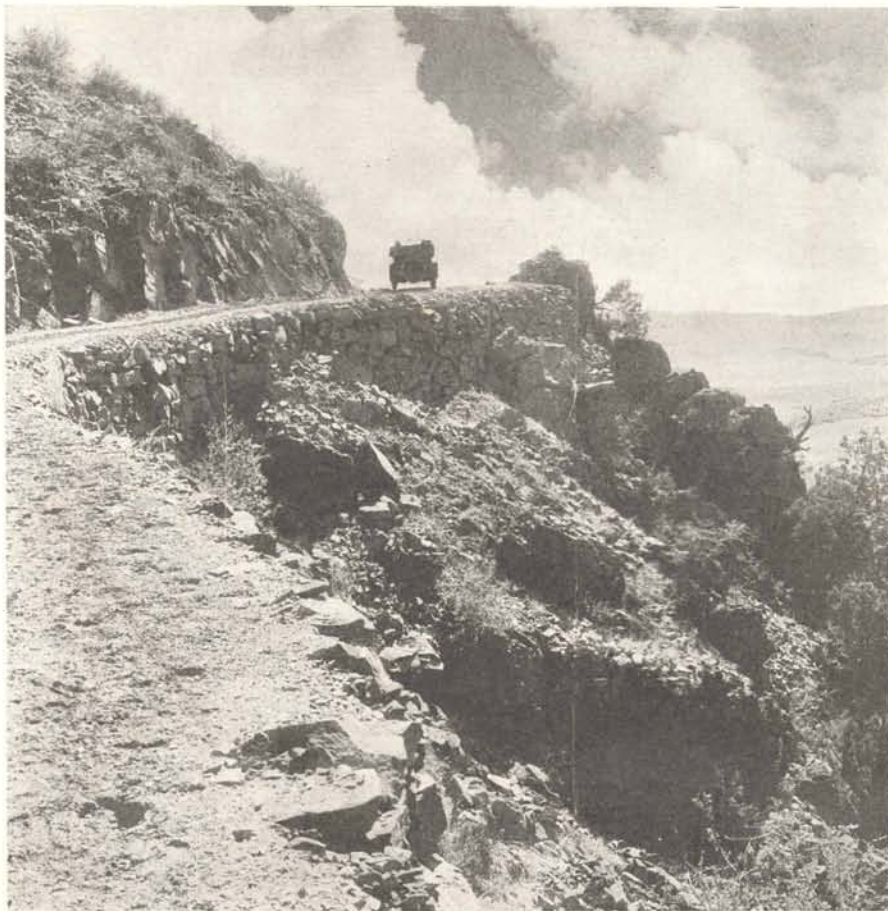


# Colorado Highways

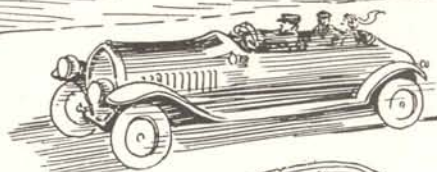
## BULLETIN

Issued by the State Highway Department



*Entrance to Turkey Creek Canyon in Jefferson County, looking out over the plains. A good idea is given here of the type of construction followed on precipitous mountain sides.*

February, 1919





# COLORADO HIGHWAY OFFICIALS

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T. J. EHRHART, Commissioner.

J. E. MALONEY, Chief Engineer.

## COUNTY AND DENVER ROAD OFFICIALS

NOTE—In the appended list of county officials the first name in each county is that of the county clerk, the second name is that of the county surveyor, and the last three names are those of county commissioners.

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WASHINGTON—L. Roy Cummings, Akron; Elbert Lewis, Akron; Homer Evans, Akron; R. M. Buckmaster, Abbott; E. A. Lewis, Burdett.

WELD—as E. Littell, Greeley; L. L. Stimson, Greeley; A. F. Peters, Mead; T. Elmer Rowe, Greeley; J. W. Birkle, Platteville.

YUMA—John Adcock, Wray; A. C. Cary, Wray; Harry F. Strangways, Wray; H. W. Jackson, Yuma; Alex. Shaw, Wray.





*Looking into the walls of Mt. Massive, Colorado's highest peak, from the summit of Tennessee Pass.*

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## COLORADO HIGHWAYS BULLETIN

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Department

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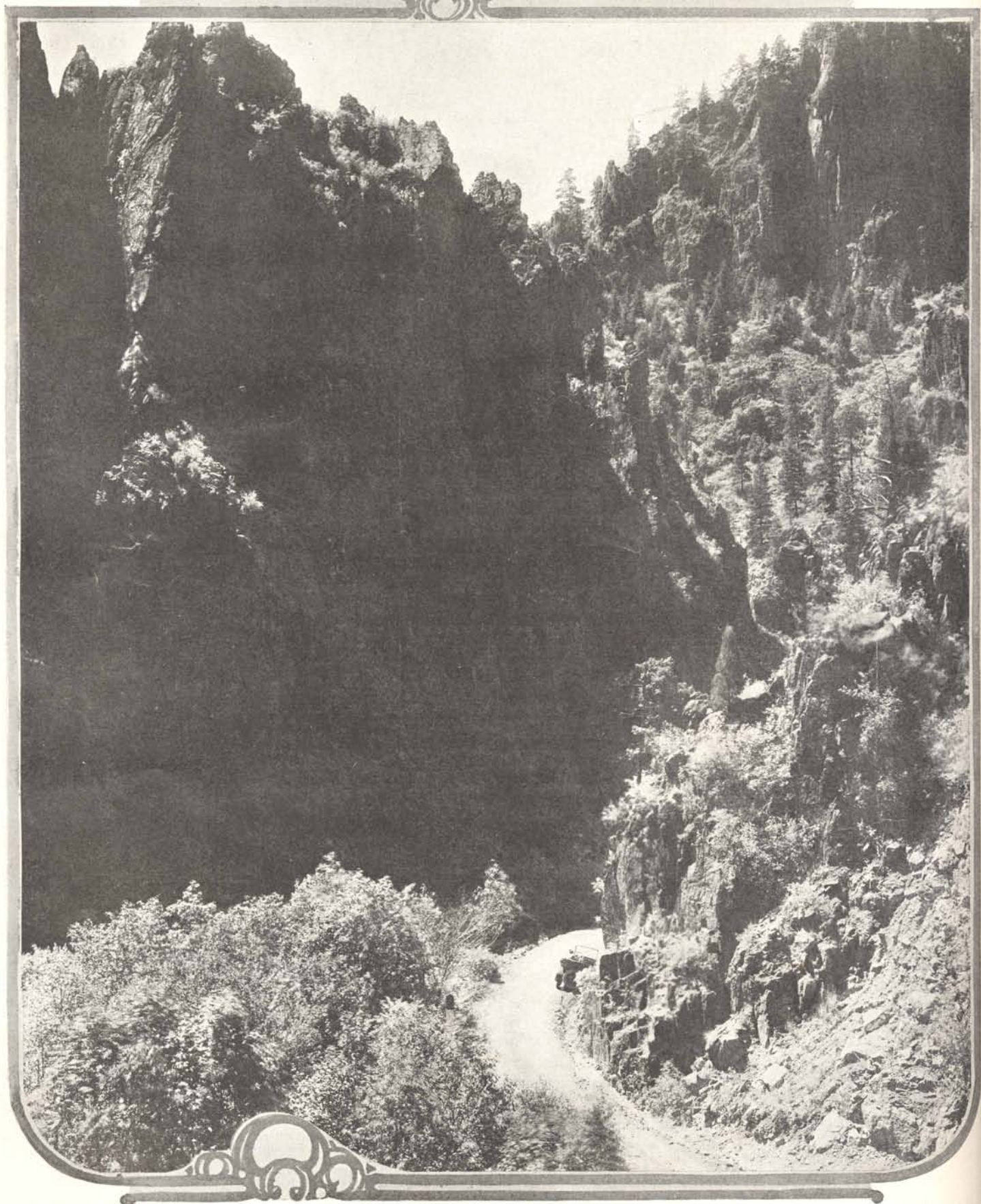
Address all communications to Colorado Highway Department, attention Pyke Johnson, editor, Colorado Highways Bulletin.

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, newspapers and periodicals and civic associations. Others desiring to obtain Colorado Highways can do so by sending 10 cents for each number desired. Associations desiring to distribute the magazine can obtain it at cost in lots of from 500 copies up.

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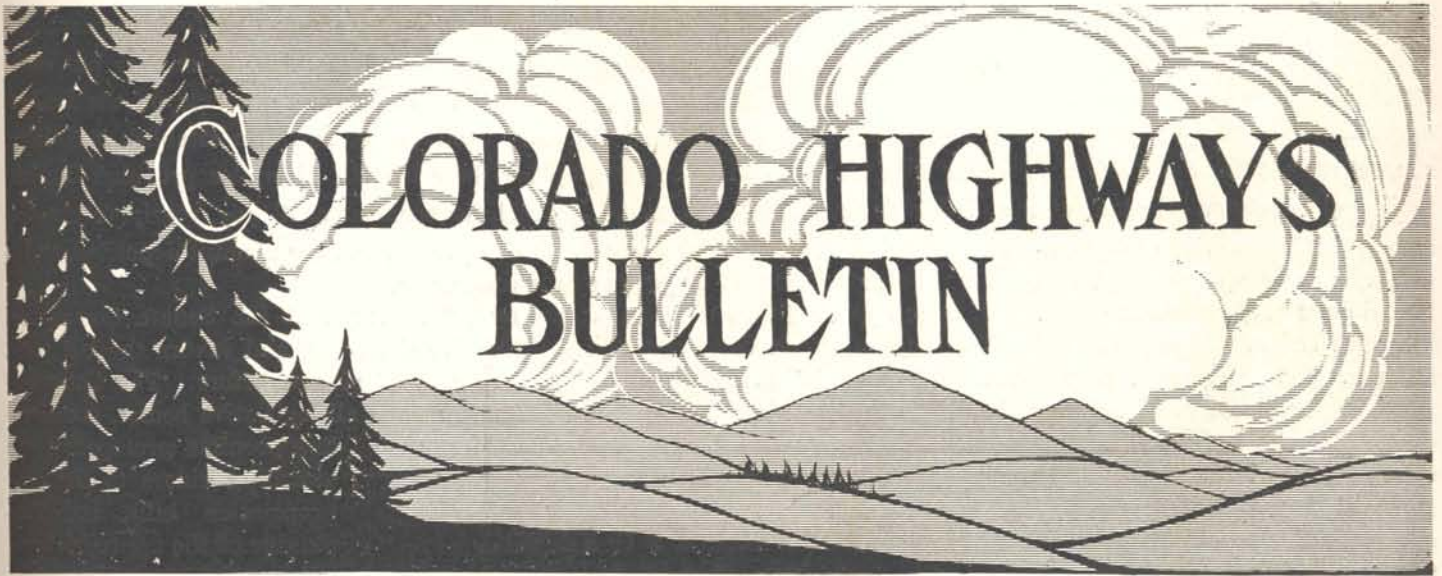


Fleeting Viŝtas, Endless Curves, Vast Cliffs! It is the Phantom Route



*The road up Phantom Canyon, Fremont County, that once was a railroad right-of-way.*





Vol. II

FEBRUARY, 1919

No. 2

## The Legislative Road Log

*A discussion of the national highway bills and what Colorado must do to meet federal apportionments*

**N**EVER in the history of the nation has there been such a universal interest in the good roads question as now, manifested by the unprecedented number of road bills before Congress and the state legislature, all looking toward the expenditure of millions for making a national highway system from the present disjointed patchwork of improved roads. In the Colorado legislature alone nineteen road bills and one joint resolution have been introduced, all touching upon the road question.

