MARYLAND GEOLOGICAL SURVEY.

WM. BULLOCK CLARK, STATE GEOLOGIST.

REPORT

ON THE

HIGHWAYS OF MARYLAND.

In Accordance with an Act Passed at

THE SESSION OF THE GENERAL ASSEMBLY OF 1898.

(LAWS OF MARYLAND 1898, CHAP. 454.)

THE JOHNS HOPKINS PRESS,

Baltimore, December, 1899.

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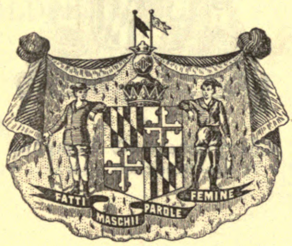

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The Lord Press
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The Friedenwald Company
BALTIMORE, MD., U. S. A.

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LETTER OF TRANSMITTAL

To His Excellency LLOYD LOWNDES,

Governor of Maryland and President of the Geological Survey Commission.

Sir:—I have the honor to present herewith a report dealing with the question of highway improvement in Maryland. The subjects discussed in the volume include the relations of Maryland topography, climate and geology to highway construction; the history of the development of Maryland highways; the present condition of the roads and best means for their improvement; the relative values of the different natural road-building materials in the several counties; the importance of good roads to the people and the methods of highway construction employed in the counties of Maryland, in other states, and in foreign countries. This exhaustive report upon Maryland highways will give much valuable information to the citizens of the state upon a subject of paramount importance and cannot fail to influence to a greater or less extent the future construction of our public roads.

Very respectfully,

WILLIAM BULLOCK CLARK,

State Geologist.

JOHNS HOPKINS UNIVERSITY,

BALTIMORE, *November, 1899.*

CONTENTS

ILLUSTRATIONS

PREFACE

The present volume deals with the questions connected with highway improvement in Maryland. The subjects discussed are of much importance to the people of the state and an attempt has been made to secure the best information available regarding them. Not only have the most modern treatises regarding road-building been liberally drawn upon, but personal inspection has been given to the best highways now under construction in other states. All types of our Maryland highways have been studied, looking to their permanent and economical improvement. The various road-materials have also been classified as regards their value and advantageous location for highway purposes. It is believed that the volume contains much of practical value.

The *Introduction, including an account of the Organization and Conduct of Highway Investigations by the Maryland Geological Survey*, by Wm. Bullock Clark, comprises Part I and gives an account of the organization of the Highway Division by the General Assembly of 1898, together with a review of the provisions of the act. Following this is a discussion of the methods of investigation which have been pursued by the Survey in platting the distribution of the road-building materials and in testing their availability for highway purposes; also an account of the detailed examination of Maryland highways and the plans proposed for their improvement. Several pages are devoted to the correspondence which was entered into with the county commissioners, farmers, turnpike companies, governors, and road officers regarding highway affairs.

This chapter closes with a brief account of the sample roads constructed, the specifications prepared for Maryland highways, and the necessary legislation for the continuance of the work of the Highway Division.

The *Relations of Maryland Topography, Climate and Geology to Highway Construction*, by Wm. Bullock Clark, forms Part II of the volume, and includes a summary of the leading topographical, climatological and geological features of the state in their relation to road-building. The dependence of the highways upon the surface configuration of the land in the various portions of Maryland is discussed in some detail and the bearing of the distribution of temperature and rainfall upon the construction of roads is fully pointed out. Much attention is given to the relationship between geology and highways, since not only the road-bed itself but the materials which are employed in the actual construction of the road so largely affect the character of the traveled ways. The different types of rocks and their distribution are described and platted upon the maps accompanying the report.

The *Highway Legislation in Maryland and its Influence on the Economic Development of the State* is the title of Part III and is prepared by St. George Leakin Sioussat. This chapter deals with the history of highway development in Maryland, including an account of the various laws which have been passed since the first road-act in 1666. The gradual development of the present road-system through its various phases, both of general and local legislation, are traced out in much detail. The influence of national legislation in the construction of the far-famed National Road forms an interesting chapter in the history of highways.

The *Present Condition of Maryland Highways* constitutes Part IV of the volume, and is written by Arthur Newhall Johnson, formerly connected with the Massachusetts Highway Commission. Mr. Johnson has very thoroughly examined the condition of our Maryland highways and presents in his report upon them a very complete account of their present condition and future needs. He has also secured a large amount of valuable information regarding the amount expended annually by the county commissioners and turnpike companies upon the highways of the several counties, and the details of this investigation are presented in his report.

