the county, provided, however, that by a two-thirds vote of the legal voters, this amount may be increased to 15 per cent. The total county bonds outstanding on January 1, 1915, amounted to approximately $6,900,000. No State-road bonds have been issued.

TEXAS.

DEVELOPMENT.

State participation in road improvement in Texas is in its initial stage, authority therefor having been granted by the legislature in 1917, consists of money aid allotted to assist the counties in constructing a system of State highways, and is administered by a State highway department.

The system of State highways comprises 12,620 miles, or 9.8 per cent of the total State mileage, selected by the State highway engineer for improvement with Federal, State, and local funds. However, State aid may not be extended to more than 10 miles of road in a county during any one year.

On January 1, 1917, 12,000 miles, or 9.3 per cent, of the total road mileage were reported as surfaced. As this work was done by and at the expense of the counties, the improvements as a rule were located to serve local needs rather than to form connecting links in a State-wide system. The post road extending from Austin, the State capital, to San Antonio, a distance of about 70 miles, was constructed with local and Federal funds in accordance with the terms of the post-road act of August 4, 1912, and is the longest stretch of improved road in the State.

During the year 1916, $10,500,000 was raised and expended by local officials for road and bridge purposes.

During the year 1917, $10,010,000 was expended by all officials for road and bridge purposes.

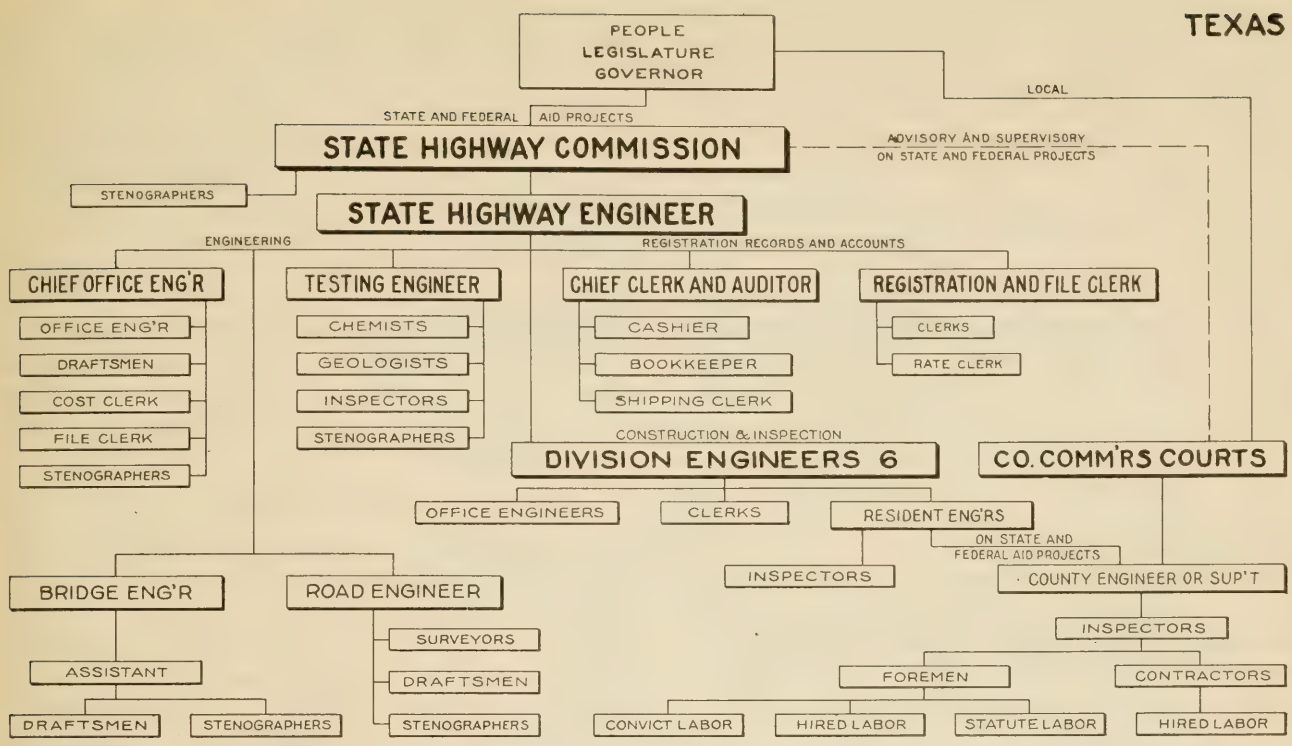
ORGANIZATION.

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

State.—At the head of the State highway department is the State highway commission, composed of three citizens appointed by the governor, with the consent of the senate, for a period of two years, the entire personnel changing at the end of each period. The commission is empowered with the administration of the State-aid law to formulate plans and policies for the location, construction, and maintenance of a comprehensive system of State highways and public roads in cooperation with the counties of the State, to establish rules for the conduct of the department, to advise with local officials relative to the improvement of county roads, to elect a State highway engineer, and collect and apportion the funds available from the registration and regulation of motor vehicles. The commission has appointed a secretary to administer the registration of motor vehicles and has provided him with the necessary clerks.

The State highway engineer is supported by a staff of engineers and appoints division engineers for each of the six districts into which the State has been divided. When convenient and expedient, county engineers will be appointed to these positions besides retaining their connections with their home county.

County.—Authority over road and bridge affairs is vested in a commissioners' court, created in each county by the election of a county judge and one commissioner elected for a term of two years each from each of the four districts of a county. The court may appoint a county engineer or road superintendent for the county or for each of the districts. Such officials are responsible for the administration of



the road program in the county or district. The county is required also to collect the fines for the violation of the motor-vehicle regulations and to enforce, after 1920, a wide-tire law, which prohibits carrying more than 2,000 pounds on a tire rim less than $3\frac{15}{16}$ inches in width.

The commissioners' court is required to divide the county into convenient road precincts and appoint road overseers and apportion the road hands for each precinct.

CLASSIFICATION, CONTROL, AND PROCEDURE.

The 128,960 miles of public road in Texas are, for the purpose of fixing responsibility for control, construction, and maintenance, divided into two groups, viz, State highways and county roads.

State highways.—These comprise 12,620 miles selected by the State highway engineer for improvement with Federal, State, and local funds. Initiative for construction is taken by the county court which makes application to the State highway engineer for Federal or State assistance. On approval of the project by the State highway engineer, plans, specifications, and estimates of cost are prepared under the direction of the county court and submitted to the State highway engineer for his approval. State or Federal funds are then provided in the ratio of one-fourth or under certain conditions up to one-half of the estimated total cost. The work may be executed by State prisoners under terms agreed to by the State highway commission and State prison commission and with the approval of the governor, or the work may be let to contract by the county board and supervised during construction by the county engineer or by a representative of the State highway department detailed at county expense. The work during progress is subject to inspection by the State highway department, and when the road has been completed and accepted by the State highway engineer the State's allotment is paid to the county. Payments during the progress of construction are made by the county court from the county funds.

Maintenance is executed by the counties in accordance with the rules and regulations issued by the State highway engineer. Failure to execute maintenance to the satisfaction of the State highway department results in withholding future allotments to the county.

County roads.—These comprise all other public roads of the State. They are improved and maintained by county officials at county expense. County prisoners may be utilized in the construction or maintenance of these roads, if so ordered by the county court. The various county courts of the State are required to consult with the State highway department relative to the expenditure of the proceeds of local bond issues when provided for roads of this group.

REVENUES.

State.—Funds are obtained from the retention of one-half of the net receipts obtained from the registration and licensing of motor vehicles. This fund for one-half of the calendar year 1917 amounted

to about $400,000 and was allotted to the various counties to aid in the construction of State highways. During 1918 it approximated $1,000,000. The State generally contributes one-fourth of the cost, but may contribute to the counties of low assessed valuation one-half of the cost. These allotments are conditioned on the county providing, in addition thereto, an amount specified by the State highway commission.

County.—Funds for road and bridge purposes are secured by the imposition of a tax at the rate of 15 cents on each $100 of assessed valuation, and when authorized by a majority of freeholders of the county a special tax may be levied at the same rate. One-half of the net receipts from the registration and license of motor vehicles is returned to the county, in the ratio in which collected, for use in the maintenance of State highways.

Statute labor is required of all male inhabitants between the ages of 21 and 45 years for a period of five days each year, or in lieu thereof a cash payment of $1 per day for each day of labor so required.

BONDS.

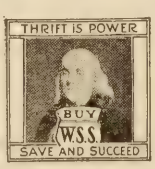
Sinking-fund bonds, in amounts not exceeding 25 per cent of the assessed valuation of the county or district, of terms not exceeding 40 years, may be issued by counties or districts when authorized by two-thirds of the taxpayers affected. On January 1, 1915, there was outstanding $14,615,016.53 of county bonds issued for road and bridge purposes. These bonds bore interest at rates of 5, 5½, and 6 per cent.

UTAH.

DEVELOPMENT.

State participation in highway construction and maintenance in Utah is of recent origin, a State road commission having been established in 1909 with power to select a State road system and to have charge of all funds appropriated by the State or the counties in the construction of this system. The State laws have been revised and amended from time to time until at present Utah is provided with a State road commission possessing broad powers over construction and maintenance of projects involving the use of State funds.

Seventeen per cent of the total public road mileage of the State has been hard surfaced and about 37 per cent of the total mileage has been graded and drained, principally under the State aid plan.



For the years 1918 and 1919 and each succeeding year thereafter an appropriation of $100,800 has been provided by the State for construction and maintenance of State and State-aid roads. A bond issue of $2,000,000 was authorized by the legislature of 1917 and the proceeds of this issue are to be devoted to road and bridge building purposes.

The total cash expenditure from all sources, State and local, for road purposes, for the year 1917, amounted to approximately $1,893,129. Of this total $120,200 of State funds and $822,929.44 of local funds were expended by or under supervision of the State highway department. State supervision thus extended to 48.3 per cent of all expenditures for road and bridge purposes.

ORGANIZATION.