Just as this issue of the Bulletin is ready to go to press the State Highway Commission has received a wire from Washington containing the information that the Bankhead bill has been attached to the Postoffice appropriation bill as a rider, and in that form it is extremely probable that the measure will carry.

The Bankhead bill, introduced in the senate by Senator John H. Bankhead, chairman of the Committee on Post Offices and Post Roads, to which all highway legislation in the upper branch of Congress is referred, originally provided for an appropriation of \$50,000,000, to be immediately available; \$75,000,000, available July 1, 1919; \$75,000,000, available July 4, 1920, and \$100,000,000, annually to July 1, 1924. It also provided for a wider interpretation of the words "post road," to cover any road that might so be used. A bill by Senator Swanson, which is said to have been recommended by the United States Bureau of Public Roads, and Representative Browne in the House, are practically identical, according to information received, with a possible exception in the Swanson bill, highly important to Colorado and the western states. This will be discussed later.

The telegram received by the highway commission would seem to indicate that the Bankhead bill has been amended by the committee so as to cut off the appropriation after the third year, although further advices may be to the contrary.

Taking the telegram as a correct statement of the present reading of the bill, however, this would mean that there will be available for road building in Colorado from federal sources, as soon as this bill is passed and is signed by the President, the following sums in round figures: Immediately available for Colorado, \$880,000; available July 1, 1919, \$1,320,000; available July 4, 1920, \$1,760,000.

But these appropriations will not be awarded the state unless they are met by funds from state sources, and the present income of the Colorado Highway Commission is no more than sufficient to maintain the road system already improved. It is highly imperative, therefore, if the state is to receive the benefit of these funds, that the \$20,000,000 bond issue be voted. Even then some method will have to be devised to meet the appropriation for this year.

To refer back to the Swanson bill it may be stated that the late Logan Waller Page, who died in office as Director of the Bureau of Public Roads last December, had presented to him by Highway Commissioner T. J. Ehrhart when here recently, a plan for allotting federal aid funds to the various states upon a basis which the several states would be able to meet. This basis was figured upon five factors: Per cent. of assessed valuation to total for the United States; miles of road per square mile of area; rural population per square mile of land area; per cent. of total mile-



age in the United States and population per mile of road. The product of these figures resulted in the division of the states into four classes: those which should meet the federal apportionments on a 50-50 basis, or dollar for dollar; those to meet them on a two to one basis; those on a three to one basis, and those on a four to one basis. Colorado was ranked among thirteen western states in the latter class, *i. e.*, she would be called upon to put up one dollar of state funds for four dollars of government funds. Mr. Page approved this idea, but before he had returned to Washington his death occurred. His successor, acting director St. John Wilson, wrote Highway Commissioner Ehrhart within the last three weeks that the bureau had been advised of Mr. Page's approval before his death and made this recommendation to Congress. The idea also appears in the senate bill by Senator Reed Smoot of Utah. Upon request of the federal road officials and state road officials of Utah the state highway commission sent its recommendations and tabulations both to Washington and Salt Lake City. The Smoot bill, it is believed, represents the recommendations of the Utah Highway Commission, and consequently the Colorado plan appears in this bill. Senator Smoot's bill provides for the formation of a United States Highway Commission, to be composed of the chairman of the Senate Committee on Post Offices and Post Roads, the chairman of the House Committee on Roads and the Director of the Bureau of Public Roads. It proposes to issue bonds to the amount of \$1,000,000,000, the proceeds of which will be distributed to the states in proportion to the average percentage of their percentages of population, total assessed valuation, and total mileage of public highways. Highway Commissioner Ehrhart's recommendation, made last November, was that \$100,000,000 in bonds be issued, apportioned to be sold at par in the states and paid into the state treasuries to be used by the state highway commissioners in building roads.

The Smoot bill deviates from this plan further by providing that, when money is supplied to the states, they must

deposit state bonds, drawing interest at four per cent., to cover the amount advanced to them. The four per cent. interest shall pay the three per cent. rate on the United States Highway bond issues, and also establish a sinking fund to pay for these bonds. It is also provided further that the Federal Government shall pay yearly to the depositing states two per cent. of the amount deposited, to be expended in maintenance.

It is apparent, however, that the Senate Committee has taken a legislative short cut, and favors the bill presented by its chairman, as related before. The Congress of the United States, among all legislative bodies, exercises this peculiar prerogative of attaching riders to the appropriation bills, and the passage of the appropriation bill carries the rider with it, the rider often being attached by mutual agreement and thus avoiding a long drawn out fight over a legislative subject. Present advices do not state whether the Bankhead bill as amended by committee requires states to meet federal appropriations dollar for dollar, or according to their ability to pay.

The National Highways Transport Committee has requested all good roads bodies, influential citizens, clubs and other organizations to wire their senators and representatives to support this Bankhead rider, as this seems the best thing at this time to do. If passed it insures an expenditure of \$225,000,000 for good roads by the government as a federal aid to states, but it also is a warning in good time that the states themselves must prepare to meet the appropriation by local bond issues if they wish to remain in the forefront of progress. Naturally the states that

provide such funds will be those to receive the benefit of the appropriation. If Colorado is to receive its share this year provision must be made though the imposition of special taxes, such as transferral of inheritance tax, or a gasoline tax, to raise some \$800,000 for duplication of the federal apportionment prior to the bond issue. Competition between the states for these reconstruction funds will be fast and furious.

## The Road That's a Friend To Man

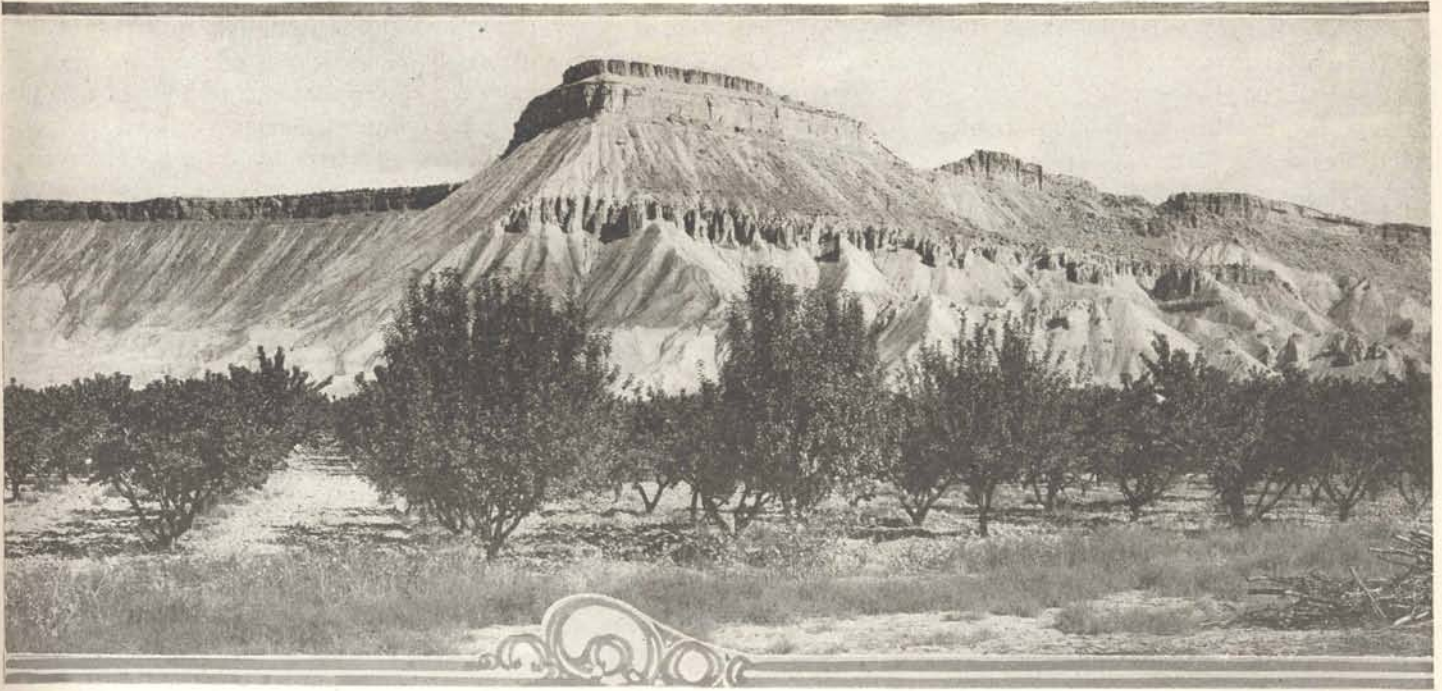
From the Plateau (Colo.) Voice.

*Let me live in a house by the side of a road  
Where the race of men go by—  
But not such a road as I have now,  
With its dust when the season's dry.  
Roads are good, they are bad, they are weak, they  
are strong,  
Built on many a diverse plan.  
But I'd like to live by the side of a road  
That is always a friend to man.*

*Let me live in a house by the side of a road  
Where flows, like the rich, red blood,  
A current of life, cars, flivvers and trucks,  
Not a highway composed of mud.  
Who could dwell in content by a rut-slashed track,  
Rock-strewn from Beersheba to Dan?  
Let me live in a house by the side of a road  
That is always a friend to man.*

*I can live only once, so why should I stay  
Where daily offends my eye,  
A crooked streak of mud or clay,  
Scooped out by the passers-by?  
I don't like to sit in the scorner's pew,  
Nor "hurl the cynic's ban,"  
But ye gods!—for a road that all the year through  
Can be counted a friend to man!*





*The Palisades on the Grand River in Mesa County, from which the prosperous fruit shipping town of Palisades takes its name, and a typical orchard of the section.*

## National Highways and the Missing Links

*Roy D. Chapin, Formerly Chairman, Highways Transport Committee,  
Council of National Defense.*

WHEN the construction of roads was first undertaken on a large scale in the United States, it was a common belief that traffic was local. It was argued that as highway transportation could not hope to compete with railway carriage over any great distance, the problem of construction of roads was that of linking up communities without considering those communities either in their relation to the state or to the United States.

For the purposes of debate, the statement that highways transportation cannot compete with rail lines may be accepted without argument, since it is generally conceded that the low rates which prevail on long hauls on rail lines cannot now be met by even the most efficient form of highway transportation, which is the motor truck.

But to argue from that hypothesis that highway transportation is local in character is to fall into a common error which has resulted in the creation of many unconnected links of highways all over the country and which, because of their isolation, have had a tendency to increase costs of transportation and consequently the cost of commodities, since traffic either originates along or travels over the road at some stage in its progress from the producer to the consumer.

Take the case of Pennsylvania and Maryland as a concrete example in hand. The state highway departments of these states have recognized for a long time the desirability of connected gateways, yet today there are but three of the main highways leading out of Maryland into Pennsylvania

which are linked up with through highways in that state.

Analyze, if you will, the gateways between any other states in the Union, and you will find a similar condition prevailing, with the exception that the farther one travels from the congested traffic centers, the less likelihood there is of finding connected systems between the states.

The reason is not difficult to find. Since the day when road building first began in a modern sense in this country, the highway departments have always been handicapped by a scarcity of funds. As they have gradually pushed out their new, modern-type roads, the benefits derived therefrom have become so generally appreciated that there is a constant demand for more roads going up from every community in every state.