The *Construction and Repair of Roads*, also by Arthur Newhall

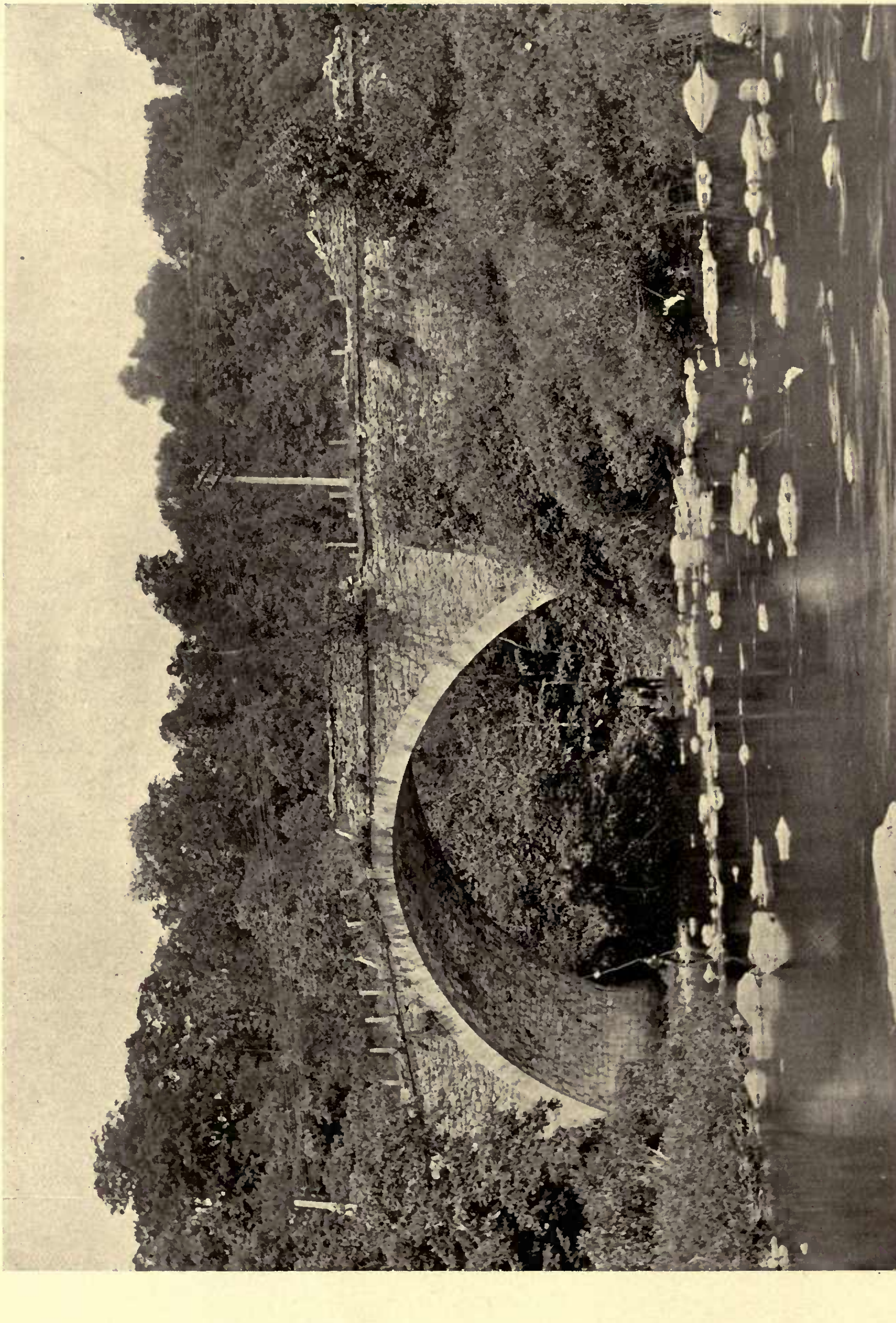
Johnson, forms Part V of the volume, and includes a treatment of the important subject of road-engineering. The latest and best information relating to the question of the construction and repair of roads is laid before the people of the state in this report, and the importance of the facts presented cannot be too strongly dwelt upon, since good roads are only attainable as the result of the best engineering knowledge.