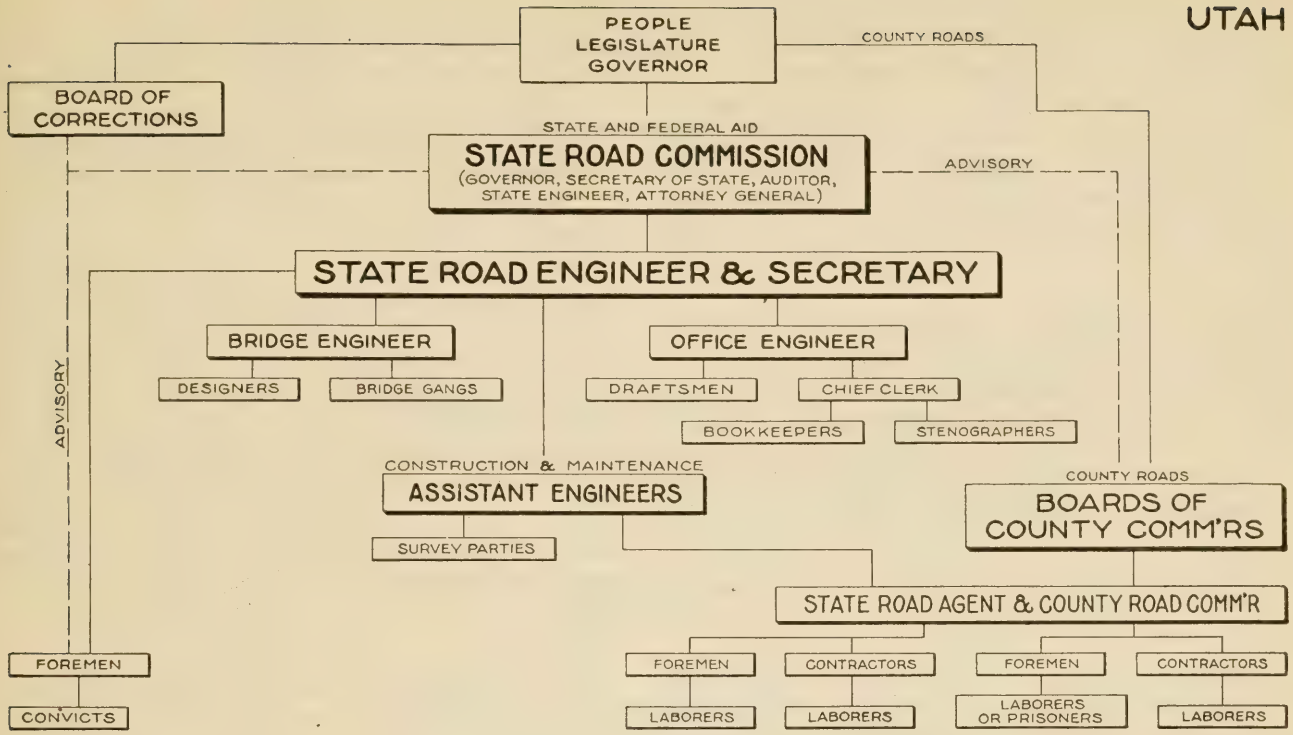
The organization of the highway forces of the State and the relations existing between them are shown on the chart.

State.—The State road commission is composed of the following ex officio members: Governor of the State, who is chairman of the commission; secretary of state, who is vice chairman; State engineer, attorney general, and State auditor, who serve without additional compensation.

The commission selects the system of State roads; has charge of the construction and maintenance of such roads; employs such engineer and clerical force as may be necessary; serves in an advisory capacity to county road and bridge officials and furnishes them on request plans and specifications and estimates of cost of roads, bridges, and culverts; and is required to prepare and issue a manual of road building and maintenance for the information and guidance of local officials in charge of such work.

The State road engineer appointed by the commission is assisted by a bridge engineer, an office engineer, several assistant and field engineers; also an office force of clerks, stenographers, etc. He is the executive officer of the commission and has active charge of all construction and maintenance of State roads. The State road commission appoints for each county an official, termed a "State road agent," who reports to the State road engineer. The county road commissioner is sometimes appointed State road agent, as he usually has the confidence of the county officials and is required to have a practical knowledge of road building. This official may act as inspector in charge of work let by contract to which State funds are contributed.

County.—County administration in Utah is vested in a board of county commissioners composed of three members elected for a term of two or four years. The board appoints a county road commissioner who assumes charge of the local roads of the county and employs and directs such help as



may be necessary to perform his duties, collects poll taxes due, and renders a report to the county board at the close of the year covering his operations. He also prepares plans, specifications, and estimates for road construction financed by county funds. Contracts for work of this nature are let by the county board. The county road commissioner, when designated "road agent" by the State road commission is considered the representative of the State road engineer and may assist in the construction and supervision of State roads.

CLASSIFICATION, CONTROL AND PROCEDURE.

The 8,810 miles of road of Utah are divided, for the purpose of fixing responsibility for control, construction, and maintenance, into three groups, namely, State roads, county roads, and trails.

State roads.—These, comprising a mileage of 3,660, are those roads designated by the State road commission and the county boards of commissioners. They are built under the direction of the State road commission with State and local funds.

The State road commission is required to notify each board of county commissioners on or before July 1 of each year of its intention to engage in State road construction in that county; to specify the amount of State funds available for the work, together with a general outline of the proposed work and a statement of the amount required to be appropriated from local funds by the county board.

Within 30 days from the date of the notice, the county commissioners are required to notify the State road commission of the amount appropriated or to be appropriated by the county for the purpose specified in the notice from the State road commission. This act constitutes the State road commission as agent of the county in all transactions connected with the construction of the proposed improvement and maintenance thereafter. In case of noncompliance by the county with the terms of the State road commission, the funds allotted to the county are held for the next yearly allotment among the various counties complying with the orders of the commission.

The State road engineer then prepares plans, specifications, and estimates of cost of the proposed improvement. The work may be done by force account under supervision of the State road engineer, or let by contract, in the discretion of the State road commission. When by contract, the State road commission, after due publicity prescribed by State law, awards contract to the lowest responsible bidder. The State road engineer designates a suitable representative or inspector to take charge of and supervise the work during its progress.

In making settlement for contract work, monthly estimates of work completed are prepared by the representative of the State road engineer and when approved by the State road engineer and State road commission are forwarded to the State auditor, who draws a warrant on the State treasurer. Payment of the final estimate is made in a similar manner, after the completed work has been accepted by or in the name of the State road engineer.

In the case of State road work, where conditions are satisfactory to the State road commission, con-

victs from the State penitentiary may, with the consent and under the rules and regulations of the State board of correction, be used to execute the work. All expense of this force, other than that for food, clothing, and bedding, is paid from the fund provided for the improvement. Completed State roads of all types are maintained by the State road commission, with joint funds—State funds being contributed in the same proportion as for construction.

County highways.—These comprise all of the roads in the county recognized by the county board as public roads and which are not included in the preceding system. They are opened, constructed, and maintained by the county board with county funds.

Trails.—Roads little traveled and not officially recognized by county boards as public roads are known as trails. No official provision is made for their repair or maintenance.

REVENUES.

State.—An annual appropriation of $100,800 has been provided by the State legislature for the support of the State road commission and for equal allotment to all counties. A $2,000,000 State bond issue has been authorized and the proceeds will be expended under the direction of the State road commission. The net receipts from the registration of automobiles, amounting to $170,707 in 1917, are used for the payment of interest on State bonds The balance, if any, is placed to the credit of the State road fund.

Each county auditor is required to certify to the State road commission, on or before October 1 of each year, data as follows: (*a*) The assessed valuation of the county; (*b*) the State road levy in mills; (*c*) the estimated amount of taxes to be derived from such levy.

Each county treasurer is required to certify to the State road commission on or before December 1 of each year the amount of money collected for State road purposes and the amount of delinquent taxes. On or before July 1 following each treasurer is required to certify to the State road commission the amount of delinquent highway taxes collected. From the data contained in these reports, the State road commission makes an equal allotment of funds provided by legislative authority among the 29 counties of the State. Counties accepting the allotments are required to provide an appropriation equal to one-fourth, one-half, or all of the full amount of the State allotment. Counties having assessed valuation of less than $2,000,000 provide one-fourth. Counties having assessed valuation between $2,000,000 and $4,000,000 provide one-half. Counties having an assessed valuation of $4,000,000 or more provide an amount equal to the State allotment.

County revenues.—The counties are authorized to levy a special road tax to provide funds for the construction of State roads. This tax rate is fixed by the State road commission and may not exceed 5 mills on the dollar valuation. Special taxes in cities, the proceeds of which are applied to the improvement of roads, are levied in counties receiving State aid when the regular 5 mills tax does not provide sufficient funds. Every able-bodied male citizen, between the ages of 21 and 50 years, not exempted by law, is required to pay a poll tax of $2.

BONDS.

State bonds to the amount of $2,000,000 were authorized in 1917. These bonds bear interest at the rate of 4½ per cent, are to be retired in 20 years, at the rate of $100,000 per year. The motor-vehicle license fee provides the fund for payment of principal and interest of this issue.

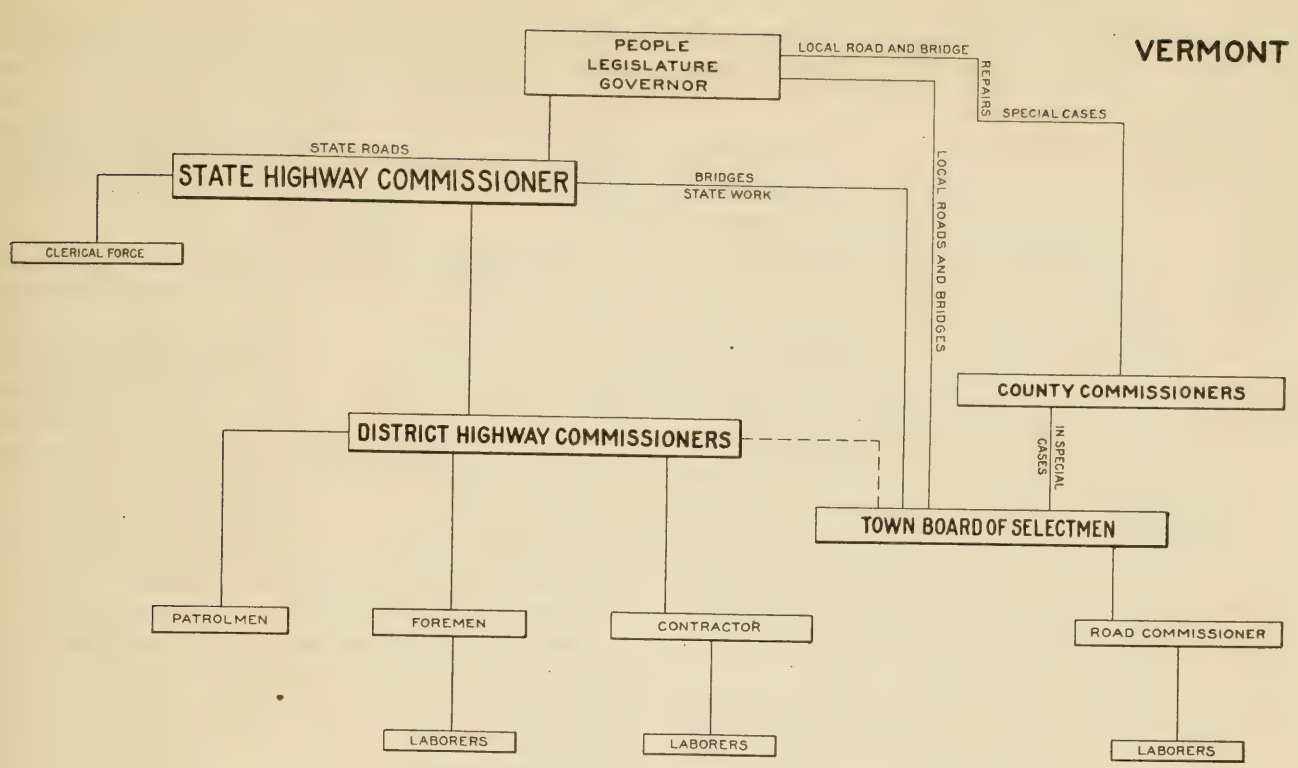
County bonds may be issued in an amount not to exceed 4 per cent of the total taxable valuation of the county, when the county board is authorized by a majority of the voters of the county. Such bonds are limited to a term of 20 years, and may not bear to exceed 5 per cent interest. On January 1, 1915, there was outstanding $281,500 of county bonds.

VERMONT.

DEVELOPMENT.

State participation in road improvement in Vermont is of State-wide scope, and has been extended since 1892. It consists of money aid to a system of State highways and main market roads, free technical advice and service to local road and bridge work, and is administered through and by a State highway commissioner.