It frequently happens that a highway carrying heavy traffic may lead right to the boundaries of a state, there to link up with a district where traffic is not heavy or where the residents have not been so insistent, for one reason or another, for the improvement of the road. The result is that the state department has naturally considered first the demands of its own public and has expended its funds in other directions.

This in itself would not be so bad if we could arbitrarily arrange boundaries for traffic. But there is always inter-state traffic to be considered which may originate at or near the boundary of one state and have its terminal right within the boundary of another. This traffic is growing steadily in volume and it should be taken care of. But



it is closely limited today by the costs of transportation which increase in a startling ratio the moment the traffic passes from a good road to a poor one, and in consequence we have not the free interchange between states that we should have.

Further, it must be remembered that traffic of this nature is not always limited to flow between two states. Actual inter-state traffic passing across two or three or more states is going on today and one of the chief difficulties which the United States Government had to overcome in its care of military supplies passing from inland points to seaports for shipment to France, was this very need of through highways. Needless to say, this traffic which originated under the press of war conditions has not died, nor will it, since there are certain economic advantages to last through highways transportation of special types of express which are now generally recognized.

In a broad sense any provision for national highways means a linking up of the gateways between states. Back of that, of course, remains the pressing need for a study of the development of traffic, where it originates and how it increases, as in practice we will inevitably find that certain of these through links must be more heavily constructed than others, since they will prove to be the most economic routes of travel and hence the trunk lines from which "feeders" will radiate in all directions.

The states are limited in this linking up process, hence the development of a national system naturally falls upon the Federal Government with its unlimited funds and its ability to analyze these problems from a national standpoint, creating the trunk lines where they are most needed.

Today there is no department in the United States that has the authority to connect up these highways or to improve any one system, nor is there a body constituted to analyze the fundamental principles governing the flow of this traffic, but that is no reason why we should not have one. New conditions create new needs and of all of our new problems none is more vital than this one of an understood and directed transportation.

Yet, it cannot truthfully be said that the principle underlying this national system of highways is a new one. European countries have recognized the need of national highways for a long time and each of them has trunk lines spreading over it today, with a consequent lower cost of highway transportation per ton-mile than we have here.

More than that, the principle has been recognized in part right here in the United States by all of the state departments. Proof of this statement is self-evident on every hand in our county road systems.

For the information of those who do not know of the evolution of highway transportation, road building first started in highway districts. It was soon found that these districts must be linked up and counties took over the work. Then the state found that it had on its hands a number of disconnected roads which started nowhere and ended in the same general location, so state funds were set aside to link up county highways.

The result today is found in the beginning of a sys-

tem of state highways which serves to link up supply points everywhere and which makes it possible for the unit of transportation to travel from one end of the state to the other over a uniform highway where funds have been sufficient to bring about a practical realization of the goal. Where funds have been lacking, then an analysis of the plan of road building of any state should show that this interrelated system is the goal.

From district to county, from county to state, from state to national highways systems is a natural, logical growth and the day cannot be far away when, if we are to take care of our transportation needs, this national system will come.

And on the day, we will find that not only have we linked up our commercial arteries but at the same time we have created a uniform medium of communication which will permit through passenger traffic (something which must be taken into serious account), which in turn will permit a closer bondship between California and Maine, North Dakota and Texas.

Realization of the ideal waits only upon an acceptance of the practical plan and its embodiment in legislation by Congress which will provide for more funds, a highway commission for the study of these problems, and a national highway system.

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## Tennessee Roads

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Approximately \$250,000 is to be spent by the Highway Department of Tennessee on the Memphis-to-Bristol highway, part of the trunk line system of interstate roads leading from New York, Washington and Philadelphia to New Orleans. A large part of the road has been completed, the section on which bids are now being received at Nashville being 21.35 miles. A Waterbound macadam, 8½ inches thick, 16 feet wide on a 24-foot roadbed, with reinforced and plain concrete drainage structures, is to be used.

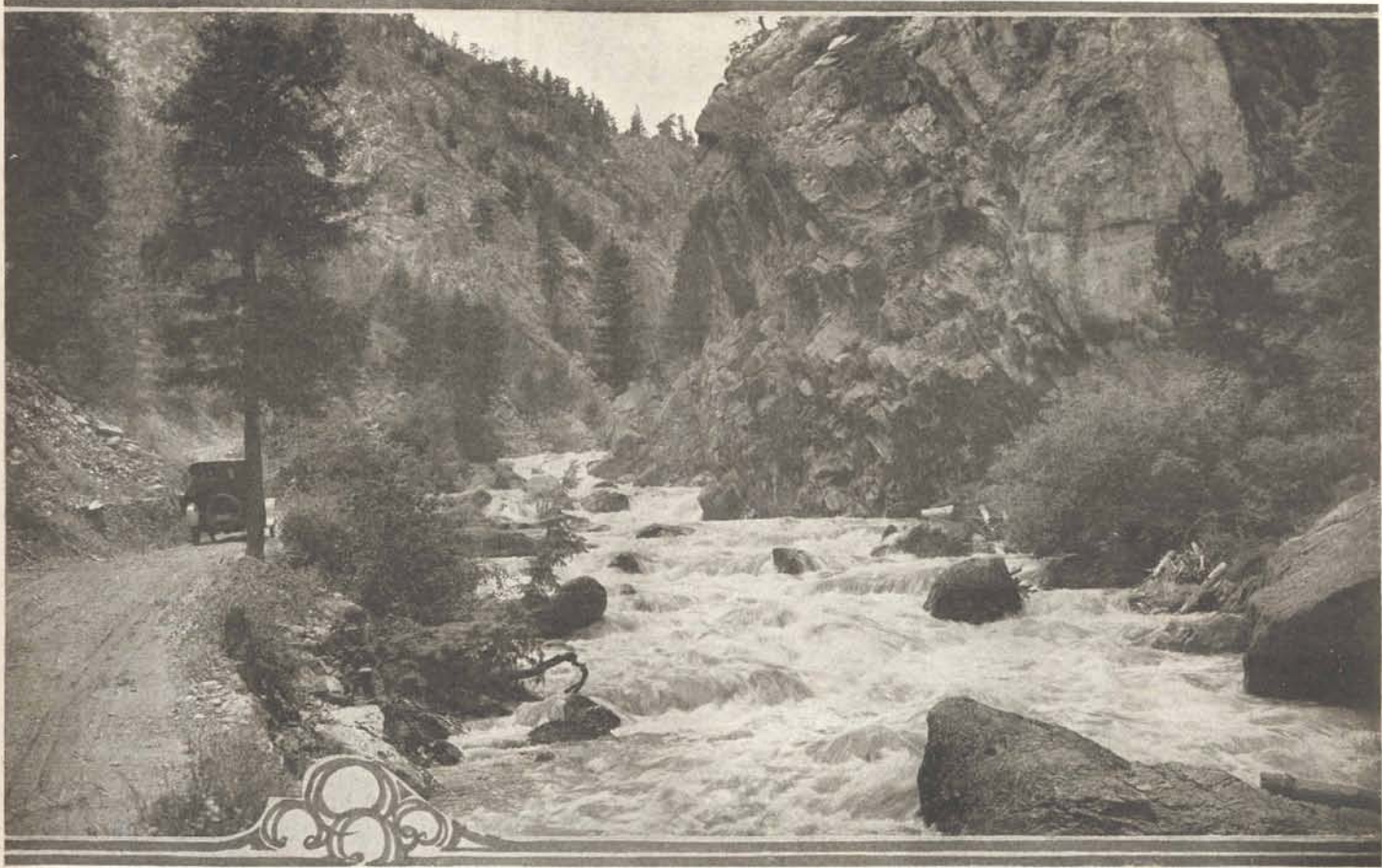
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## New Federal Bureau

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The Division of Public Works and Construction Development, a section of the Information and Education service of the United States Department of Labor, is now being organized by F. T. Miller, publisher of construction periodicals. The particular objective of the Bureau's research will be to secure data for the use of construction industry, but the material to be collected will be so varied that the information will be of value to the industry generally. The facts made available will be of help to any community or investor in determining whether it is advisable to undertake public or private building at present. In a recent statement Mr. Miller said: "The country is probably a full year behind in its civil construction program, amounting to at least \$3,000,000. This amount must be caught up and normal building continued; a condition of permanently arrested development of the country is inconceivable."





*The road up the Big Thompson, between Loveland and the Rocky Mountain National Park, which will be widened and improved this year to meet the growing demands of tourist travel.*

## Good Roads and County Commissioners

*Highway Recommendations of Two Important Conventions.  
W. H. Emmons, Sec'y Colorado Good Roads Association.*

### TWENTY MILLION DOLLARS FOR GOOD ROADS IN COLORADO!

This was the slogan of good road advocates from all over the State, who gathered in Denver during the week of the 20th of January to discuss the question of how best to secure better highways for the State.

Three good road measures, now pending before the General Assembly, were discussed by these good road advocates. These are the enabling act, providing for an issue of \$20,000,000 in bonds for the construction of roads; the bill to place a tax of one cent per gallon on all gasoline used by conveyances on the public roads, and third, the measure providing for an increase in the inheritance tax. These three bills have, since their inception, been the subject of various conferences held in Denver and attended by representatives from various parts of the State, and at the annual convention of the Colorado Good Roads Association resolutions were adopted endorsing all three of these measures and committees appointed to urge their passage in the Legislature. The State Association of County Commissioners has also appointed committees to work to secure the enactment of these same measures.

The enabling act for the bond issue, as now before the Legislature, provides that this question be submitted to the people at the general election to be held in November, 1920. The bonds are to be fifty-year bonds, bear 5 per cent interest and be issued in denominations of \$50.00 and over. It is hoped by this means to so popularize the bonds that they will become a ready source of investment by Colorado people, thus keeping the securities within the State. The measure also provides that the first of these bonds shall be issued June 1, 1921, in an amount of not to exceed \$2,000,000, and that they may be issued in amounts not exceeding \$3,000,000 in any one year, annually for the next years. These bonds shall not be issued at less than par and accrued interest.

The proceeds from these bonds would be used to construct good roads through the State, and a plan for the expenditure of this sum on a comprehensive system of State highways is now being worked out by the State Highway Commission. This survey is to be made by the State Highway Commission during the coming summer, and the plan for the expenditure of this money will, therefore, be placed

(Continued on page 20.)



# Wanted---Camp Sites for the Motor Gypsy

*A bill to provide free public grounds along state highways*

**I**RATE Ranchman—What are you doing on my land? Didn't you read that sign? Are you blind? "No camping or fishing allowed." Now move on.

Kansas Tourist—But we couldn't find an unfenced place along the road, and we had to sleep. We've just started dinner.

Irate Ranchman—Can't help that. If I let one in fifty come, chop down my trees, fish out my stream, litter up my place.

Kansas Tourist—Well, what do you invite people to your state for? I suppose you want us to come, give you our money and hang on a Christmas tree.

Irate Ranchman—Now, see here, I said move on. I didn't invite you to camp here.

Kansas Tourist—All right—we'll go. But I'll be blanked if I ever come to this state again.

The above incident is not of any particular place or people or year. It is not of any particular state, but happens every year in every state through which the motor gypsy passes. Both the ranchman and tourist are right and wrong—the former because he has a right to the inviolability of his land, yet has done nothing to provide a place for the tourist to stop—the latter because he has no right on private property, but has a right to expect a few accommodations when he enters the state in answer to alluring invitations for enjoyment, the healthful air, and magnificent scenery of the Rockies, to which no man has a land office patent.