The *Qualities of Good Road-Metals and the Methods of Testing Them* comprises Part VI of the volume and is prepared by Harry Fielding Reid, the Chief of the Highway Division. The relative wearing and cementation values of the various rocks of the state, based upon the results of numerous mechanical tests, are described fully in this portion of the volume. The great importance of this experimental work to those invested with power in highway matters is clearly shown by these investigations, and the hope is expressed that our county authorities will submit in the future their road-materials to the Survey to be tested. A description of the laboratory of the Survey is likewise given.

The *Administration of Roads*, also by Harry Fielding Reid, forms Part VII of the volume, and includes a discussion of the laws regulating road-construction and maintenance in the various counties of Maryland, in the several states of the Union, and in the leading countries of the world.

The *Advantages of Good Roads*, also by Harry Fielding Reid, forms Part VIII of the volume, and contains a summary of the more important facts brought forward in the preceding chapters, together with a discussion of the great advantages resulting to any community by the employment of intelligent methods of highway-construction and maintenance. The financial, moral, and social advantages of good highways are presented. It is pointed out that such results are only attainable as the result of proper engineering skill, which can best be secured through a well organized state highway bureau.

The majority of the illustrations were especially made for this volume. The Maryland Geological Survey desires to give credit to



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STONE ARCH OVER CASTLEMAN RIVER, GARRETT COUNTY.

PART OF THE NATIONAL ROAD, BUILT 1816.

INTRODUCTION

INCLUDING AN ACCOUNT OF THE

ORGANIZATION AND CONDUCT OF HIGHWAY INVESTIGATIONS

BY THE

MARYLAND GEOLOGICAL SURVEY

BY

WM. BULLOCK CLARK

No subject to-day more demands the attention of the people of Maryland than that of road-construction. When hundreds of thousands of dollars are being annually appropriated for our highways it is pertinent to inquire whether this outlay is intelligently made, and if not, whether better methods of road-construction cannot be adopted in order that the people of the state may secure a larger return for the money which they expend. It was with the object of ascertaining the actual facts in the case that a bill was presented at the last session of the General Assembly authorizing the State Geological Survey Commission to investigate the subject of road-building in Maryland and make a report thereon. The bill which is given below was introduced in the House February 24, was passed by that body April 1, by the Senate April 4, and received the signature of the Governor April 9, 1898. It is as follows:

A Bill, entitled "an Act to confer additional powers upon the Commission established by the Act of General Assembly at the session of 1896, Chapter 51, by providing for the investigation of the question of road-construction in this State, and for the preparation of reports thereon, and to make an appropriation therefor."

SECTION 1. *Be it enacted by the General Assembly of Maryland*, That the Commission established by the Act of the General Assembly of Maryland at the session of 1896, Chapter 51, be and the same is hereby authorized to make provision for the investigation of the question of road-construction in Maryland.

SEC. 2. *And be it enacted*, That the said Commission be and the same is hereby authorized to appoint, under the direction of the Superintendent of the Survey such assistants and other employees, as they shall deem necessary, and the said Commission shall also determine the compensation of all persons employed, and may remove them at pleasure.

SEC. 3. *And be it enacted*, That the said Commission shall see that proper investigation is made of the condition of the roads in this State, and of the best means of improving the same, together with a study of the classification and distribution of the road-building materials in the several counties.

SEC. 4. *And be it enacted*, That the said Commission shall see that a report upon the state of the roads and the best method of improving, constructing and maintaining the same, with estimates of costs, expenses and plans, be submitted at the next session of the Legislature, and that special reports be prepared at such time as they are deemed necessary.

SEC. 5. *And be it enacted*, That the said Commission shall see that record is kept of all its proceedings, and of all moneys received and spent under its direction and for what purposes; which record and account shall be submitted to the said Commission at the semi-annual meetings of the same to take place in March and November, such records and accounts to be always open to the inspection of any committee which the Legislature may appoint.

SEC. 6. *And be it enacted*, That all moneys paid out on account of this work shall be paid by the State Treasurer upon the order of the Executive Officer of the Commission endorsed by the Comptroller.

SEC. 7. *And be it enacted*, That the sum of ten thousand dollars annually, or so much thereof as may be necessary, be, and the same is hereby appropriated out of any money in the Treasury not otherwise appropriated, for the purpose of carrying out the provisions of this Act.

SEC. 8. *And be it further enacted*, That this Act shall take effect upon the date of its passage.

Many prominent citizens throughout the state, as well as the State Road Convention, the Road League, and the League of American Wheelmen, exerted their influence toward the passage of the bill. The valuable support given by the latter organization, particularly by its Chief Consul, Conway W. Sams, Esq., who has advocated good roads for many years, was of the utmost importance in bringing about successful legislation.