State participation in its initial stage consisted in the levying of a uniform State-wide tax at a rate of one-half mill on each dollar of valuation and reapportioned among the various towns of the State in the ratio that road mileage of each town bore to the total road mileage of the State. While much benefit was secured from this form of taxation to road improvement which tended to assist the poorer towns at the expense of those more able to bear the financial burden, the lack of skilled supervision over road matters was apparent. To remedy this condi-



tion, the office of State highway commissioner was created by the legislature in 1898.

The powers and duties of the commissioner have been extended from the educational and advisory duties required in 1898 until he now has a considerable advisory control on bridges of 4 to 30 foot span constructed on State roads and receiving State aid, and quite complete control of such work of improvement over the maintenance of State roads as is done under State supervision. The system of State roads locally improved by each town comprises 28 per cent of the total road mileage of the State.

A total of 2,032.52 miles, or 13.4 per cent, of the total road mileage of the State has been improved since 1892, although some unknown portion of the mileage of the earlier years was undoubtedly not permanent improvement. Since 1907, 1,734.22 miles have been permanently improved. This includes the mileage in cities and villages as well as towns coming under State supervision. During the year 1916 $519,449.26 of State funds and $357,650.95 of local funds were expended by or under the supervision of the State highway commissioner. These figures do not cover expense of supervision or administration. The total estimated expenditures by all forces of the State for road and bridge purposes during that period reached $1,607,800. The State highway commissioner thus exercised supervision over about 54.5 per cent of all road and bridge expenditures in the State.

During 1917 $1,680,000 was expended by all road officials of the State.

ORGANIZATION.

The organization of the road forces of the State and the relation existing between them is shown on the chart given herewith.

State.—At the head of the State highway department and in control of the construction of State roads done with State money or under the supervision of the State is the State highway commissioner, appointed by the governor with the advice and consent of the Senate for a term of two years. The commissioner is assisted in the discharge of his duties by an adequate clerical force and by district highway commissioners. The district commissioners represent the State commissioner in their several towns, locate the work, see that suitable plans and surveys are made, and supervise the work.

County.—The counties ot Vermont do not initiate improvements or expend funds on road and bridge work. However, a county board of three commissioners appointed by the county court has power to make or cause to be made necessary road or bridge repairs when the town officials have neglected or refused to make such repairs. The county commissioners act on petition of three or more citizens or taxpayers who have first invited the attention of the town officials to the necessity of making these repairs, and who then turn to the county board for relief. The expense of such repairs is borne by the town concerned.

Town.—Each town is governed by a board of selectmen elected annually by the qualified voters. The board has charge of and control over local road affairs and effects administration through one or two

road commissioners who may be appointed by the board or who may be elected at the annual town meeting.

CLASSIFICATION, CONTROL, AND PROCEDURE.

The 15,111 miles of public roads in Vermont have been divided for the purpose of fixing responsibility for construction and maintenance into two groups, namely, State roads and town roads.

State roads.—These comprise about 4,300 miles of road designated by the boards of selectmen of the various towns with the approval of the State highway commissioner. Such roads are improved either with State or State and local. Funds, but are generally improved with joint funds. The initiative in new construction is taken by the town board which provides the necessary funds to secure an allotment of State funds. On approval of the project by the commissioner, surveys, plans, specifications, and estimates of cost are made under his direction and bear his approval. They are then forwarded to the town board, which is authorized by the commissioner to construct the work either by force account under supervision of the district highway commissioner or by contract let after due publicity. If done by contract, supervision during the progress of the work is exercised generally by the district highway commissioner or by an engineer inspector detailed thereto by the State highway commissioner.

Monthly payments, covering 85 per cent of the completed work as evidenced by the estimate prepared by the engineer in charge or the superintendent of the work, are ordered by the board of selectmen, and are paid by the town treasurer. Final payment for the completed work is ordered by the board of selectmen after the completed work has been accepted by the State highway commissioner or his authorized representative. Payment of the State's portion of the cost is then made to the town treasurer or by the State treasurer on a warrant of the State auditor, issued by him on certificate of completion made by the State highway commissioner.

Roads constructed in accordance with the above procedure and roads previously constructed by the town which are in a condition acceptable to the State highway commissioner, are maintained by patrolmen employed by the State under supervision of the district highway commissioner in accordance with regulations and rules issued by the State highway commissioner, at the joint expense of the State and towns.

Town roads.—All other roads of the State are town roads. They are maintained by and at the expense of the town, provided that a town may secure at the expense of the State the services of an engineer to make surveys, plans, specifications, and estimates of cost and to supervise the construction of any bridge of 4-foot span or over. Bridges of 30-foot span or over constructed in accordance with the above conditions may, at the discretion of the State highway commissioner, receive an allotment of State funds to the extent of 33⅓ per cent of the cost, provided, however, that the allotment may not exceed $400.

REVENUES.

State.—The funds at the disposal of the State highway commissioner are obtained and allotted as follows:

1. An appropriation by the legislature of $260,000 per annum which is allotted in amounts not less than $100 nor more than $1,000 to towns providing an equal amount, the combined fund to be expended on State roads, and the remainder of the appropriation is expended at the discretion of the commissioner under such arrangements as he may make with the towns benefiting by the improvement.

2. Receipts from the registration of motor vehicles are used for the maintenance of State roads. It is estimated that this fund will produce about $326,032 in 1917.

3. An appropriation of $25,000 for State aid to bridge construction.

Towns.—Funds are obtained in part from the imposition of a State-wide tax of one-half mill on each dollar of valuation which produces annually about $125,000, and which is reapportioned among the towns in the ratio that their road mileage bears to the total road mileage of the State. Additional funds for town roads are provided by majority vote at the annual town meeting. The sum so authorized for road and bridge purposes is raised by taxation as a part of the general town fund and is expended by order of the town board of selectmen.

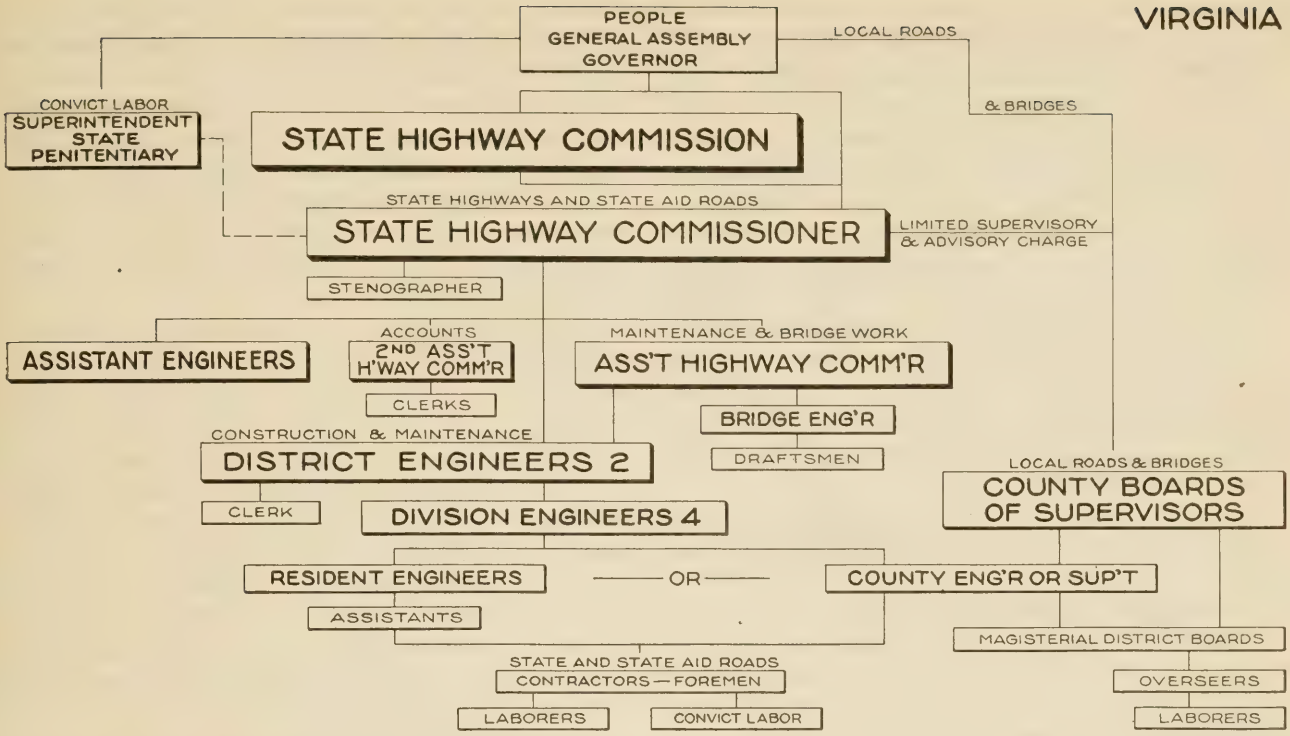
State or town bonds have not been issued in any appreciable amount in Vermont for road and bridge purposes.

VIRGINIA.

DEVELOPMENT.

State participation in public road improvement, as a State policy, dates from 1906, consists of money aid and convict labor applied to a system of State highways and to a system of principal roads selected by the various counties, and is administered by a State highway commission.

Turnpike construction was instituted in Virginia as early as 1785, and during the 50 years following a considerable mileage of road of this type was constructed, in which the State and various counties owned stock. With the rise of the railways as a transportation agency many of these roads began to be unremunerative and were allowed to deteriorate, and finally became public roads under the control of the public officials.



With the decrease of State and county interest in turnpike construction and operation, control of the greater portion of the road mileage of the State passed into the hands of county and district officials who, for a period of 50 years or more, were handicapped by inadequate funds and lack of technical knowledge of the principles of construction and maintenance of durable roadways. To remedy this condition the general assembly, in 1906, authorized the use of State convicts on highway work and also authorized the organization of a State highway commission with supervisory and advisory duties. This assistance was supplemented in 1909 by the grant of money aid to counties not receiving convict labor and the policy was further strengthened in 1918 by the selection of a State-wide system of State highways, to be constructed and maintained at State expense.

At the close of the year 1916, 5,500 miles, or 10.3 per cent of the total road mileage of the State had been surfaced. Of this total, 4,463 miles had been improved by means of State-aid combined with local funds.

The expenditures for road and bridge purposes during 1916 by all forces of the State were as follows: State funds to the amount of $542,524, and local funds to the amount of $1,348,725 were expended by or under the supervision of the State highway commission, while $1,364,825 were expended by local authorities. Thus, the State contributed 16.6 per cent and exercised supervision over 58 per cent of the total expenditures. During 1917 $4,137,000 was expended for road and bridge purposes by all road officials.

ORGANIZATION.

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

State.—Control and supervision over road construction and maintenance is vested in a State highway commission, composed of the State highway commissioner and a professor of civil engineering from each of the following institutions: The University of Virginia, the Virginia Military Institute, and the Virginia Agricultural and Mechanical College.

The State highway commissioner, appointed by the governor for a term of six years, is required to be a competent civil engineer and a resident of the State. He is executive official of the highway department, and through a force of assistants consisting of an assistant commissioner, second assistant commissioner in charge of accounts, bridge engineer, two district engineers, four division engineers, and such other assistants as may be required, has charge of or supervision over all work to which Federal or State funds or State convict labor is contributed. The department has full supervision over construction and maintenance of the State highway system, and general supervision over the main traveled roads of the State, and may make recommendation to the local authorities having jurisdiction or to the governor of the State with regard to their condition and as to means for their improvement.