It is to obviate this difficulty and protect both the rancher and tourist that State Highway Commissioner T. J. Ehrhart drafted the public camp site bill, now before the state legislature. The idea is absolutely new. It is peculiarly fitting, but natural, that it should originate in Colorado, for Colorado invented the automobile camp.

As yet the camps have been located in or near cities, but the public camp site bill provides for the purchase of country camp sites along the state highways, where the tourist may find a pleasant, shady site, running water and a few simple accommodations; perhaps outdoor stone ovens, a convenient wood-pile and an open shelter house, such as may be found on the National Forest recreation grounds.

The bill was introduced in the House of Representatives by Rockwell and Lacey, and its text is given here:

"A bill for an act providing for the purchase of camping sites along State Routes and Highways of Colorado.

"Be it enacted by the General Assembly of the State of Colorado:

"Section 1. The boards of county commissioners of the several counties of Colorado are hereby empowered, with the approval of the State Highway Commission, to

Time: The close of a pleasant summer day.
Place: A grove of pines by a rushing mountain stream.
Principals: Kansas tourist, wife and two children; irate farmer; the flivver.

purchase parcels of land to be used as free public camping grounds, not exceeding five acres in one tract, at a cost not to exceed \$100.00 per acre, along and contiguous to a state route or

highway, and pay for the same from the county road fund.

"Sec. 2. The boards of county commissioners before making any purchase of land under this act, shall visit the proposed site and, if a satisfactory agreement can be made with the owner as to the price and acreage, a survey and plat shall be made and abstract of title secured, which shall be submitted to the county attorney for his approval. A full statement concerning the proposed camp site purchased shall be forwarded to the state highway commission, and if the said commission shall approve the purchase, it may instruct the state highway commissioner to issue a voucher on the state road fund, payable to the county treasurer, reimbursing the county to the extent of fifty per cent. of the cost of such purchase. No camp site shall be purchased without first securing the approval of the state highway commission.

"Sec. 3. In the selection of camping sites, the topography of the land must be convenient for automobiles and other vehicles, with convenient water supply, and, where possible, shade trees. Rules and regulations governing the use by the public of such camping sites may be agreed upon between the boards of county commissioners and the state highway commission. A reasonable amount may be expended in fencing where necessary, and otherwise improving any camp sites.

"Sec. 4. It shall be a misdemeanor, subject to a fine not to exceed \$100 for any person to destroy any tree, deface any natural object, or befoul any source of water supply, located on or in any public camping site as defined in this act."

There is a sound reason for making it necessary for boards of county commissioners to secure the approval of the highway commission before a camp site is purchased. It will prevent any "friendship" sales of unsuitable sites, prevent the payment of extravagant prices for land, and, at the same time, permit the establishment of a connected system of sites, located on roads where travel is great, at convenient and reasonable points along the routes. Such camp sites, if established, will take the motor tourist into sections of the state which he now seldom visits, because of lack of accommodations for camping, and induce him to stay in the state for weeks at a time instead of for days. The practical benefit to rural communities, which now seldom see the tourist, is at once apparent, for the average motor tourist lives well while on the long trail, and is motor-gypsying, not because he cannot afford trains and hotels, but because he wants to camp out and rejuvenate a tired body and brain.



In Spots Like These the State Should Establish Motor Gypsy Camps.



Top—In Denver's city motor camp. Below—Motor campers in the Denver Mountain Parks.



# Grade Limits and Traffic Conditions

By J. E. Maloney, Chief Engineer, State Highway Commission

## Explanation of Diagram of Cost of Operating Traffic.

Line 1 is based upon the gasoline used upon the different classes of road, as determined by Mr. A. N. Johnson, Consulting Engineer of the Portland Cement Association, in his experimental tests, and I have assigned the following values for the road resistances:

Concrete .....	28 lbs.
Macadam somewhat worn.....	70 lbs.
Gravel good .....	75 lbs.
Gravel fair .....	105 lbs.
Earth clay .....	210 lbs.

Lines 2 and 3 are also based upon the same experiments, with the cost of oil and of tires and repairs, respectively, added to show the increasing percentage of cost variation.

Line 4 shows the oil and gas, tires and repairs for Nos. 9 to 18 inclusive, given in the table of costs of operation in January, assigning the values of 135 to 140 lbs. and 235 lbs. to 240 lbs. as the road resistances.

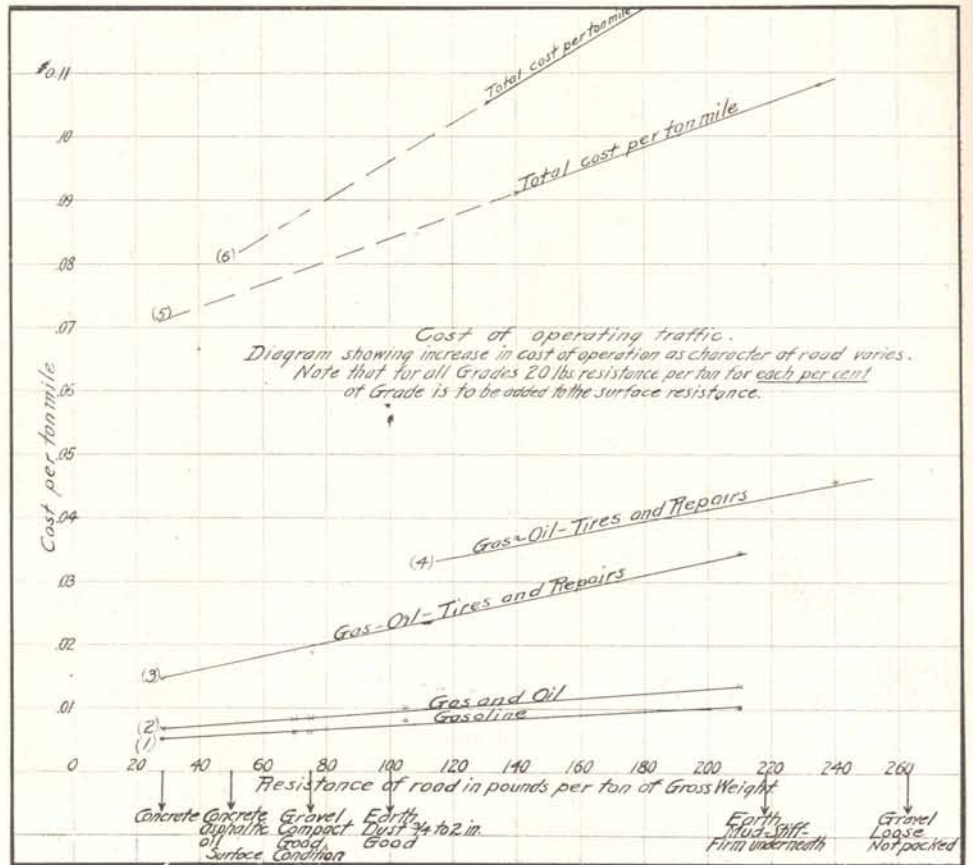
These two lines, Nos. 3 and 4 on the diagram, show the same general percentage of variation, but the recorded costs are higher than the costs based upon the experiments.

Lines 5 and 6 on the diagram show the variation using the total cost of operation as given in the tables published heretofore; line 5 being based upon the cost of operation of Nos. 17 and 18 in the table of operating costs published in January, and line 6 being based upon the cost of operation of Nos. 9 to 16 inclusive of the operating costs.

As line 5 shows the lower percentage of increase of cost it is used for the comparison of traffic costs on the different classes of road with the assurance that any future determination based upon more complete data will increase rather than decrease the rate of change, and will therefore be making a conservative estimate.

The designation of the character of road at the bottom of the diagram, and the resistance applied for each, is based upon the experiments of Prof. J. B. Davidson of the University of California, made for the Good Roads Bureau of the California State Automobile Association.

It is recognized that men's judgment will differ as to the values to be assigned to the road resistance for each particular case, and that the lines drawn on the diagram may be shifted one way or another as this resistance factor is changed. I believe, however, that any change which more complete data will show necessary, will be to replace the straight line with a curve flattened at the lower resist-



ance, say up to 40 lbs., and increasing the angle at the higher resistances.

In using the diagram to find the total cost per ton mile for a paved road, enter the diagram at the bottom at the point of the road resistance desired; for instance, take the point at 28 lbs., get the intersection of this vertical line with line five. This will give the horizontal line of cost, being 7.3 cents per ton mile. For gravel road compacted and in good condition, take the resistance at 75 lbs. per ton. The vertical line followed from this point to line 5 intersects at the horizontal of 8.5 cents per ton mile, showing a saving of 1.2 cents per ton mile for the paved road over the gravel.

Application of the operation costs to the traffic records on the roads of this State:

Taking the traffic for the 3827.6 miles, estimated in the tables published in December as 162,926,098 ton miles, and applying the average cost as given in the operating costs, of 10.8 cents per ton mile, will make \$17,595,917 dollars per year as the operating cost for the traffic alone.

A saving of but one cent per ton mile on this traffic would equal \$1,629,261 dollars annually, which sum capitalized at 5 per cent would warrant the expenditure of \$32,585,200 in the improvements necessary to effect this annual saving.

(Continued on page 21.)



# Common Drainage Problems

*John S. Whittaker, District Engineer,  
U. S. Bureau of Public Roads*

**R**OAD drainage has been a complex problem for the engineer and the public since roads were first constructed and no doubt will continue until the end of time. It has been kept constantly before those who build roads or keep them in repair, and yet it remains one of the most neglected problems in construction and maintenance. Location, grade and drainage are said to be the only permanent features of a highway, and of these drainage appears to be the hardest problem for the locator to solve. Almost every engineer can relate from his experience incidents and problems requiring special methods to remedy and overcome. The fleets of army trucks traveling from the factory to the seaboard, and the short-haul motor truck lines in operation last winter and spring presented new problems for the road engineers of the more populous states to solve. Investigation in practically every case led to the decision that lack of drainage was the fundamental cause. No universal remedy was decided upon as a cure for all cases investigated.

The question of road drainage is so broad that the subject will be discussed only in a general way. The new factor of motor transport of short-haul freight requiring hard-surfaced highways with foundations and drainage problems special to each surfaced highway constructed, is just now appearing for all highway departments to solve. However, it is not this to which I call attention; rather it is to the every-day problems so common in the past, present and no doubt also in the future, so neglected in their entirety and yet in the end requiring and receiving special consideration and treatment.

Bridges and culverts generally are problems as to area of openings, strength, and materials of construction. The area of opening can be determined closely, by standardized mathematical formulae in which the drainage area, amount of rainfall and rapidity of run-off are the main factors. This result is checked whenever possible by the clear area of other structures if any on the same water-course and by records of maximum flow. The materials are largely determined according to their availability and cost, and the importance of the highway. However, in order that these may become permanent and capable of carrying the future traffic, uniform legislation defining the maximum load and maximum weight per linear inch of wheel tread, as well as the maximum rate of speed, must not only be enacted but must be enforced.

Whether cross-drainage structures are of wood, corrugated steel, vitrified clay, concrete or stone is largely a question of availability and cost. The size, location and proper installation are the determining factors which decide for success or failure. If proper outlets are not provided to quickly take care of the run-off, the result may be failure even if all other provisions made for cross-drainage are properly provided.



*Lack of proper side-ditches is emphasized.*

The drainage of earth roads in Colorado and other intermountain states presents special problems due to the range of climatic conditions and the wide variations in topography and subsoil. The arid, semi-arid or irrigated, and mountain sections each presents its special problem which becomes complicated with the variation in subsoil.