CHARACTER OF THE INVESTIGATIONS.

Immediately upon the passage of the bill a Highway Division was established as part of the State Geological Survey under the direction of Professor Clark, the State Geologist, and Dr. Reid was placed in charge of the work as Chief of the Highway Division. Communication was at once opened with the Highway Commissioners of Massachusetts, Connecticut, and New Jersey, where the latest and most intelligent methods of state road-building are now in full operation. At the invitation of the Commissioners visits of inspection were made to those states by Messrs. Clark and Reid and the leading roads examined in various stages of construction. Through the courtesy of the Board of Highway Commissioners of Massachusetts one of the best trained of their younger engineers, Mr. A. N. Johnson, was secured as road-expert for the Maryland work.

Messrs. Clark and Reid have been widely over the state during the past eighteen months in connection with the various investigations that have been undertaken by the Highway Division and which are fully described in the subsequent pages, and Mr. Johnson, who began his investigations upon the first of June, 1898, has traveled over 2500 miles of Maryland roads in his study of the present condition of the highways, as explained by him in the later chapters of this report. Dr. Mathews, the Assistant State Geologist, and the chiefs of the various geological divisions with their assistants have also devoted much attention to the accumulation of information regarding the condition of the highways in those portions of the state in which they have been conducting their geological investigations. Every member of the Survey was furnished with a definite plan of highway work which he was to pursue in connection with his other investigations. In this manner most of the highways of the state have been actually observed by some member of the Survey staff and detailed information secured for the preparation of the report.

One of the most important lines of investigation which the Highway Division has been following is that connected with platting the distribution of the natural road-building materials. This study was conducted under the direction of the chiefs of the three geological divisions, Messrs. Mathews, Prosser, and Shattuck, each of whom had under him several efficient assistants, who were especially detailed to this work. Particular attention was given to the study of the distribution of the basic eruptive rocks or "traps" in the Piedmont Plateau, as they are the most valuable road-building materials in the state. Dr. Mathews had associated with him in this work Messrs. Leonard and Bonsteel, who spent the entire summer in mapping the boundaries of these rocks and in locating the most available points for quarries. The character and location of the gneisses, granites, and limestones in the same district were carefully considered, since they may also be used to advantage under certain conditions. The study of the distribution of the widely extended iron-bearing gravels of the southern and eastern counties of the state has occupied the attention of the Coastal Plain Division of the Survey under Dr. Shattuck, and he and his assistants have already completed the mapping of this material throughout the district. The importance of these gravels in future road-construction throughout the tide-water counties cannot be over-estimated, and a fuller discussion of this subject will be given by the author in the subsequent pages of the report. The distribution of the limestones and iron-bearing sandstones in western Maryland has been mapped in much detail by Professor Prosser and those associated with him, and this accurate location of the best natural road-building metals of our western counties cannot fail to be of advantage to the residents of that section of the state.

By far the most significant phase of the highway investigations is connected with the practical physical tests to which the natural road-materials have been subjected. The tests of the abrading, fracturing, and cementing qualities of the rocks of the state, as explained more fully by Dr. Reid in later chapters, are of great importance to the officials of our counties who are anxious to expend the public funds in the most economical manner. Nothing more largely affects the value and permanency of highways than the selection of proper materials in their construction. The information which the Survey will be able to give upon this subject to the people of the several counties will many times repay any expenditure which the state has made for these investigations. The machinery which has been secured for this experimental work can be employed with constantly increasing value to the established authorities and to those private individuals who may desire to send their road-metals to the Survey to be tested. The Survey will be glad, so far as time will permit, to make all such tests free of charge to the citizens of the state of Maryland. It is greatly to be hoped that our county officials will avail themselves of this opportunity to ascertain the actual facts regarding the availability of their natural road-building materials instead of spending the public funds first and then relying upon the actual serviceability of the materials to determine their value.

The Maryland Geological Survey will also be glad to furnish such expert assistance, either in the drawing up of actual specifications and plans, or in supervising the same, as the Boards of County Commissioners may desire. The Survey will be pleased, so far as the time and funds at its disposal will permit, to render any services to the citizens of Maryland that are within its powers. Having secured a large amount of valuable information regarding the needs of Maryland highways and the distribution and character of the best natural road-building materials, and having at its disposal trained highway experts, it believes that it is in a position to perform an important public service to the state.

Highway Correspondence.