The State highway commissioner may detail competent assistants to counties at county expense to take charge of new construction, instituted with the

proceeds of bond issues, or he may make such detail whenever requested by the county officials.

County.—Road affairs in each county are administered by a board of supervisors, one being elected from each district in the county. The number of districts in the county may vary from three to nine. Each elective supervisor has supervisory charge of the road and bridge affairs in the district represented by him. General administration of road improvement or maintenance of county roads is vested in an official termed a "county superintendent," or "district superintendent." Such officials are appointed by the county board, generally on recommendation of the State highway commissioner. County engineers may be employed by the county board if deemed necessary.

Of the 100 counties in Virginia many enjoy the benefits of special road legislation. Therefore, the organization and powers of the county road forces are not uniform throughout the State. The board of supervisors of most counties may adopt for their county any special road act applicable to any other county in the State. However, a few counties are prohibited by State law from carrying out this procedure.

District.—Counties are usually divided into magisterial districts, and road matters therein are administered by a board composed of the supervisors, district superintendent, who is usually a deputy county superintendent, and one other member.

CLASSIFICATION, CONTROL, AND PROCEDURE.

The public roads of Virginia, with a total mileage of 53,388, are divided for the purpose of fixing responsibility for control, construction, and maintenance into three groups, namely, State highways, State-aid roads, and county roads.

State highways.—These comprise 28 routes with a total mileage of 3,500 selected by the general assembly for improvement with Federal funds, State funds, State convict labor, and local funds. All stages of construction and maintenance are under the supervision of the State highway commissioner. Maintenance is executed by the State highway commissioner at State expense.

The 4,463 miles of main traveled road improved prior to 1918 at State and local expense are now included either in the State highway system selected by the general assembly or in the system of main traveled county roads selected in each county by the county board subject to the approval of the State highway commissioner for improvement at joint expense.

State aid.—Unimproved roads selected in the above manner may be improved in accordance with the following statutory requirements: The sum of $300,000 per annum provided by the general assembly for State aid is apportioned to the counties of the State not receiving convict-labor aid, the rate of apportionment being in proportion to the amount of State tax paid by each county participating. Convict labor is apportioned among the various counties in the order of their application; provided, however, a county may not secure such service for a longer period than five years if other counties desiring such services are unsupplied.

Plans, specifications, estimates of cost, etc., for work of this class are prepared by or under the supervision of the State highway commissioner, and are submitted to the county board for inspection and approval. Upon acceptance by the board bids, if the work is to be let by contract, are requested by the State highway commissioner, and contracts therefor are let by the board with his approval.

Supervision and inspection during the progress of the work is exercised by an assistant engineer detailed by the State highway commissioner, the expense of the engineer being met by a special fund composed of not to exceed 5 per cent of the joint fund available for the work.

Monthly payments covering 90 per cent of the completed work, as evidenced by the estimate of the engineer in charge, are made by county officials, the State's portion of the cost being transferred to the county treasury by order of the State highway commissioner whenever such funds are needed. Ten per cent of the contract price is retained until the work has been completed, accepted, and undergone 90 days' actual use.

The county authorities may determine what proportion of the local share of the cost shall be borne by the district or districts of the county benefiting from the improvement. Completed roads of this group are maintained by the counties at county expense, although the State highway commission may, and in a few instances has, allotted State funds for this purpose.

County roads.—These comprise all other roads of the State. They are opened, controlled, constructed, and maintained by county or district boards with local funds. When the county roads are improved with the proceeds of bond issues, the work is required to be done in accordance with plans and specifications furnished by the State highway commissioner and under the immediate supervision of an engineer approved by or detailed to the county by the State highway commissioner.

REVENUES.

State.—State funds for road improvement purposes are provided by the general assembly as follows: For the fiscal year beginning September 1, 1918, $425,000 has been appropriated for the State highway system. For the same period $200,000

has been appropriated for the support of the convict road force, $300,000 has been appropriated for aid to county highways, and $39,000 as the State's highway contingent fund for the support of the State highway department. In addition thereto the net proceeds of the motor vehicle license fund, estimated at $475,000, are placed at the disposal of the State highway commission for highway purposes. The latter fund may be used for the maintenance of the State highway system or allotted to the various counties of the State for construction purposes under the State-aid plan or for the maintenance of State-aid roads already constructed. Thus for the calendar year 1918 a total of $1,439,000 has been made available for State participation in highway improvement. The general assembly has also provided a State tax of 3 cents on each $100 valuation and it was estimated that about $375,000 raised by this means would be available for expenditure on January 1, 1919.

County.—Road funds are secured from a general tax levied at a rate of not to exceed 40 cents on each $100 assessed valuation. District funds are secured from a general tax levied at similar rates, provided, however, that when the combined proposed county and district tax exceeds 15 cents on each $100 assessed valuation, the proposal must be decided by a majority of the districts concerned.

BONDS.

Bonds may be issued for road construction purposes by counties or by districts when authorized by a majority of the voters concerned in an amount not exceeding 10 per cent of assessed valuation of the county or district. Such bonds when issued may not run to exceed 34 years at rates of interest not exceeding 6 per cent. While the bonds are of the sinking-fund type the county or district has the right to redeem the bonds on call therefor. Counties having a population of 300 or more persons per square mile of area may issue bonds in an amount not exceeding 18 per cent of the total taxable valuation of the county. On January 1, 1915, $5,650,994.93 of county and district road and bridge bonds were outstanding.

WASHINGTON.

DEVELOPMENT.

State interest in and assistance to road and bridge improvement in Washington has become a fixed State policy and is applied to a State-wide system of roads designated by the legislature and to local roads of importance selected, with the approval of the State highway board, by local officials.

State-aid was extended in territorial days by the appropriation by the legislature of special funds for the construction of certain roads under the supervision of local commissioners named in a special act of the legislature. The counties benefiting were required to provide funds equal to 50 per cent of the amount thus appropriated. This practice was continued for several years after statehood was accomplished, but was finally abandoned. In 1905 the offices of the State highway commissioner and the State highway board were created to supervise the expenditure of a fund provided for State aid in the constructing of 12 designated State roads.

A State-aid law providing for State assistance to local roads of importance was enacted in 1907, and funds were provided for carrying its provisions into effect. However, in 1911 this law was repealed and the "permanent highway law" was enacted to provide a more equitable manner of apportioning State aid. State aid has been extended by means of special legislation to the construction of bridges of more than local importance in communities unable to bear the total financial burden imposed by such improvements.

From time to time the system of State roads has been extended until this system now comprises 3,365 miles, of which on January 1, 1917, 951 miles, or 28¼ per cent, had been surfaced. On the same date 894 miles had been surfaced under the terms of the "permanent highway act." Of the 42,428 miles of public road in Washington 5,900, or 13.9 per cent, were reported as surfaced on the date above quoted.

Expenditures for road and bridge purposes during the year 1916 reached a total of $7,518,343, of which $859,672 were State funds and $2,104,340 were local funds expended by or under the supervision of the State highway board. The State thus contributed about 11½ per cent and supervised the expenditure of about 39 per cent of the total.

During 1917 a total of $7,116,000 was expended by all road officials of the State.

ORGANIZATION.

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

State.—At the head of the State highway department is a State highway board composed of the governor as chairman, the State auditor, the State treasurer, a member of the public service commission, and the State highway commissioner, who is appointed by the governor, and who serves as secretary of the board and is executive official of the State highway department.

The assistant highway commissioner, appointed by the commissioner, with the approval of the board, has general charge of the clerical department, right of way department, and administrative charge of the engineering department.

The chief engineer, in charge of the engineering department, is appointed by the commissioner. Other employees, technical and clerical, are appointed by the commissioner as needed. Location and construction parties are under the supervision of a district engineer or assistant engineers. State superintendents or resident engineers are detailed to take charge of the construction of State roads and bridges.

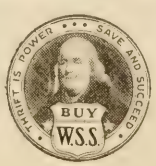
The State highway department has charge of all steps of construction of State roads and bridges, provides standards of construction for local roads and bridges, and is required, on request, to provide local road and bridge officials with plans, specifications, and estimates of cost of such work or to furnish advice on local road and bridge matters.

County.—Each county is governed by a board of three commissioners, elected for terms of three years from the three districts into which the county is divided. The county clerk and county treasurer are respectively secretary and fiscal agent of the board. In each county a county engineer is elected every two years. He serves as the county official in charge of the road and bridge construction and maintenance instituted under the direction of the board. Supervisors are appointed by the board for each road district of the county. The commissioner of each district exercises supervision over the supervisors thus appointed.

Township.—Boards of supervisors consisting of three elective members, are vested with administrative powers over local roads and bridges (only three counties of the State have adopted township organization). The township is divided into road districts, and an overseer is appointed by the board for each district. The township board, cooperating with the county engineer, may open and establish new highways or alter existing highways.

Special districts.—These may be authorized by the county boards to carry out road improvements under the assessment plan. Such districts are administered by a board of three supervisors. This board is required to cooperate with the county engineer in all matters relating to construction and assessment of final costs.

Independent highway districts.—Such districts may be constituted by the county board when authorized by a majority of the voters of the territory affected. The affairs of such districts are administered by a board of three elective directors. This board may, under certain conditions, construct and maintain roads and issue bonds to defray the cost of construction.



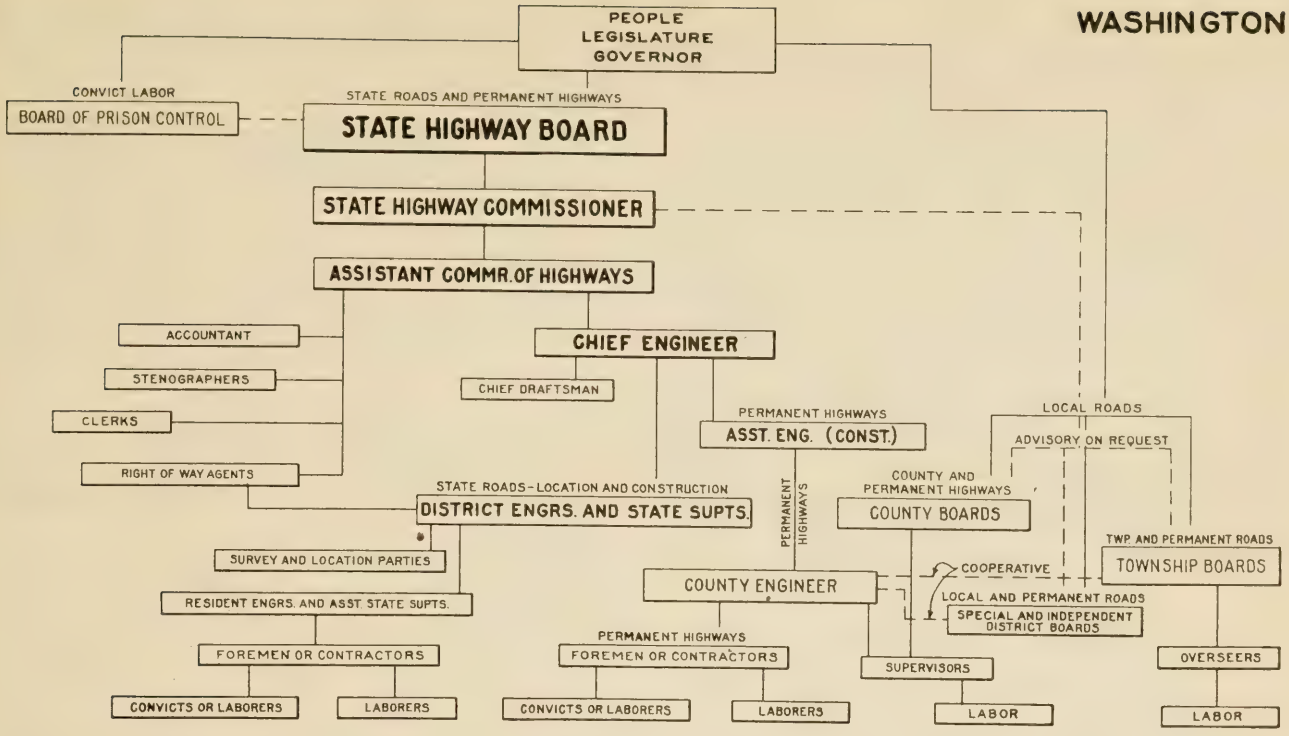
CLASSIFICATION, CONTROL, AND PROCEDURE.