If the road surface is well above the abutting land on both sides there will probably be no trouble from lack of drainage unless the subsoil is unusually spongy. If on the other hand the abutting land is materially above the level of the roadway, the subsoil of the road is likely to intercept, not only surface drainage seeping under the road, but subdrainage from springs under the high ground at the sides. Consequently the experienced locator concerns himself not only with alignment and grade, but carefully observes the topography and examines the soils and strata formation. In his final location he avoids as much as possible soils which have a tendency to retain moisture; for it is acknowledged that practically any class of material, if kept dry, will provide a good foundation for the road structure.

In the arid or dry-farming sections soft road surfaces will seldom be experienced except during the winter snows

(Continued on page 20.)



*Ice blocks solid the culvert's mouth.*





## An Exploded Theory

In the discussion of road-building, as one of the great reconstruction measures desirable as a means of furnishing employment to the soldiers withdrawn from civil life by the war, we have heard the argument advanced that the soldier expects something better from his country than a job as a pick and shovel wielder.

On its face the argument is not a poor one, but it is based on false premises. The pick and shovel man is only one of the elements in the complex business of road construction. It is safe to say that the number to be employed in the various industries and professions involved in road-building will be fully equal to the army of day laborers.

What about the engineers, instrument men, rodmen and chainmen who must make surveys for every foot of road that is built, or the draftsmen and other office employees who must plat and advertise the road systems?

What about the contractors, their superintendents and timekeepers, or the road supervisors and inspectors who must patrol them?

What of the innumerable mechanics who must be engaged in the manufacture of automobiles, trucks, farm tractors and culverts, the drivers of the motor apparatus used in the construction work, or the commercial trucks that will use the roads in ever-increasing numbers as the mileage is extended?

What of the expert concrete men, handlers of high explosives, expert bridge builders and structural steel workers?

We might go on and list the scores of trades and industries that will be engaged, directly or indirectly, in pushing onward and extending that potent factor of civilization—the road—but we think that enough has been said on this point to convince the thoughtful man that the argument to which reference has been made is not well founded.

## Good Business

After all, the question of good roads is eminently a practical one—a mere matter of dollars and cents. It matters not whether the road is a city street or a country highway, its improvements make the abutting property more valuable to the taxpayer. But in the latter case the improved road brings many more advantages. We have only to cite a simple illustration to drive this fact home, even to the most skeptical.

Every man, woman or child who rode a wheel when the bicycle was the rage, every farmer who has driven a

team, has experienced the drudgery of passing through a stretch of loose sand. In the case of the bicycle rider he has had to exert the utmost of foot pounds held in reserve within his body, while the farmer has seen his team strain every muscle to pull the load through the retarding element.

Then, when the vehicle reached an improved section of highway, or a hard-surfaced road, it has seemed to shoot forward of its own volition and with little apparent force from the motive power.

Now this strain on the vehicle, the wheel rider or the team meant in each instance a loss of time, wasted effort and an increased ratio of deterioration for the vehicle. A strain on a steel cable, if it lasts long enough, will snap that cable and cut short its life. In the case of an automobile it means that the engine will wear out earlier than if used on a road where the least possible resistance occurs. In other words, good roads are worth while because they save time, reduce depreciation to the minimum, lessen the percentage of breakage. One may leave out the question of pleasure and comfort entirely and still must arrive at the inevitable conclusion that good roads are worth while from the practical, cash standpoint. It is good business to have them.

## Interest and Sinking Fund

There has been some discussion as to the best manner of providing for the interest and sinking fund on the \$20,000,000 bond issue, provided the Legislature decides to submit this to the people for a vote. Several bills for raising additional road funds by fees or a gasoline tax have been introduced in the General Assembly, and the suggestion has been heard that this income should be set aside for the purposes mentioned. Bond dealers, however, who have been consulted upon the proposition, are of the opinion that the proper way to provide for interest and sinking fund is by a straight tax, as license bills or a tax on gasoline would be subject to alteration at any session of the Legislative, and offer no sound assurance to investors that the interest and sinking fund would be taken care of.

As the situation stands now the present income of the Highway Commission will not go much farther than maintenance, and if the State roads are to be increased and improved more funds will be necessary. There are 42,000 miles of roads in Colorado, of which 7,000 miles are State routes. This bond issue would be used on these 7,000 miles, not already improved, or those requiring a hard surface. Estimates made by the Commission engineers upon probable expenditure of the \$20,000,000 bond issue provide for improvements on 3,800 of the 7,000-mile road mileage.



# Laying the Dust of the Bond Issue Bill

*An analysis of the situation by State Highway Commissioner T. J. Ehrhart, and some predictions upon the benefits that may be expected if it is adopted. An address delivered before the county commissioners' association in Denver last month.*

IT has been my privilege to be associated with the Boards of County Commissioners for the past six years in a program for betterment of Colorado Roads. We started in 1913 on a "Shoe String," which we have, I think you will agree, used to good advantage. The Automobile Blue Book, the best authority in America, through its scouts and engineers places Colorado in the ninth rank as to roads in the list of states in America.

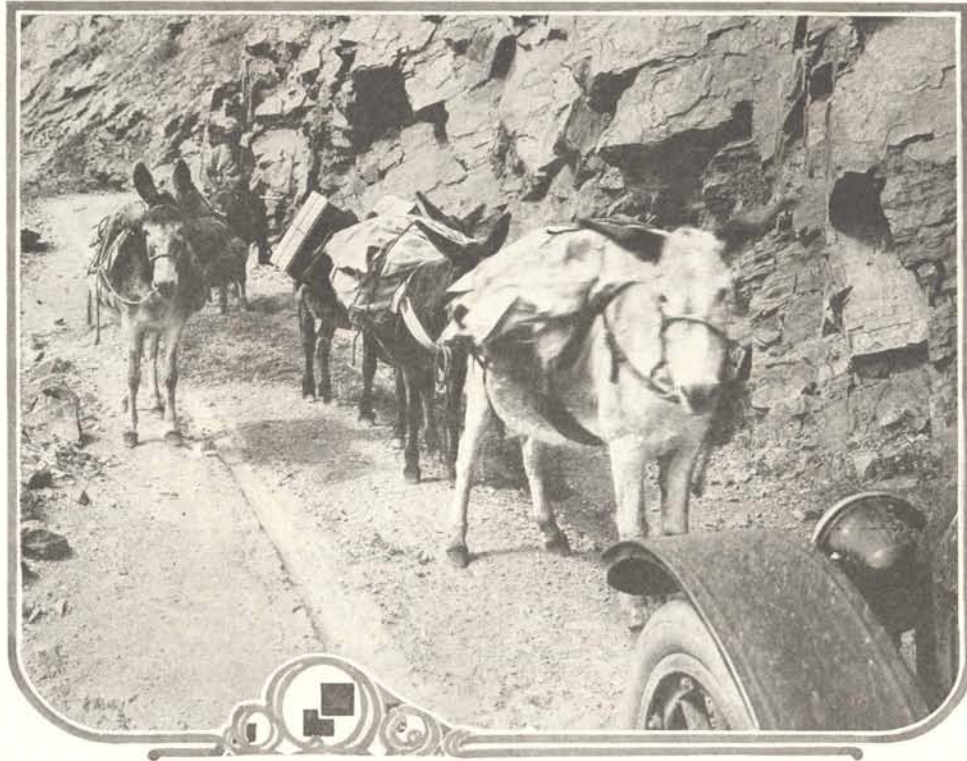
But at this time we have almost reached the limit of further constructive advancement, as the county and state funds now available are needed for maintaining the system of roads we have already improved. It seems imperative that we have additional funds to go on in a progressive way with the work so well begun.

The sentiment of the people is, without doubt, for better roads. Various plans for increasing the State Road Fund have been presented to the present Legislature, looking toward immediate relief. An increased automobile and truck license fee, and the transfer of the Inheritance Tax to the State Road Fund, are two. I do not know of a better use for these funds, or one that will do the whole people so much good, than to use them for road construction.

Some relief of this character is needed at once so that the funds, coming from the government to the State under the Federal Aid Road Act, which requires one dollar of state funds for every dollar of Government Aid, may be utilized. The State Highway Commission is compelled to set aside from the State Road Fund a sufficient amount to meet the yearly allotments due the State from this source, during the federal fiscal year, which begins July 1, 1919.

There will be due Colorado more than \$350,000, which must be met by a like amount. The following year approximately \$450,000 will be due. This will require almost half the available State Road Fund. It seems imperative to me, therefore, that the Legislature make some provision to increase the State Road Fund sufficiently to meet the Federal Road Aid, so that our ordinary fund may be applied to general county State road improvement.

There is a bill now being considered by Congress which



*A disputed right-of-way on the Durango-Silverton Toll Road, to be completed by contract this summer. One of the federal aid projects.*

has the endorsement of the administration at Washington. It proposes an appropriation of \$600,000,000 to be expended on general road construction in the several states during the coming six years. Under the method of distribution incorporated in the bill Colorado would be entitled to \$1,590,000 for each year, but in order to receive this fund, will be required to provide a like amount. This would be impossible with the limited fund we now have, and would require some legislative provision to enable the State to avail itself of the funds allotted.

The Legislature will more than likely take the necessary steps to submit to the voters at the regular election, to be held in 1920, the proposition of a \$20,000,000 issue of road bonds.

If the people of Colorado can, as a whole, arrive at a full appreciation of the investment value to them of twenty million dollars in good road construction within the next seven years, there will be no dissenting opposition to an immediate campaign for that amount and provisions for more to follow.

Our state is destined to be the mecca for tourist travel in America. I predict that within ten years we will have 250,000 tourist automobiles visiting us each year, carrying a million passengers, who will travel to every corner of Colorado.

From personal observation and systematic inquiries covering three years, I am convinced that our visitors will stay in the state an average of thirty days, and that they will expend an average of not less than \$100.00 each. This



means an annual business of one hundred million dollars. The net returns to the business of the state would be \$15,000,000, estimating 15% profit—surely enough to justify us in mortgaging the future to the extent of a few millions each year to improve our road system to facilitate travel and transportation.

Possibly the foregoing statement may seem like an air castle to some of you, but we have the following eight states directly tributary: Iowa, Texas, Kansas, Nebraska, Missouri, Oklahoma, Arkansas and Illinois, representing twenty per cent. of the population, twenty per cent. of the area, twenty-five per cent. of the taxable valuation and twenty-five per cent. of the number of automobiles (1,580,994) in the United States. All are within an average distance from Colorado of 450 miles, or, over the present roads, an easy three-days' trip.

In addition to this vast tributary region and population we have already coming to us thousands of cars from other states. In the next ten years the population will largely increase and the number of local automobiles may be doubled. With improved roads, which will shorten the time and lessen the difficulties, we may, in my opinion, expect a larger percentage of tourist automobile visitors. Therefore, my guess as to the number of visiting cars is not at all improbable.