The Highway Division of the Survey has endeavored from the beginning to place itself in close touch with the highway needs of the state. Thousands of circular-letters have been sent out to county and municipal officers and to the prominent people of every section. Attempts have been made to secure the most intimate knowledge of the manner in which the county officers and private companies have conducted their highway affairs. It has been difficult, oftentimes, to obtain satisfactory answers to the questions, but in many instances very comprehensive statements have been secured, so that the results regarding highway-management which are presented in the subsequent chapters of this volume are confidently felt to be based upon the best information which it is possible to secure. It has been especially difficult to obtain the needed information from the private turnpike companies, as they have seemed in most instances unwilling to make a public statement of their affairs.

LETTER TO BOARDS OF COUNTY COMMISSIONERS.

The first circular-letter sent out by the Highway Division was addressed to the Boards of County Commissioners, and highly satisfactory answers were secured to the questions which were submitted regarding the construction and maintenance of the county highways. The results of this correspondence are presented in a later portion of the volume.

MARYLAND GEOLOGICAL SURVEY, JOHNS HOPKINS UNIVERSITY,
BALTIMORE, December 3, 1898.

To the Board of County Commissioners:

DEAR SIRS:—I take the liberty of enclosing a series of questions, careful answers to which will greatly facilitate the work of the Highway Division of the Maryland Geological Survey. I hope we may secure your co-operation in this matter and for the trouble and expense incurred by the clerk of your Board in filling out many of the questions submitted the Survey will be glad to send him a check for $10.00. Where exact figures are not at hand we hope that as close estimates as possible will be given, indicating in each instance whether it is an estimate or not.

The Maryland Geological Survey, acting under authority granted by the General Assembly (Laws of Maryland, 1898, Chapter 454), is most anxious to find out the views of the people regarding the important matter of highway improvement. In addition to the questions asked, the Survey would appreciate any statements which you may give regarding present methods of highway management or suggestions, if any, for their improvement. As the representatives of the counties in all matters of highway management your opinions will have much weight. If any of the following questions do not appear clear and further information is desired please communicate with this office at once and every effort will be made to put the matter in a clearer light.

Very respectfully,

Questions.

To what extent does your Board think it practicable for the State to enter upon actual highway improvement?

Would your Board favor having a section of a model road built in your County under the supervision of the Highway Division of the Maryland Geological Survey, the Survey to prepare the specifications and plans to be used in the construction of the road according to one of the following divisions of cost:

a. To have expense divided between State and County?

b. To have expense divided between State, County, and Districts through which improved piece of road passes?

c. To have expense divided between State, County, and abutters upon such piece of road?

d. Or would your Board suggest some other plan as to division of expense?

What plan would your Board suggest to provide for the maintenance of roads improved under one of the above plans?

Under what act or acts of Assembly with regard to road management is your County acting at present?

How many miles of roads (exclusive of city streets) within the limits of your County? (Estimate as closely as possible.)

a. Miles of dirt roads?

b. Miles of stone roads?

c. Miles of gravel roads?

d. Miles of shell roads?

Indicate which are the main traveled roads in your County, giving towns along such roads and at terminals.

Which is the main traveled road of your County?

What is the cost of breaking stone? By hand: per perch——— or per ton——— or per cubic yard———; by crusher: per perch——— or per ton ——— or per cubic yard———.

What is the cost of hauling stone per cubic yard? (State about the average distance hauled.)

What is the cost of spreading stone on road?

What is the cost of gravel per cubic yard?

What is the cost of hauling gravel per cubic yard? (State about the average distance hauled.)

What is the cost per square yard for spreading gravel?

What is the cost of shells per bushel? (State whether raw or steamed shells.)

What is the cost per bushel of hauling shells? (State about the average distance hauled.)

What is the cost per square yard for spreading shells?

About how much stone is used per mile to stone a road, giving width of portion stoned? Cost of same?

About how much gravel is used per mile to gravel a road, giving width of portion graveled? Cost of same?

About how many bushels of shells are used per mile to shell a road, giving width of portion shelled? Cost of same?

How much tile drain has been laid for purposes of road drainage during the last three years?

What does it cost per foot to lay tile drain?

About how much has been spent on brick or stone culverts during the last three years?

How many road supervisors in your County?

What amount do they receive per day?

How many additional men are employed by the supervisors?

How much do they receive per day?

About how many days during the year do the supervisors and men work upon the roads?

What is the required width between fences of new roads?

What width of roadway (that is, portion of road to be traveled) should, in the judgment of the Board, be required in the construction of such roads?

To what extent have plans with grades of roads shown thereon been used in grading roads in your County?