The 42,248 miles of public road in Washington are, for the purpose of fixing responsibility for control, construction, and maintenance, divided into four groups, viz, State roads, permanent highways, county roads, and toll roads.

State roads.—These comprise 2,112 miles of primary highways and 1,263 miles of secondary highways, selected by the State legislature for improvement by the State highway department with funds provided by the legislature, the amount available for expenditure on each section being specified in the appropriation. All surveys required, plans, specifications, and estimates of cost, letting of contracts, supervision of work during progress, and final acceptance thereof on completion of roads of this group are administered by the State highway department. Convict labor, subject to the control and management of the State board of control, may be utilized by the State highway department on road work coming under their jurisdiction. Maintenance of roads of this group is executed by and at the expense of the county; maintenance of primary highways being subject to supervision by the State highway department. Funds used by the county for maintenance of State roads are taken from the county permanent highway maintenance fund.

Permanent highways.—An improvement under the permanent highway laws is initiated by resolution by the board of county commissioners, either on their own motion or following a petition of the owners of two-thirds of the linear frontage of lands along the road sought to be improved A certified copy of this resolution is sent to the State highway commissioner, who is required to make an investigation to determine if the road designated is of sufficient importance to merit improvement under the provisions of the act. In case the proposed improvement receives the highway commissioner's approval, the county engineer, or a construction engineer employed by the county board, is directed to prepare plans and specifications and an estimate of cost of the improvement at county expense. These are forwarded to the highway commissioner for his approval, rejection, or revision, and returned to the county commissioners, who formally adopt the approved plans by resolution.

The work during progress is under the supervision of the county engineer or construction engineer. Monthly payments covering 80 per cent of the completed work may be made when based on estimates prepared by the engineer in charge and which bear the approval of the county board and the State highway commissioner. Final payments are made



when the work has been examined and accepted by the State highway commissioner. When the improvement is initiated by petition of the abutting property owners not to exceed 85 per cent of the total cost is borne by the "permanent highway fund," and not less than 15 per cent is borne by the owners of the abutting and adjacent property. Property so taxed extends not less than 660 feet and not more than 3 miles on either side of the highways. The land so taxed is divided into three zones bearing seven-fifteenths, five-fifteenths, and three-fifteenths of the total cost assessed against the property, the rate of taxation being inverse to the distance from the highway. Maintenance of roads of this group is executed by the county from the county permanent highway maintenance fund. Roads improved by this method may be either State roads or county roads, the intent of the law being to provide a method of improving roads of local importance or parts of important State routes.

County highways.—These comprise all other public roads of the State. They are improved at the expense of the counties and townships.

Toll roads.—County roads may be improved by and at the expense of private corporations and tolls collected from the users thereof. At the expiration of the franchise the roads revert to the public.

REVENUES.

State.—State funds for highway improvement are raised by a State-wide tax of 1 mill for State highways and a State-wide tax of 1½ mills for the "permanent highway fund." As the budget system prevails in Washington, the proceeds of these taxes are appropriated by the legislature for specific purposes, as follows:

1. For State roads for the two years 1917 and 1918, $1,939,301.28. The routes to be improved and the amounts available therefor are specified in the act of the legislature.

2. For the "permanent highway fund," $4,992,-198.18 to be expended among the various counties in the ratio in which collected.

3. For the support of the State highway department, $64,820.

The State has thus made available for the two-year period $6,996,319.36.

County.—The county permanent highway maintenance fund for maintenance of State and permanent highways and roads of like character is composed of 5 per cent of the "permanent highway fund," allotted the county by the State and the proceeds from automobile license fees, fines, and collections. A portion of the net motor licenses is apportioned among the counties in the ratio of $100 per mile for maintenance of primary highways, and the remainder of the fund is applied to maintenance of permanent highways and other roads of like character. Other funds for county road and bridge purposes are obtained by a general county tax of 4 mills, and a district tax of not more than 10 mills levied in each district for road and bridge purposes.

Township.—The ordinary road and bridge tax levied in the township may not exceed 8 mills on each dollar of assessed valuation.

BONDS.

Counties or townships when authorized by a three-fifths majority of the voters of the county or township may issue bonds in an amount not exceeding 5 per cent of the assessed valuation of the county or township. The bonds are required to be of the sinking-fund type, bear interest at a rate not exceeding 6 per cent, and may not run more than 20 years.

Independent districts may, when authorized by a majority of the voters, issue bonds in an amount not exceeding 5 per cent of the assessed valuation of the district. Such bonds may bear 6 per cent interest, and are required to be of the deferred serial type, limited to a term of not more then 20 years, and may be payable 10 years from the date of issue. State bonds for bridge purposes, and county bonds for road and bridge purposes outstanding on January 1, 1915, amounted to $1,555,000.

WEST VIRGINIA.

DEVELOPMENT.

State participation in road and bridge improvement in West Virginia is of recent origin, limited in amount, although of State-wide scope. State interest in road improvement may be said to date from 1907, with the appointment of a State highway inspector, who was empowered to investigate the conditions of the roads throughout the State and to make recommendations to the legislature concerning such new legislation as in his opinion would be beneficial. The office of public roads, administered by a commissioner of public roads, with limited supervisory and advisory duties over road and bridge matters, was created in 1909 and abolished in 1911. The State road bureau was created in 1913. State financial aid was not annually extended until 1917, at which time the State highway department was reorganized and a system of State roads was designated. The principal duties of the State road officials prior to 1917 were to furnish advice and supervision when requested by the county officials having charge of local improvement.

The system of State roads designated in 1917 comprises about 14 per cent of the total road mileage of the State, and will be constructed under the supervision of the State highway department.

The main traveled roads of West Virginia comprise about 20 per cent of the total mileage of the State, and about one-fourth of these roads, or 1,600 miles of the total, have been improved by surfacing.

Practically all of the road improvement in the State has been carried out by the counties, which, under the State law, are invested with broad powers over road work, subject, however, to limited State supervision.

The State, during 1916, expended $10,967 for support of a highway department and the counties expended about $5,500,000 for road and bridge improvement.

During 1917 a total of $8,200,000 was expended by all road officials of the State.

West Virginia is traversed by mountain ranges from north to south and presents difficult problems in road location and construction, although, generally speaking, road material of good quality is abundant in the eastern and western parts of the State, and is scarce in the central portion of the State.

ORGANIZATION.

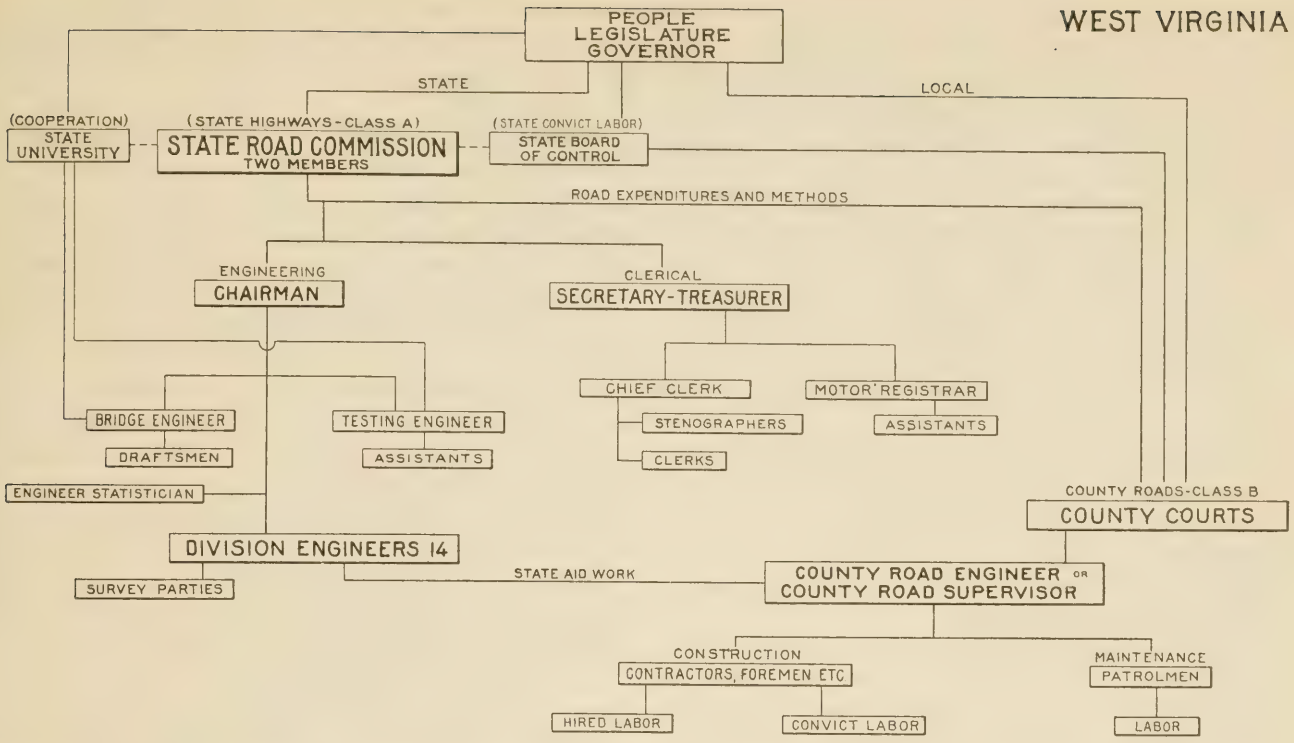
The organization of the road forces of the State and the relation existing between them is shown on the diagram.

State.—The State road commission is composed of two members, appointed for terms of four years by the governor of the State, with the advice and consent of the State senate. The members are required to be citizens and residents of the State and to represent the two leading political parties of the State. One member is required to be a practical civil engineer of known business qualifications and who shall have had at least three years' responsible charge of the construction and maintenance of public roads and highways. The other member of the commission is required to be of known and successful business qualifications, and one member is designated by the governor as secretary-treasurer of the commission.

The commission elects one of its members as chairman and has the power to select and fix the compensation of such assistants, agents, or employees as may be required to carry out its duties. The commission collects all the fees due the State under the motor vehicle and chauffeur law, issues licenses therefor, establishes rules and regulations relative to the repair and improvement of class A roads by county engineers, tests materials proposed to be used in improvements dependent in whole or in part on Federal funds, has the power to investigate any or all expenditures made by the various counties of the State for road construction and maintenance, and to cause prosecution of officials failing to adopt proper methods of construction and maintenance or to provide proper supervision and inspection.

The commission is required to prepare at the expense of the county plans and specifications and estimates of cost for the improvement of any public road of the State when requested by the local officials having jurisdiction.