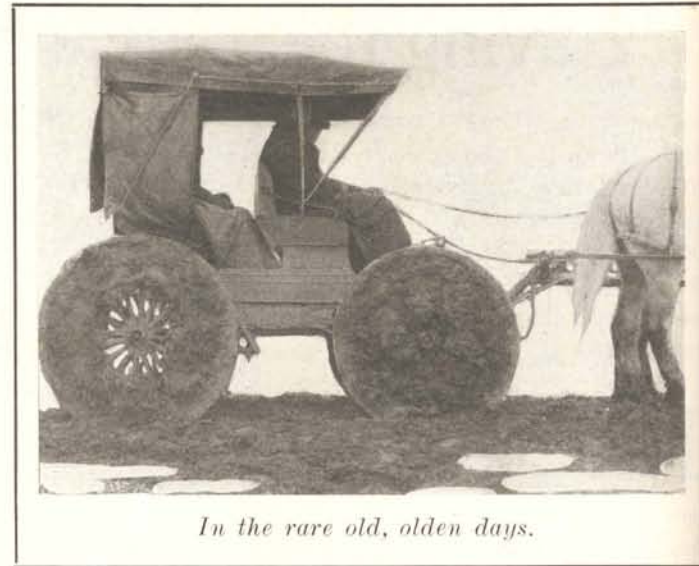
If we accept this as near the truth, it behooves Colorado to "get busy" in preparation for their entertainment. We must have more and better roads, increased and varied hotel facilities. I predict that the tourist business will, within ten years, develop into the most profitable single asset of the state, will bring a growing increase in the permanent population, and will add more to the value of our lands than the entire amount that may be expended upon our whole road system.

Good roads will be the greatest factor in land settlement and the establishment of summer homes throughout the mountain section. This will increase taxable valuations.

Colorado has everything to gain and no possibility of loss by investing millions in road building. There is little loss to the state in the expenditure of money in road construction, because it is paid out to a large extent for labor and is at once returned to the various business channels, finding its way back to the pockets of those who contributed it through taxation.

Public camping grounds should be set aside and maintained in the vicinity of every town and through the entire mountain district. A law should be enacted giving County Commissioners authority to purchase sites for this purpose along our public highways. Thousands of our visitors come to camp in the open and our own people like to do it. The necessary cost would not be great and these free public camping places would form a novel and attractive feature fully appreciated by every visitor.

I believe we can show by actual figures that, with the expenditure of the \$20,000,000 proposed on the general State Highway System, we can save ten per cent. of our gasoline consumption, ten per cent. in time and add twenty per cent. to our load on the roads improved.



*In the rare old, olden days.*

The expenditure of the funds derived from the bond issue in construction on the main highways would relieve in large part the expense on these roads to counties, and permit the rapid extension and improvement of local county roads with county road funds.

There is some criticism concerning the construction of scenic mountain roads. I do not know of any section of road in the State Highway System that will not be used for commercial purposes. Hundreds of tons of Colorado produce and goods are transported each year into Estes Park, the Cripple Creek district and the San Juan country over state roads that are scenic beyond comparison. What our state needs is a network of good roads throughout both the farming districts and mountain sections. More funds are a necessity. With this need supplied there will be no question of ultimate satisfactory results.

### License Fees Suggested

In answer to the request upon the State Highway Department for suggestions as to the proper amount of automobile and truck license fees to be established by legislative enactment Highway Commissioner T. J. Ehrhart and Chief Engineer J. E. Maloney have submitted the following:

Passenger cars—Up to 2,000 pounds, at 25 cents per 100 pounds; from 2,100 to 3,000 pounds, inclusive, 40 cents per 100 pounds; 3,100 pounds or over, 50 cents per 100 pounds.

Trucks—\$5.00 per ton or fraction thereof up to and inclusive of five tons; \$20.00 for each additional ton.

### Farmers and Autos

The extent to which farmers are buying automobiles is indicated by an investigation made through dealers by the Haynes Automobile Company of Kokomo, Indiana. The results of the query as to sales during the past year showed that of 1,643 Haynes owners, information as to whose occupations was received, 331, or approximately 20 per cent, were agriculturists. The dealers said that this was the largest number of cars bought by any one class.



# Colorado's Road Management and Control

*An Analysis by M. O. Eldridge, Assistant in Road Economics, G. G. Clark and A. L. Luedke, Engineer Economist of the U- S. Bureau of Public Roads*

STATE participation in road improvement in Colorado is of state-wide scope and consists of money aid, technical advice and supervision, and was first evidenced in 1918 by the employment of state convicts on the improvement of certain roads designated by the legislature.

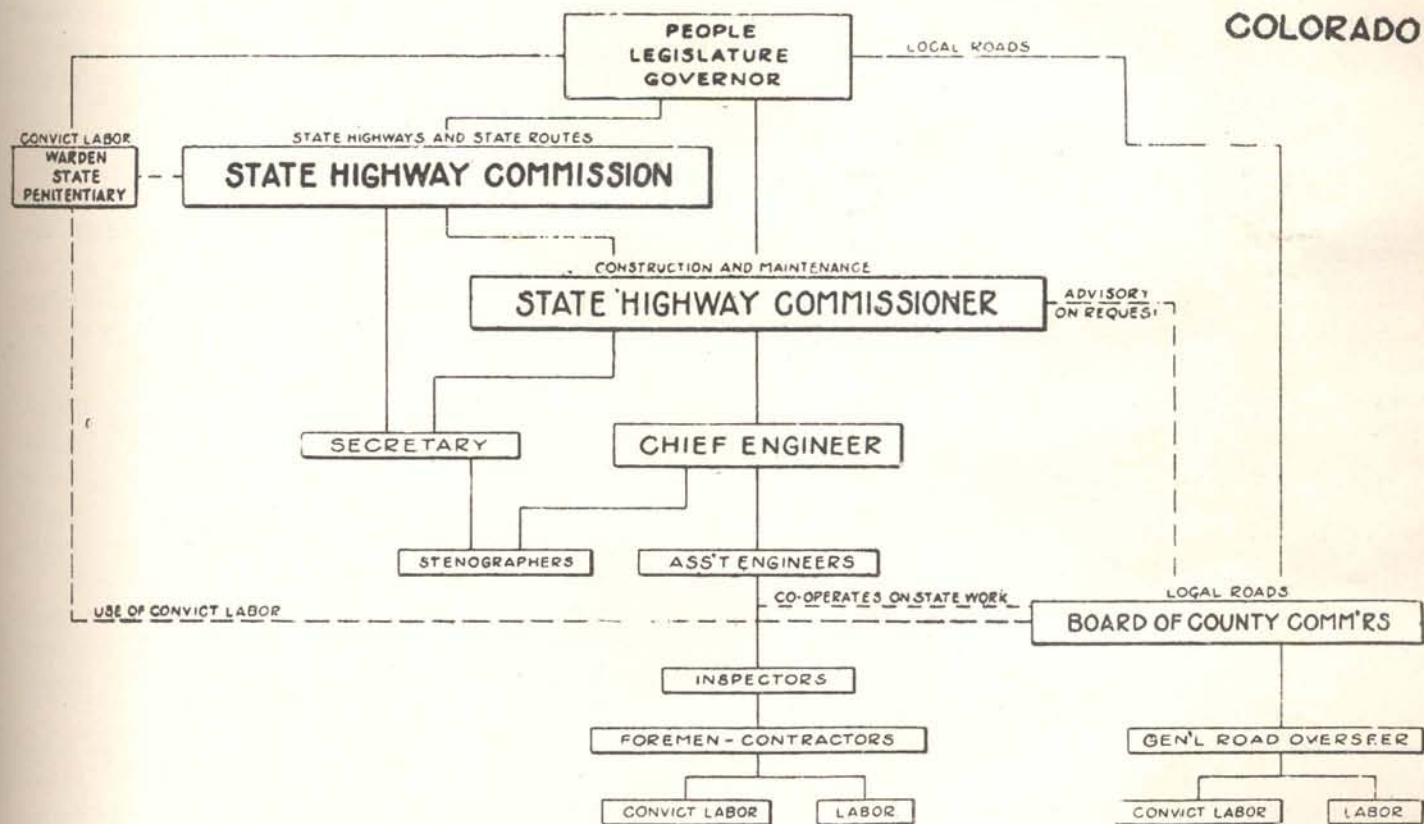
A highway commission was created in 1909 with advisory powers over all roads of the state and had at its disposal a fund for state aid to the various counties.

The laws relating to state aid and state highway officials have been modified and strengthened from time to time until at present the highway department of Colorado is well organized, has funds at its disposal for state participation in road work throughout the state, and exercises to

special appropriations for the construction of bridges in various counties of the state.

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

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



a limited extent supervisory and advisory powers over local work executed by county officials.

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

The state legislature from time to time has provided

## ORGANIZATION

The organization of the road forces of the state and the relation existing between them is shown by the accompanying chart.

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

The commission is composed of five members appointed



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

The state highway commissioner may be removed from office by the vote of all members of the commission. If they fail to agree, the governor, acting with the majority of the commission, decided the matter. In case of removal the successor to the commissioner is appointed by the commission to serve the remainder of the term for which the removed official was appointed. The state highway commissioner is appointed by the governor for a term of four years and is required to designate an employe of the department to act as deputy in case of absence or incapacity of the commissioner.

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

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

#### **CLASSIFICATION, CONTROL AND PROCEDURE**

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

The state route system comprises all roads designated prior to 1917 as state highways and such other roads as in the opinion of the commission should be added thereto. It is the intent of the state law that the state highways

shall not be set apart from the state route system unless they have been improved and maintained as state routes by means of a joint fund supplied by the state and county in such proportion as may be mutually agreed to by the state and local officials. Federal funds, with the approval of the Secretary of Agriculture, may be used either for the construction of state highways or state routes. Construction of either the state highways or state routes is done under the supervision of the state highway commissioner either by force account, convict labor, with the approval of the warden of the state penitentiary, or may be let by contract. When executed by contract, let by the state or by the state and county, payments are made on order of the state highway commissioner.

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

#### **REVENUES**

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

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

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

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



# The Blue Lodge of Colorado Road Builders

By Smith Riley, U. S. District Forester

IT is an indisputable fact that those who crossed the plains behind ox-teams were pioneers. But there have been other pioneers and under this proud classification comes the man who drove a snorting, bucking, old-fashioned automobile down Sixteenth Street in Denver the first time the horseless buggy made its appearance in the "wild and wooly" West.

The ox-train pioneer was a brave man without doubt, for he faced the shafts of the redskins without fear, but it is doubtful if the Indian arrows were any sharper or more dangerous than the shafts of ridicule and amazed disdain which were faced by S. E. Norton, when he essayed his record-breaking trip.

Perhaps it was the courage of a pioneer father that led him to make the venture, for Mr. Norton is a native son of Denver and Colorado, and first saw the light of day thirty-five years ago somewhere on upper Curtis Street. The car that he piloted on his memorable trip was a steamer of antique design that would be highly valued by the State Museum if it had survived the attacks of time.

But Mr. Norton did not confine his pioneer explorations to Denver. He also took the first automobile to Leadville from the metropolis, and the first car from Denver to Cheyenne. That was a trip that required nerves of steel, much patience and a plentiful supply of provisions, for the run that may now be made in a couple of hours took four and one-half days then. It was not so much the inferiority of the car as it was the lack of roads, and, dating from this experience, Mr. Norton became one of the most

consistent and persistent boosters of good roads in Colorado. When Colorado began organizing for the war Governor Gunter selected Mr. Norton for the chairmanship of the Highway Transport Committee of the State Council of Defense. He took charge for the government of motor truck food delivery, and rendered such good service that Governor Shoup asked him to continue in his position.

When it was decided to hold a motor transport parade in Denver, Mr. Norton was placed in charge of the arrangements, and the memorable representation he secured will long remain fresh in the memory of those who witnessed the event.

With the end of the war and the rise of the reconstruction plans it was Mr. Norton again who was selected as chairman of the Good Roads meeting, held by various motor, good roads and commercial organizations to discuss the proposed bond issue. It was at this meeting that the legislative committee was selected, which took charge of the \$20,000,000 bond issue bill and saw that it was introduced in the Legislature. This committee will remain on duty during the present session of the General Assembly, and urge the adoption of an adequate road program for the State.