County.—County road and bridge administration is vested in a county court composed of elective members designated as judges. The county clerk



is clerk of the court and the county sheriff is ex officio tax collector and treasurer. The county court has power to fix tax rates and provide for the collection thereof and to enter into contracts for road and bridge improvement.

The county engineer or county supervisor, appointed by the county court for a term of two years, is required to be a practical road builder. He is executive officer of the court in all matters pertaining to road and bridge construction and maintenance. In matters concerning class A roads, he is subject to rules and regulations and orders of the State road commission. He is also required to assist the State road commission in its campaign of creating public interest in road improvement. It is the duty of the county engineer or county supervisor at the end of each fiscal year to ascertain and to report in writing to the county court the amount of money necessary to open and keep in repair all main county roads and the roads of each of the magisterial districts during the ensuing fiscal year. The court may amend the report as it may think proper. However, the sections of the report showing the amount required for maintenance of class A and class B roads are used by the court in laying tax levies for road purposes.

The county may be divided by the court into sections and a road patrolman appointed for each magisterial district who is required to patrol daily, except Sunday, the roads of his district and to execute such repairs as may be necessary and to superintend persons performing statutory labor on the road.

CLASSIFICATION, CONTROL, AND PROCEDURE.

The 32,024 miles of public road of West Virginia are for the purpose of fixing responsibility for construction and maintenance divided into two groups, namely, class A and class B roads.

Class A roads.—These comprise about 4,600 miles of road selected by the county courts of each county, subject to the approval of the State highway commission. These comprise two or more main roads of the county, and all roads selected must connect with similar roads in adjoining counties. Other main roads may, on request of the county court, be added to this system from time to time with the approval of the State road commission.

Roads of this group are improved with joint funds provided by the State and county, the State funds for road purposes at the disposal of the State road commission being allotted among the counties on the basis of class A mileage in each county, conditioned, however, that the county provides an equal amount. The roads of this group are improved in accordance with plans and specifications furnished at the cost of the county and approved by the State road commission. Improvement is executed by the county subject to supervision by the State road commission or its authorized agent. The work of construction may be done by force account, convict labor, or by contract.

When by convict labor, convicts not less than 10 in number are furnished under contract entered into by the State board of control and the county court. The work during progress is under general supervision of the State road commission. When exe-

cuted under contract let by the county court, the State road commission is notified in advance of the date of letting and is required, if requested, to furnish the county court for its private use an estimate of the reasonable cost of the improvement. Supervision of the work in progress is vested in the county engineer or supervisor.

Monthly payments to the contractor based on an estimate prepared by the engineer or supervisor in charge are made by the county treasurer on order of the county board. Payment of the State's portion of the cost is made to the county as the work progresses by order of the State road commission, the payments being based on an estimate prepared by the county engineer or county supervisor. During the progress of the work, an amount not to exceed 20 per cent of the contract price is withheld, and on completion this amount is not turned over to the contractor until the work has been accepted and a reasonable time has elapsed.

Improved roads of this class are maintained by county forces with county funds, the maintenance being subject to inspection by the State road commission, or its authorized representative. Future allotments to the county may be withheld when maintenance is not executed to the satisfaction of the State road commission.

The county engineer or supervisor is required to report monthly to the State road commission relative to all transactions concerning construction and maintenance and the costs thereof of all Class A roads under his jurisdiction. Maintenance may be executed by patrolmen, by force account consisting of statutory or paid labor, or sections of road may be sold to the lowest bidder.

Class B roads.—These comprise all other public roads of the State and are located, constructed, and maintained by county officials with county funds. However, on request of the county officials the State road commission is required to investigate materials proposed for use in improvement of roads of this group, and to advise as to methods of construction and maintenance. The amount of work pertaining to roads of the group thus voluntarily placed under the control of the State road commission is increasing each year.

REVENUES.

State road fund.—The net revenues accruing from the registration and license of motor vehicles and chauffeurs are deposited in a fund called the State road fund. This fund may be increased by appropriations by the legislature. The expense of the State road commission, limited by the legislature to $63,700 per year for the years 1918 and 1919, is paid from this fund. The remainder, about $276,000 for 1918, is allotted among the various counties of the State for construction and maintenance of class A roads in proportion to the mileage thereof. However, counties do not receive both State and Federal funds.

Motor vehicles engaged in transporting passengers or freight over regular routes pay a privilege tax in an amount determined by the commission. Ninety per cent of the tax obtained from this source is returned to the county or city originating it for maintenance of the roads actually used by such vehicles. The remaining 10 per cent is added to the State road fund.

County revenues.—County revenues for road and bridge purposes are in part obtained from a general levy, laid by districts, on all property at a rate not to exceed 15 cents on the $100. In cases of emergency it may be increased by an additional levy not to exceed 10 cents on the $100.

The county court shall levy a capitation tax of $1 per year on all males 21 years of age or over and not otherwise legally exempt or may require four days' road work from such persons.

The county in addition to this may levy a tax of 25 cents on each $100 for class A roads and in addition may levy an emergency tax of 10 cents on the $100 when required for such roads, and may set aside a part of the general county levy of 30 cents on the $100.

BONDS.

The county court, when authorized by a three-fifths vote, obtained at an election held for that purpose throughout the county or such portion thereof as may be affected, may issue bonds for the purpose of road or bridge improvement, or instead of bonds a special tax levy for a period not exceeding 10 years may be laid. The proceeds obtained from the sale of bonds or from the special levy are expended under the supervision of the State road commission.

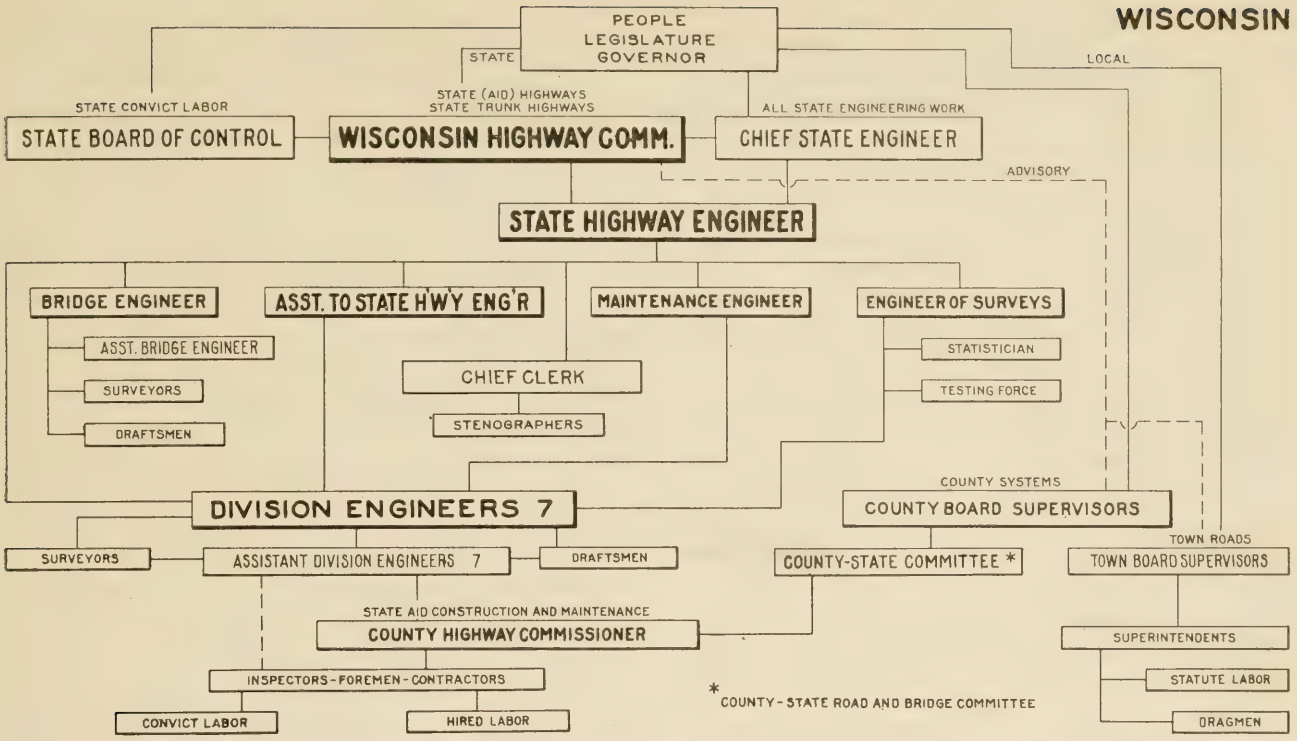
No State bonds have been issued for road purposes. Bonds issued by counties for road and bridge purposes amounted on July 1, 1917, to $16,941,500.

WISCONSIN.

DEVELOPMENT.

State participation in road improvement in Wisconsin is of comparatively recent origin, of State-wide scope, is extended in the form of money aid, technical advice, and supervision of construction and inspection of maintenance, and is administered through the State highway commission.

Centralized control of road improvement had its beginning in the county aid road law passed in 1898 and was further supplemented in 1907 with the enactment of a law requiring the designation of a



county road system to be administered under the supervision of a county highway commissioner in each county. The expense incident to the designation of these systems was borne jointly by the county and township boards.

In 1907 the State geological and natural history survey instituted a free consulting engineering service for the benefit of county and township road officials. In 1911 a State highway commission was created and a policy of State money aid was inaugurated. The State highway commission, whose engineering staff is now a division of the State department of engineering, has control over the system of State trunk highways connecting all county seats and towns of 5,000 or more inhabitants, the State-aid funds, and supervision of the maintenance of such roads when constructed.

State-aid funds have been expended on county systems of prospective State highways which when completed will form the State highway system. The improvements have generally been made in accordance with local interests, with the result that isolated systems of market roads have been created rather than improvements of a State-wide system connecting the various sections of the State.

As the State trunk highway system was not authorized until 1917, little work has been done other than designating its location. The system as outlined comprises about 6½ per cent of the total road mileage of the State.

The county systems eligible for State aid, which when completed will form the State highway system, comprise 26 per cent of the total road mileage of the State. In many cases, the two systems of roads will overlap, and where this occurs the section concerned will be designated a State trunk highway. At the close of 1916 about 20 per cent of the total mileage of public roads of the State had been hard surfaced.

During the year 1916, $950,000 of State funds and $4,120,764 of local funds were expended by or under the supervision of the State highway commission. The total expenditure during the year by all road forces of the State reached $10,570,764. State supervision thus extended to 48 per cent of the expenditures for road and bridge purposes.

During 1917 a total of $9,887,000 was expended for road and bridge purposes by all road officials of the State.

ORGANIZATION.

The organization of the forces of the State for highway control and improvement and the relation existing between them is shown on the chart.

State.—The State's participation in highway work is exercised through the State engineering department headed by the State engineer, who is in charge of all engineering work in the State in which the State has investment. The State engineer is appointed by the State railroad commission.

The State highway commission is composed of five members, two being ex officio members, namely, the dean of the College of Engineering of the State University, and the State geologist. The three appointive members are appointed, one every two years, by the governor for terms of six years.

The State engineer appoints, subject to the approval of the State highway commission, the State highway engineer, who, as executive official of the State highway commission, is required to secure his instructions on engineering matters from the State engineer and on all other matters from the State highway commission. Such technical assistants as may be required by the commission are detailed thereto by the State engineer.

In fixing the final location of the State trunk highway system the State highway commission was assisted by a committee of five members of the legislature designated by the governor.

The State highway commission, subject to the above limitations, exercises supervision over construction and maintenance of the State trunk highways and the State highway systems, and allots funds at its disposal for the two systems above designated to the various counties of the State.

For administrative purposes the State is divided into eight divisions, each in charge of a division engineer who reports directly to the State highway engineer.

County.—The county board of supervisors composed of one supervisor from each town who is the chairman of the town board of supervisors, one supervisor from each city ward, and one supervisor from each incorporated village, has charge of the road and bridge affairs coming under the jurisdiction of the county. The county clerk and county treasurer are respectively clerk and fiscal agent of the board. In counties containing 250,000 or more inhabitants authority is vested in a board of supervisors, one member, whose term of office is four years, being elected from each assembly district. The term of the office of members of the regular boards is in most cases one year, but any county board may by resolution decide that members shall be elected for three years.

Each county board is required to appoint a county highway commissioner or to request the State highway commission to designate an acting highway commissioner. He is the executive officer of the board, subject to the orders of a committee appointed by the board and designated as the county "State road and bridge committee." Members may be either members of the board or merely residents of the county. In addition thereto, the chairman of the town board is ex officio member of this committee when road matters in his town are considered by the board. This committee represents the county in all road and bridge work to which the county contributes except county-aid bridges costing less than $500.

Town.—Towns are governed by a board of three supervisors elected annually, one of whom is designated on the ballot as chairman. The town clerk and the town treasurer are clerk and fiscal agent of the board. In counties containing not less than 100,000 inhabitants, the term of office of town officials is two years.

The town board appoints one or more superintendents of highways to superintend construction and repair of all roads and bridges under the jurisdiction of the board. When more than one superintendent is appointed the county is divided into suitable districts and each district is placed under the jurisdiction of a district superintendent. In towns where the highway tax is paid in labor, a town road overseer may be appointed who, under the orders of the board, exercises supervision over district superintendents. The town board has the power within statutory limits to levy taxes, issue bonds, and to enter into contracts.

CLASSIFICATION, CONTROL, AND PROCEDURE.

The 77,270 miles of public road of Wisconsin are, for the purpose of fixing responsibility for control, construction, and maintenance, divided into four groups, namely, State trunk highways, State highways, county systems of prospective State highways, and town roads.

State trunk highways.—These comprise about 5,000 miles of road designated by the State legislature to connect all county seats and towns of 5,000 or more inhabitants. These roads are constructed under the supervision of the State highway commission with funds provided in equal amounts by the Federal Government, State, and county. The county may assess not to exceed 40 per cent of its share of cost to the town or towns benefiting by the improvement. The county is also required to expend 50 per cent of its allotment of State aid, with the accompanying local funds, on the State trunk highway system. Improved roads of this group are maintained by the county with county funds in accordance with the instructions and under the supervision of the State highway commission. Reimbursement of the total cost of maintenance, or a portion thereof, is made to the county by the State highway commission from funds derived from the proceeds of motor-vehicle license fees.

The program of construction in each county for any given year is published by November 1 of the previous year in order that the county's portion of the cost may be paid into the State treasury before

construction is instituted. If a county fails to provide the amount required by law to secure its allotment for State trunk highways, the State highway commission is required to notify the secretary of State of such failure. The secretary then levies a special tax in the county, the proceeds of which are placed in the State treasury on behalf of the county and are available for construction purposes. The State highway commission executes surveys, provides plans and specifications, and supervises construction. The construction may be done by force account, convict labor with the permission and under rules and regulations of the State board of control, or by contract. When by contract let by the State highway commission, the manner of letting, making payments, and final acceptance is decided by the commission.

State highways.—These comprise about 5,070 miles of public road originally included in the county system of prospective State highways, and which have been improved at State and local expense under supervision of the State highway commission, and are maintained by the county with county funds under the instructions and supervision of the State highway commission.

The county systems of prospective State highways.—These comprise about 20,000 miles of which 5,070 miles have been improved as above described while approximately 15,000 miles remain unimproved. These roads may be designated by the county boards with the approval of the State highway commission for improvement with State and local funds. The construction of such roads is administered by the county board through its State Road and Bridge Committee and County Highway Commissioner, in accordance with plans and specifications approved by the State highway commission. On request of the county highway officials the highway commission will delegate suitable officials to take charge of construction. Inspection may be made any time during the progress of the work when administered by local officials by a representative of the State highway commission. The work may be done by paid labor or by contract let by the board through its committee. The approval of the State Highway commission is required to all contracts let for roads of this group. Partial payments may be made by the county treasurer from time to time when recommended by the engineer in charge of the work and ordered by the county commissioner of highways. A copy of the approved estimate submitted by the engineer in charge must accompany the warrant drawn on the treasury.

When at least 50 per cent of the work has been completed to the satisfaction of the State highway engineer, he then orders the State treasurer to transfer to the county treasurer the State's portion of the cost of the work. The State's portion may not in any case exceed 40 per cent of the total cost when the remainder is borne by the county, or 33⅓ per cent of the total cost when the county and towns share the remainder of the cost. Final payment may not be made to the contractor until the work has been accepted by the State highway commission, and such acceptance in writing has been filed with the county commissioner of highways, and the town clerk. When the improvement has been completed the road becomes a part of the system classed as State highways, and is maintained by the county. Unsurfaced graded roads of this group are also maintained by the county in accordance with general instructions and under the supervision of the State highway commission.

Town roads.—These comprise all other public roads in the State. They are controlled and administered by the town boards of supervisors with local funds. The county board is required to allot to each town a portion of the county's share of the State-aid allotment based on the assessed valuation of the various towns, to levy a county tax of at least equal amount, and to levy against the town a tax not more than the county tax nor less than the State money allotted. The combined fund thus at the disposal of the town must be expended on the county system of prospective State highways and the location of the improvement is designated by the county board which also determines the character of the improvement. Bridges may be built on the same terms as roads.

REVENUES.

State.—Motor vehicle fees collected after July 1, 1917, are distributed as follows:

1. After the cost of collection has been deducted, one-fourth of the net proceeds is returned to the county in proportion to the amounts paid in by the residents thereof for the maintenance of the county systems of prospective State highways.

2. There is set aside from the remaining three-fourths a sum not to exceed $80,000 for the use of the State highway commission in administering the State trunk highway law.

3. There is then set aside an amount sufficient to pay the State's share of Federal aid construction.

4. The remainder is then allotted for maintenance of the State trunk highway system, and is distributed among the counties in the ratio that their trunk line highway mileage bears to the total mileage of the system.

It is estimated that for administration, the amount available to meet Federal aid construction and for trunk highway maintenance during the fiscal year ending June 30, 1918, will be $1,500,000.

An annual appropriation of $785,000 for the fiscal years 1917 and 1919 has been made by the legislature for allotment to the counties for State-aid construction. The allotments are made in the ratio that the assessed valuation of each county bears to the total assessed valuation of the State.

An annual appropriation of $65,000 has been made to defray the expense of operation of the State highway department in the administration of the State-aid law.

Thus the State funds expended by or under the supervision of the State highway department, exclusive of local contributions, will amount to approximately $2,350,000 per annum.

County.—One-fourth of the net proceeds of the motor vehicle license fees collected from each county is returned thereto as a fund to be applied to maintenance of roads on the county system of prospective State highways. The counties are required also to maintain portions of the State trunk highway system within their limits, and when this is done in a manner satisfactorily to the State highway commission, the county is entitled to receive its share of the portion of the proceeds of motor vehicle license fees devoted by law for this purpose.

Each county is required by law to provide the amounts necessary to carry out the Federal aid and State aid construction contemplated within its limits. To receive its allotment of Federal aid money a county must provide a sum at least equal to one-half the joint proceeds of the Federal and State money. One-half of each county's allotment from the State aid fund must be expended on the State trunk highway system at points designated by the county board together with an amount at least one and one-half times as great to be provided by the county. The remaining one-half of the county's allotment of State aid is required to be distributed among the towns, villages and cities in the county unbenefited by an improvement on the State trunk highway system during the same year in proportion to their assessed valuations. The county is required to provide an amount at least equal to the allotment of State aid and to assess against the town, village or city a tax in an amount not less than the State aid allotted and not greater than the county aid allotted.

Town.—A poll tax of $1.50 per year is levied on all male citizens not otherwise exempt between the ages of 21 and 50. A property tax is levied at the rate of not less than 1 nor more than 7 mills on each dollar of assessed valuation. This may be increased by a majority vote at the annual town meeting by a levy not exceeding 10 mills on each dollar of assessed valuation. The total amount so raised is limited by statute in accordance with the population of the town and may be used either for road or bridge construction. Special bridge taxes not exceeding a total of $300 per annum may be levied each year by a unanimous vote of the board of supervisors. The towns are entitled to receive county aid in proportion specified by law to aid in the construction of all bridges costing more than $200 each. Special highway taxes may be levied in a similar manner to produce not more than $600 in any one year whenever the proceeds of the existing taxes are not sufficient to carry out the work deemed advisable or necessary.

BONDS.

Bonds may be issued in a manner prescribed by law by counties and towns for road improvement purposes.

Any county board may determine to issue nontaxable, semiannual interest payment coupon bonds running not more than 20 years to an amount not to exceed one-fifth of 1 per cent of the assessed valuation of the county. The total amount of these bonds outstanding at any one time shall not exceed 1 per cent of the assessed valuation of the county. These bonds shall be in a form approved by the State highway commission.

If it is desired to issue bonds for greater amounts than the foregoing, the issue may be submitted to the voters of the county on petition of a number of voters at least equal to 10 per cent of the number of votes cast for governor at the preceding general election, or by resolution of the county board. If the issue is submitted by resolution of the county board it may be submitted at a special election on a date named in the resolution, otherwise it must be voted on at the regular April or November elections.