Mr. Norton is one of the pioneer automobile dealers of the State, having been in the business continuously for twenty years. He is the president of the Norton-Buick Automobile Company, one of the largest firms of its kind in Denver.



S. E. Norton.

## Legislative Road Bills

Nineteen bills and one joint resolution, the latter providing for submission to the voters of the \$20,000,000 bond issue, have been presented in the Colorado Legislature. These are as follows:

### House Bills.

110—Hosman and Raye—Autos crossing main lines of railroad tracks are required to come to a full stop within 50 feet of the crossing.

112—Rhodes and Jenkins—Providing for the registration and licensing of motor vehicles.

406—Rotruck, Bond and Tedmon—Providing for a gasoline tax of one cent per gallon.

471—Rhodes and Jenkins—Providing for the licensing of motor vehicles.

473—Cole—Providing for the compilation of road statistics, distribution of funds, etc.

476—Bond—To double the inheritance tax and give 50 per cent to the State Highway Commission for building roads.

481—Rockwell and Lacy—To provide for the purchase of free camp sites for motor tourists.

(Continued on page 21.)



## Good Roads and County Commissioners

(Continued from Page 9.)

before the people almost a year before they are asked to vote on the bond issue.

The bill providing for the tax of one cent per gallon on the gasoline used in public conveyances is designed to raise a fund which will at once provide revenue which will enable the road work to be continued this year without interruption, and at the same time offer a possible means of paying for the entire \$20,000,000 bond issue together with the interest on the same. It is estimated that from this one source alone there will be available for good roads construction in this State in the neighborhood of about \$300,000 or more, and that this sum will increase annually.

During the coming year Colorado must take advantage of the Federal Road Law, which gives government aid in the building of postroads. It is this sort of aid which made possible the construction of the Littleton road, leading from Denver to Littleton. The Federal government at present requires that the states availing themselves of this aid put up dollar for dollar with the government. There is, however, at this time an amendment to the Federal law proposed, which would allow the government to aid the states on the basis of the states putting up one dollar to every two, three or five that the government would contribute. This is in line with the provisions of the present highway law in this State, and would allow those states which have not as large a road fund as some other older and wealthier states to receive proportionate aid in road construction.

Should the proposition for the bond issue be favorably voted upon by the people, and this sum become available at once for road work throughout the State, it is proposed that at that time (after 1910) the revenues from the gasoline tax be used to pay for the interest and sinking fund for the bond issue, thus avoiding the necessity of a direct tax for these bonds, and at the same time make the cost of the improvement of the highways fall upon those who are constantly using the roads. This is in line with the action in Illinois where \$60,000,000 have been voted for good roads, and the bond issue will be met from the taxes derived from the auto licenses. The plan of campaign adopted by the Illinois Highway Improvement Association, and which has resulted so successfully, is in line with that which has been mapped out for the Colorado campaign. The Illinois Highway Commission prepared a statement showing where the moneys would be expended under this bond bill, and that is what is being done now by the Colorado State Highway Commission.

Recognizing the fact that the people should be fully acquainted with any plans proposed, under which funds to be derived from the bond issue would be expended, the Colorado Good Roads Association has requested that a survey be made during the coming summer of all the State highways, and that then a comprehensive plan be prepared for the improvement of these highways. This plan will be announced within the year, and the people will then have at least eight months or more before election in which to consider the methods proposed.

In the construction of these highways special attention will be given to the needs of the farmers, the ranchers and the merchants who are today the chief users of the highways by reason of the increased use of the motor trucks. Experiences of the last few years, especially the lessons learned during the war, have proven that good roads are necessary to the upbuilding of any community and particularly in reference to the transporting of the products of the farms, ranches and mines to the city and vice versa.

With this idea in view, Colorado is now preparing a program of road construction such as has never been attempted before. If the roads are made fit for motor transport service, they will be fit for the tourist travel and this will come wherever the good roads are built. Colorado, therefore, stands to profit well by the construction of better highways, and the movement now inaugurated seems fair to gain such momentum in the next two years that the people will without doubt vote at the election in 1920 \$20,000,000 for better highways in the State.

## Common Drainage Problem

(Continued from Page 13.)

and rains. Roads constructed in these sections should wherever possible be raised above the land on either side. If this can not readily be done, adequate ditches between the road and the higher ground, if constructed on proper grades and provided with free outlets, will generally suffice. For drainage across the road adequate culverts must be provided. Earth or gravel surfaced roads in this class can be kept crowned by regular and systematic dragging, and at a reasonable expense per mile, so that all water will quickly leave the road surface.

For the roads through irrigated sections similar construction methods should be followed. Here, however, the water problem is quite generally continuous throughout the summer, and the lack of proper side ditches is forcibly impressed upon the mind of the traveler when he is obliged to proceed through the water, sometimes quite deep, or when driving an automobile into an apparently small amount of water the wheels sink into the soft surface and the machine is stalled. The energy used in moving one machine from such places, if properly applied, might remedy the defect. If this experience could only occur often enough to the authorities in charge of each particular road where such conditions exist, no doubt in time many such spots would be repaired.

Possibly the worst troubles in irrigated sections are encountered where the ditch or irrigated land lies above, and the impervious earth strata slopes toward the road. In a few such cases the water-soaked earth above may be at such a degree of slope as to start a sliding action in the surface. In such cases if the cause cannot be eliminated it generally proves cheaper in the end to immediately secure a new location for the road. If this cannot be arranged then side drains, drained foundations, and other special remedies must be resorted to. The conditions are so varying that each case will require special treatment.

In the mountainous section the problem is generally



one of deep and heavy snowfall in winter, and frequent light, with occasional very heavy, rainfall in summer. Also cloudbursts occur, but these are rather exceptional in a particular locality and very in such a degree of magnitude that drainage structures ample for the extreme cases can hardly be expected. Due consideration of such occurrences should, however, enter into the design and water area of all large culverts and bridges, and these should, if possible, be adequate for any occurrences of this nature.

For earth ditches or gutters on grades from four to seven per cent. and draining fourteen feet of roadway, erosion commonly begins at 400 to 600 feet and sometimes occurs at 100 feet from the beginning of the flow of water. This distance varies with different types of soils. Swamps in high altitudes present interesting problems, involving the decision between draining the swamp, going around it, crossing it on a special foundation, or a combination of these methods. At high altitudes and in the northern latitudes alternate thawing and freezing often results in freezing from the "bottom up" of layer upon layer of ice, blocking solid the mouth of the culvert and overflowing the road grade. Where this occurs the road embankment in the spring is generally full of moisture and without stability or bearing power for long periods. Also it has been washed away to an extent varying with the quantity and degree of water run-off.

The important features then for earth road drainage are clean, free-flowing gutters or side ditches, adequate culverts in sufficient numbers, and unobstructed free-flowing outlets. To these must be added constant maintenance beginning early in the spring, and in the mountainous region, continuing and following up the melting snow until after its disappearance in the early summer.

Attention is directed to Bulletin No. 724, recently issued by the U. S. Department of Agriculture, entitled "Drainage Methods and Foundations for County Roads," which explains in detail drainage problems, the different types of structures, and methods of construction.

### Grade Limits and Traffic Conditions

(Continued from Page 12.)

That this saving in annual cost of operation can be made is, to my mind, clearly shown by the increase of cost for operation for the unimproved road over the improved road, as indicated on the diagram.

This saving per ton mile of one cent is, in my judgment, a conservative estimate.

Considering the question as to what character of improvement over existing conditions would be warranted by the possible saving on the operation of the traffic:

For every 20 lbs. reduction in resistance of road surface there is an indicated saving of approximately 4/10 of a cent per ton mile in the cost of operation of the traffic.

Assuming an average cost	
per mile for an 18-ft. paved road.....	21,000.00
per mile for a 9-ft. paved road.....	15,000.00
per mile for an 18-ft. gravel road.....	8,000.00
per mile for a 9-ft. gravel road.....	4,000.00

From a gravel to a paved road there would be an average saving of 1 1/10 cents per ton mile, so that an annual traffic of 95,000 or more ton miles per mile of road would justify an expenditure of \$21,000.00 per mile for the improvement.

Similarly an annual traffic of 68,800 or more ton miles per mile would justify an expenditure of \$15,000.00 per mile, and an annual traffic of 36,000 or more ton miles per mile would justify an expenditure of \$8,000.00 per mile for the improvements.

This can be worked out in a similar manner for any traffic, and any existing condition and proposed improvement.

It will be noted that this applies to improvement of existing road conditions, and is to be considered in the reduction of grades as well as in the improvement of the surface conditions.

#### *Some Exceptional Conditions.*

In the roads to be improved there will be stretches of road which may not in themselves seem worthy of very extensive improvement, but which as necessary connecting links, will be found desirable to be fully improved in order that the road between the main points shall be complete.

Also in the opening of roads to afford an outlet for any particular portion of the State the improvement will be in the nature of development work, essential to the State and communities served, even though apparently not warranted by the probable traffic.

### Legislative Road Bills

(Continued from page 19.)

484—Rockwell—Making an appropriation to build a road between Delta and Nucla.

502—Bond—Providing for the expenditure of the \$20,000,000 bond issue.

519—Colgate—Providing for the diversion of the inheritance tax to be used for highway construction.

568—Rotruck—To levy a tax for building good roads.

#### *Senate Bills.*

65—Warren—Providing that cities and towns may use county funds for roads.

281—Tobin and Lines—Providing for the expenditure of the \$20,000,000 bond issue.

349—Hattenbach—To create a State Highway Department and make the districts conform to the 13 judicial districts.

372—McWilliams and Booth—Providing for a tax on motor vehicles.

388—Hattenbach—Providing for the expenditure of the bond issue.

425—Fincher—To create a State Highway Department.

431—DeBusk, McWilliams and Staley—To create a State Highway Department.

432—DeBusk, McWilliams and Staley—To create a State Highway Department.



# Sign Posts Along the National Highways

Six bills dealing with highway construction were introduced in Congress during December. One of these was the bill introduced by Senator Smoot of Utah, providing for a complete reorganization of highway administration by the federal government, for the issuance of bonds to the amount of \$1,000,000,000, which is discussed elsewhere in this issue. Other bills either are amendments to the present federal aid highway law, or utilize the organizations of the war and post office departments. A joint resolution has been introduced, which provides for handing over to the Secretary of Agriculture by the Secretary of War of such war material as may be used in highway construction work. Of the four bills providing for the utilization of the present federal highway administration, those by Senator Bankhead and Senator Swanson in the senate, and by Representative Browne in the house, are in the form of amendments to the present federal aid highway act, and consist of a change in wording to permit a wider interpretation of the words "post road," to cover any road that might so be used. They also provide for the appropriation of \$50,000,000, to be immediately available; \$75,000,000 available July 1, 1919; \$75,000,000 available July 4, 1920; and \$100,000,000 annually to July 1, 1924. Another bill, introduced by Representative Shackelford, provides for a similar change in wording and for an appropriation not to exceed \$150,000,000 a year. The other bill was introduced by Senator Swanson, and provides for the setting aside of 50 per cent of the net proceeds derived from the operation of motor trucks engaged in carrying parcel post, to be expended in the survey, construction, reconstruction, improvement, repair, maintenance and administration of such highways as might be selected by the Postmaster General for the transportation of mail.

Governor Robertson of Oklahoma hopes to induce the legislature to adopt a \$40,000,000 bond issue for the purpose of supplying the Indian state with a connected road system. It is his idea that interest and sinking fund can be met chiefly through the production tax from oil and the registration tax from automobiles.