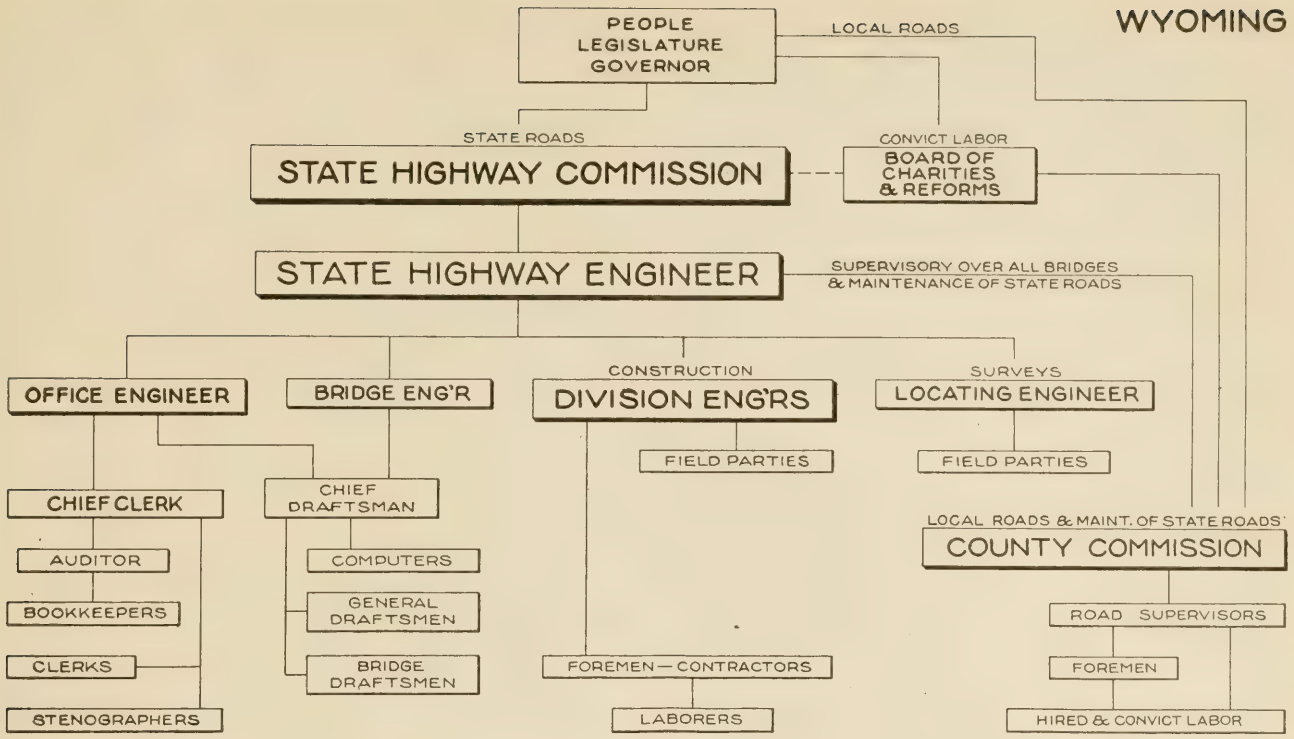
Towns are authorized to bond for highway improvement by issuing bonds of the same type as those hereinbefore described for the counties. The amount of bonds outstanding at any one time can not exceed the legal limitation, nor can any bonds be issued except after submission to the voters of the town at a legally called special meeting, or at the annual town meeting previous to which the issue must be advertised. The proceeds of town bonds are not available to obtain State aid and may not be issued unless the county board shall determine to issue bonds in a like amount for the improvement of the roads contemplated to be improved by the town.

The total county and town bonds outstanding on January 1, 1915 amounted to $281,078.

WYOMING.

DEVELOPMENT.

State participation in road work in Wyoming is in its initial stage, but provision has been made to extend the State system throughout the State. The highway commission organized in 1917 has



supervision over all bridge work in the State and control over the construction of a system of State roads designated by the State highway commission, and which comprises about 23 per cent of the total road mileage of the State. In 1911 the legislature directed that sections of the present system of State roads be improved by means of convict labor, and the operating expense of this force was borne by the respective counties in which the work was done. Practically no permanent construction other than machine grading was accomplished.

Wyoming has an area of 97,594 square miles with a population of about 1½ persons to a square mile. As no navigable streams are found within the State and only 1,821 miles of railroad are in operation, roads are the principal means of communication. As the State does not provide an adequate amount of funds, the burden of construction necessarily falls to a great extent upon the counties. The soil, climatic, and traffic conditions are such that well graded and drained earth roads give better results than in many other States. However, at the close of 1916, 520 miles or 3½ per cent of the total mileage of the State had been hard surfaced, although the greater part of this mileage was located in the Yellowstone National Park, and had been constructed by the United States Government. The total expenditures during 1916 for road and bridge purposes by local officials amounted to $450,000, but during that year no funds whatever were expended by the State directly for road improvement.

During 1917 a total of $590,000 was expended by all road officials of the State for highway purposes.

ORGANIZATION.

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

State.—The State highway commission is composed of five members appointed by the governor, from five divisions of the State, for terms of 6 years, not more than three of these members being of the same political affiliation. The commission has power to enter into contracts and agreements with the United States Government relative to construction and maintenance of roads, and to do all things required by the Secretary of Agriculture of the United States, to carry out the provisions of the Federal aid road act.

The commission may prescribe methods of cost accounting for road construction and require the various counties to adopt the same, it may publish requirements governing the issuance of certificates of competency by the State highway engineer to persons who may be employed as foremen or superintendents in charge of the construction of roads and bridges, and may prohibit counties from employing persons not possessing such certificates. The commission is empowered by State law to adopt general rules governing the letting of contracts for work under their supervision.

The State highway engineer is appointed by the commission, acts as its secretary and executive officer, and serves until removed by a vote of four members of the commission. He is required to be a competent civil engineer, experienced and skilled in road and bridge work. He employs, with the

approval of the commission, such assistants and other employees as may be necessary to carry out the duties imposed on him by law and the orders of the State highway commission. In addition to his general supervisory work coming under jurisdiction of the commission he is required to furnish plans of all bridges and culverts constructed in the State which are of more than 5-foot span or which cost more than $200, and he is further required to inspect same when completed.

County.—Road and bridge control in the county is vested in a board of three county commissioners elected by the people, two members for terms of two years each and one member for four years. When they divide a county into road districts a supervisor therefor is elected at each general election for county officers. When division is not made, a county road supervisor is elected for a term of two years. Such supervisors are under the direction and control of the county board and may be removed from office by the board for due cause. The county boards have the right to levy taxes within statutory limits and to expend the funds so raised.

CLASSIFICATION, CONTROL, AND PROCEDURE.

The road mileage of Wyoming, comprising about 15,000 miles, is divided into two classes for the purpose of fixing the responsibility for construction, control, and maintenance, namely, state roads and county roads.

State roads.—These comprise about 3,100 miles designated by the legislature and which have been or will be improved by convict labor or with State or Federal and local funds. The procedure for construction is substantially as follows: County boards designate a section of State road acceptable to the State highway commission and request an allotment of funds to aid in construction, and agree to pay one-half the cost of survey and of investigation. The site of the proposed improvement is viewed by the State highway engineer or his representative, who prepares the plans, specifications, and an estimate of the total cost thereof. The county board by resolution appropriates an amount not less than one-half of the estimated total cost of construction. The State highway commission may allot State funds or request Federal aid in an amount equal to 50 per cent of the estimated total cost.

All work done under the direction of the State highway commission which has an estimated cost of $2,000 or more is let by contract except in those cases where convict labor is employed.

Convicts confined in the State penitentiary may be used on State road work under certain conditions, which are substantially as follows:

The county board of commissioners petition the State commission of prison labor for convicts. If convicts are available, the State commission of prison labor equips a gang with guards and sends them to the site of work. The county furnishes tools and materials and pays the salary of the engineer in charge of the work and the additional salary of the guard, if such is required.

When the work is done by contract due publicity is given and all bids are received and opened at the office of the State highway commission in Cheyenne. The contract is awarded to the lowest responsible bidder, conditioned on his filing a bond acceptable to the State highway commission.

Supervision of the work in progress is vested in the State highway engineer and payment from State or county funds can be made only with his approval. The county's portion of the cost is paid by the county board when the account has been approved by the State highway engineer.

Maintenance is executed by the county, subject to supervision by the State highway officials.

County roads.—These comprise all other roads in the State. They are opened, constructed, and maintained by the county boards with county funds.

REVENUES.

State.—A State-wide levy of one-fourth mill on each dollar of valuation is levied on all taxable property throughout the State, and will yield approximately $70,000 per annum.

The State highway commission sets aside from the fund representing the one-fourth mill tax a sufficient amount to pay all expenses of the commission and its employees. An amount not exceeding one-fourth of the remainder of the fund is set aside for emergency construction or repairs and for additional aid to counties. The balance of the fund is expended for the construction of roads other than those receiving Federal aid. Such roads are designated by the commission in conjunction with the respective boards of county commissioners, and financial aid is conditioned on the appropriation by the county boards of an amount equal to that provided by the State highway commission.

County.—The road and bridge funds are obtained from a tax at a rate not to exceed 3 mills on the dollar on all taxable property in the county; 80 per cent of the auto-license fees originating in the county; a poll tax of $2 per year collected from every able-bodied man not otherwise legally exempt between the ages of 21 and 50; by revenues from an inheritance tax in effect in this State; 25 per cent of the revenues collected by the United States forest reserves in the State is delivered to the treasurer of the State, who distributes it among the counties in which the reserves are located. This fund is divided between the road and school funds. No State and county bridge bonds are outstanding.

TO CHANGE OHIO ROAD DEPARTMENT.

A bill has been introduced in the Ohio Legislature to reorganize the highway department of that State. It abolishes the present nonsalaried advisory board and increases the salary of the commissioner from $4,000 a year to $6,500, provides a chief engineer at $5,000, three assistants at $4,000 each, a fiscal secretary at $4,000, and 11 district engineers at not to exceed $3,600. It would add more than $2,000,000 to the highway fund by restoring the half-mill levy, which was cut to three-tenths mill in 1914. Another bill provides for the patrol system for maintenance of improved roads.

HOUSTON-SAN ANTONIO HIGHWAY.

The first contract for the fine highway planned between Houston and San Antonio, Tex., has been let. It calls for $72,000 work in Fayette County. The estimates of the State department call for an expenditure of $341,000 right away on the project, of which $118,000 will be Federal aid.

FLORIDA ROAD BUILDING.

Florida is making plans to resume the road-construction work interrupted by the war. Bonds totaling hundreds of thousands of dollars had been sold or voted by counties before the war cut short road building. Ending October 31, 1918, the State road department had available $285,203 Federal-aid money, $1,906,105 from various counties, $139,605 from the automobile license tax for road building and repair, and a total of $1,065,445 from the automobile license tax for maintenance during 1918.

ASSESS LAND FOR ROADS.

In considering the measure now before the Oklahoma Legislature providing for a $50,000,000 bond issue for roads the house committee has voted to assess property for the first half mile back from the road at 10 cents an acre, for the next half mile 8 cents, for the next 6 cents, the next 4 cents, and the next 2 cents an acre. This is regardless of valuation. Railroad companies are to pay $15 a mile, telegraph companies $4, and telephone companies $2. This assessment is for maintenance purposes only.

REIMBURSING JERSEY COUNTIES.

The New Jersey highway commission has set aside $500,000 from the 1920 highway tax to reimburse counties which have built roads under the system of highway construction in that State. This money will be available about July 15 for Monmouth, Middlesex, and Morris Counties.

MONTANA ROAD PROJECTS.

About 30 highway projects will be ready for pushing in Montana by the time the season is right for road building. They will cost about $800,000, half of which will be furnished by the Government. Other State-aid projects are under way, and the State commission will cooperate with counties and private subscribers in the construction of the Anaconda-Hamilton road, which will shorten the distance between the two places from 150 to 72 miles.

ILLINOIS PLAN FOR TENNESSEE.

The "Illinois plan" for good roads is in operation in that State and is working well. By its provisions the State issues bonds to be paid entirely by direct tax upon auto owners. This arrangement enables the roads to pay for themselves in a few years and gives a profit paying investment to the automobilists, as the additional tax is not equal to the sum saved in gasoline and repairs. The people of Illinois voted on a $60,000,000 bond issue and they will build 4,400 miles of concrete roads connecting all towns of 2,000 and more population. The plan in Tennessee would cost $40,000,000, it is estimated. South Carolina and Georgia are agitating the adoption of this scheme for good roads and Tennessee may well consider it.—*Nashville (Tenn.) Tennessean.*

WOULD CHANGE STATE CONSTITUTION.

If the constitution of Iowa will not permit the issuance of bonds for the construction of highways, we should change the constitution at the earliest possible moment. If there is to be a comprehensive system of highways in the State, it will never come about if each county is to take its own time and way. It will result in a patchwork of good highways and poor highways.—*Storm Lake (Iowa) Pilot-Tribune.*

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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.

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Dept. Bul. 660. Highway Cost 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.

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.