Governor Davis of Virginia has put forward the proposition in the Old Dominion of raising \$25,000,000 for building 1,200 miles of state highway.

The Division of Public Works and Construction Development, which has just been organized in Washington by the Department of Labor, has obtained from the Bureau of Public Roads and Rural Engineering of the Department of Agriculture a compilation of estimates of the amount of road work to be undertaken in several states during 1919. These indicate an expenditure of about \$300,000,000. Cash expenditures on highways in 1916 from all sources were, according to the Department of Commerce, \$272,634,424.

There exist in the United States approximately 2,750,000 miles of roads, of which not over 300,000 miles have been improved. To improve the remaining two and one-half million miles would require, at the rate we have been going, something like 166% years.

In a speech delivered before the Highways Transport Committee, Herbert C. Hoover was quoted by the press on the following statement: "If we are to do our duty to the world and

ourselves, we must utilize every means to increase production and distribute food efficiently. The development of the rural expresses, using the highways of the country, commands every moral support of which we are capable. The direct results, which appeal to me strongly at this time, are the labor saved and the productive area extended by the employment of more efficient mechanical means.

"Another of the results of a perfected highway's use would be to cut down the waste of perishable foods. Fifty per cent of our perishables never reach the consumer. We lose from forty to sixty per cent of our potatoes yearly. Besides stopping this terrific waste, a highly-developed rural express would work to establish lower prices."

In his annual report Postmaster General Burleson printed the following: "At the close of the fiscal year 6,041,404 families, comprising 27,790,459 persons, were being served by rural carriers throughout the country; and 43,451 routes, serving 1,127,110 miles daily, were in operation; of these 823, covering 44,510 miles daily, were operated by motor vehicles."

The state senate of Michigan has passed a joint resolution providing for a constitutional amendment to permit a bond issue of \$50,000,000 for good roads. The house is said to be overwhelmingly in favor of the resolution, which provides for the submission of the proposition at the April election.

Officials of the Lincoln Highway association estimate that \$20,000,000 will be required to bring that national artery to its proper standard. Approximately \$4,000,000 have been expended on it, and its condition in the various states is as follows: New Jersey and Pennsylvania, practically 100 per cent macadam; only a few miles of natural dirt roads, most of the remainder being brick; Indiana is rapidly concreting the road; macadam, interspersed with gravel and natural-dirt road, make up the Illinois stretch; Iowa, without laws to enable issuance of bonds, has so graded and dragged the route that in dry weather it is a perfect dirt boulevard; Nebraska, work accomplished is negligible; from Salt Lake City west the roadbeds are of hard-packed salt; California, well maintained boulevard most of the way.

The bill introduced by Senator Swanson in the United States senate to amend the present provisions of the federal aid road act, called the Page bill because of the work done by the late Logan Waller Page in drafting it, is the bill endorsed by the American Association of State Highway Officials at the Chicago meeting on December 10, 1918.

One of the first new developments to follow the concreting of the Detroit-Monroe, Mich., and Toledo, Ohio, road, until then a notoriously bad piece of road, was the establishment of an interurban motor truck refrigerator service between Detroit and Toledo. Two trips a week are made and the saving on transportation charges is 60 cents a hundred.

Governor Pleasant of Louisiana has approved the plan suggested by the American Forestry association for planting trees along Jefferson Highway to commemorate the part her sons played in the war. Oaks will be used for the most part, and the trees will stand about 40 feet apart. Altogether 440 miles of "victory oaks" will be planted.



# Road Work and Road Builders the State Over

Should the \$20,000,000 bond issue for Colorado good roads carry the taxpayer would be called upon to pay one dollar a year on every \$1,000 valuation. If the farmer owns a \$5,000 ranch he would pay five dollars a year to secure a real road by his place that would save him many times this amount annually in vehicle upkeep and time.

Toney Monell, county clerk of Montrose, secretary of the state association of county commissioners, member of the legislative committees of that body and the Colorado Good Roads association, will be in Denver while the legislature is in session, and will doubtless find something else to do during his spare time.

The five convict crews in Weld, Pueblo, Larimer, Boulder and Garfield counties are emulating the allied forces at Archangel in staying on the job all winter long. Snow and cold weather may delay, but cannot stop them in building roads.

County Commissioners Thomas A. Forkner, R. S. Hamilton and R. B. Overholt of Moffat county, took occasion while in Denver to attend the county commissioners' meeting, to call at the state highway commission offices and talk over ways and means for starting the new bridge over the Bear river below Craig, early this season. The old bridge went out in a washout.

It is expected that the survey for widening and improving the road from the mouth of the Big Thompson to Estes Park will be completed early this month. Twenty miles will be treated at a cost of \$90,000. The work was inaugurated last month by Highway Commissioner T. J. Ehrhart, Chief Engineer J. E. Maloney of the highway commission, Engineer June Johnson of the U. S. Bureau of Public Roads, County Commissioner James Graham of Larimer county, and County Engineer James Edwards of the same county.

Costilla county is ready to co-operate with the government and state this spring in improving the 17-mile stretch from Ft. Garland to San Luis. County Road Superintendent Parrish and County Commissioner W. R. Morris brought this news to the highway commission last month.

The 17 miles on the Durango-Silverton road uncompleted last season because of labor difficulties, will be let by contract this year, four contracts covering the work. This decision was reached after a conference between the highway commission of the state. Assistant District Forester Stahl, District Forestry Engineer Bonar, Acting District Engineer Loder of the U. S. Bureau of Public Roads and Engineer Palen of the same service. The road is a federal aid project.

St. John Wilson, acting director of the U. S. Bureau of Public Roads, has notified Highway Commissioner Ehrhart that he has recommended amendments to the federal road bond issue, approved by the late Logan Waller Page just before his death. This means that western states will not have to meet the government expenditures dollar-for-dollar, but in some instances will have to pay only one dollar to four of government expenditures—provided, of course, that the amendments are adopted by Congress.

The survey for improvement of the road from Trinidad to a point on the Santa Fe Trail route, a distance of six miles, is now practically finished.

County Commissioners Simon Olson and J. B. Stevens of Grand county, discussed estimates for improvement of the Midland Trail near Granby, and requested a survey for the road up the Blue River between Kremmling and Dillon, at the last meeting of the state highway commission.

Necessary data for advertising various highway projects and federal aid projects is being prepared by the office force of the state highway commission. This work will be completed speedily so that advertisements may be printed and work started in the early spring.

County Commissioners G. L. Garren, Charles Engel and R. Bradfield of Dolores county, urged the highway commissioner to push work on the bridge over the Dolores river between Rico and Dolores, and speed up work north of Rico to Lizzard's head this summer so that the Dolores section may secure its long-needed outlet toward Montrose, during a recent visit at the commission's offices.

Surveying parties from the state highway commission are making the survey for the two miles more of hard-surfaced road north of Denver. Some of the Brighton folks would like to see the hard-surface laid from Brighton south to Denver and have so notified the commission.

The worst road conditions in northeastern Colorado this winter were caused by snowdrifts on tops of the hills between Broomfield and Lafayette. The last snow stayed on the ground in an unprecedented manner.

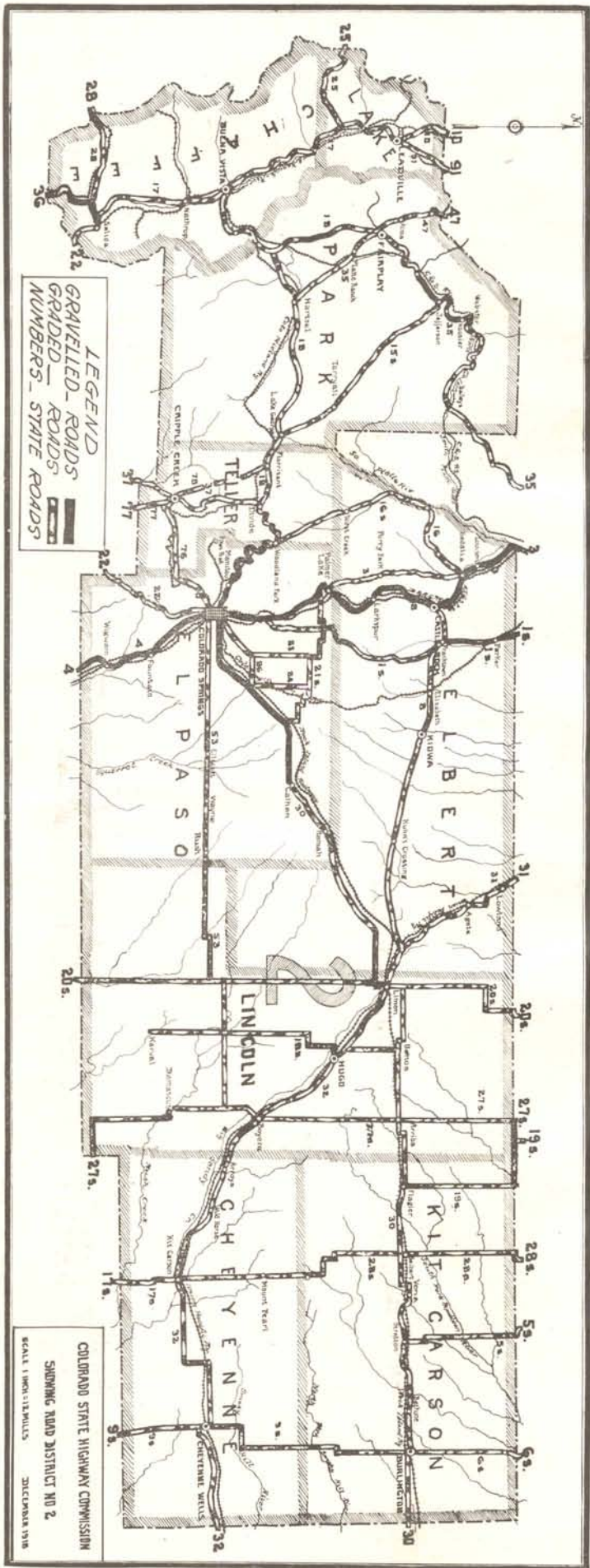
At the recent annual meeting of the county commissioners' association, former State Treasurer Robert H. Higgins, one time president of the association, suggested that the passage of the \$20,000,000 bond issue would not mean a direct tax, but that the interest and sinking fund could be met from the inheritance and other taxes of that nature. This plan has been adopted in several states.

H. A. Edmonds of Fort Collins, H. G. Tiffany of Brighton, and Samuel A. Greenwood of Boulder, were named by the county commissioners' association and the Colorado Good Roads Association as a committee to wait upon the legislature and urge three important road propositions: passage of the concurrent resolution calling for a \$20,000,000 bond issue, a road tax levy of one cent per gallon for gasoline, and the doubling of the inheritance tax.

The nineteen-mile road from Rifle to Meeker in Rio Blanco county will be rushed through in short order next spring. Edward O'Neill, the contractor, is hauling shale to depot points along the road so that it may be spread with as little delay as possible when the weather opens in the spring. Grading is proceeding whenever the weather permits operations.

If the \$20,000,000 bond issue is adopted by the people no funds will become available for road work until 1921. The bond proposition would not be submitted until the fall of 1920 and the bonds would then have to be printed and floated. The first funds available would be \$2,000,000 in 1921. After that \$3,000,000 would be available each year for a period of six years. It would take a full year to complete a full fledged organization and get outfits on the roads and in working order.





Map of Road District No. 2, Showing Gravelled and Graded Roads.