What road machinery is owned by the County?

What was the cost of same?

What is the cost annually of keeping this machinery in repair?

Does this machinery give satisfaction to the people of the County?

About what, on an average, does the farmer living along a toll-road pay per year in tolls?

On a rough estimate what proportion of farm wagons in your County do you think have tires over $3\frac{1}{2}$ inches wide?

Do most farmers order tires as wide as $3\frac{1}{2}$ inches on new wagons?

State the cost of maintaining roads and bridges in your County as far as possible, filling out the blanks in the columns below opposite the years indicated.

	Total amount levied for roads and bridges.	Amount spent for bridges.	Amount spent for new roads.	Amount spent for stone roads.	Amount spent for gravel roads.	Amount spent for shell roads.
1870	....	....	....	....	....	....
1880	....	....	....	....	....	....
1888	....	....	....	....	....	....
1889	....	....	....	....	....	....
1890	....	....	....	....	....	....
1891	....	....	....	....	....	....
1892	....	....	....	....	....	....
1893	....	....	....	....	....	....
1894	....	....	....	....	....	....
1895	....	....	....	....	....	....
1896	....	....	....	....	....	....
1897	....	....	....	....	....	....
1898	....	....	....	....	....	....

What cities and towns have been helped by the County in the maintenance of their streets and how much has been paid such cities and towns?

(Sign here)..................................

Clerk Board County Commissioners.

..................................County.

It is very desirable that these blanks should be returned filled out not later than December 31, 1898.

LETTER TO THE NEWSPAPERS OF MARYLAND.

A few days after the above communication had been sent to the Boards of County Commissioners, the following circular-letter was sent to the newspapers of the state.

MARYLAND GEOLOGICAL SURVEY, JOHNS HOPKINS UNIVERSITY,

BALTIMORE, December 7, 1898.

DEAR SIR:—The Maryland Geological Survey has sent to the Boards of County Commissioners a series of questions similar to those appended to this letter hoping that it may secure careful answers to the same as far as possible. It is believed that the information secured will be of benefit in formulating action in the future. It is the desire of the Geological Survey to put itself in touch with the enlightened sentiment of the people of the State upon this important question. It realizes that no progress can be made, however, except by hearty co-operation on the part of the established authorities of the several counties.

The Maryland Geological Survey is acting under authority granted by the General Assembly (Laws of Maryland, 1898, Chapter 454) in its investigation of the highway conditions of Maryland and in its study of the character and distribution of the natural road-building materials. A careful survey of every county in the State has been made along these lines during the last eight months as described in the Baltimore *Sun* of December 7. The methods which are being followed are those that have been adopted by countries and States which are intelligently constructing their roads. No radical change in existing road laws is proposed by the Survey, but it is believed that the construction of model roads throughout the State will gradually bring about an improved system of highway construction on the part of the people themselves.

It is the hope of the Survey that you may be willing to give wide publicity through your paper to the questions submitted and will ask your readers to send, such answers as they may feel inclined to give, to the *Chief of the Highway Division, Maryland Geological Survey, Baltimore, Maryland.* These letters will receive most careful consideration.

Will you kindly send copies of any issues of your paper which refer to our work.

Very respectfully,

LETTER TO THE FARMERS OF MARYLAND.

Several months later a letter was addressed to the farmers and other landed proprietors of the state. Over three thousand of these letters were sent to the leading citizens of the counties with the result that about one thousand replies were secured. These replies have been of great importance in tabulating information regarding the present condition of Maryland roads, since they come from those citizens of the state whose interests are most directly affected.

Maryland Geological Survey, Johns Hopkins University,
Baltimore, April 7, 1899.

Dear Sir:—The Highway Division of the Maryland Geological Survey, acting under a recent act of the General Assembly, is collecting information concerning the present condition and methods of maintenance of the highways of the State, together with other data which will prove of value in formulating plans for the improvement of the roads throughout Maryland.

Circulars have been sent to your Board of County Commissioners asking for information concerning the number of miles and kinds of roads in the county; the cost and nature of various types of road work as carried on at present; and what road machinery is owned by the county. We have also obtained as far as possible the amount it has cost the county for repairs of roads for the past ten to twenty years. In addition to this information many miles of roads in every county in the State have been gone over with a view to ascertaining as nearly as possible some of the actual conditions which exist.

In our laboratory, established for investigating the natural road-building materials, tests are being made of the rocks from all localities in the State. The result of these experiments enables us to tell the relative value of the different rocks for road purposes.

Any stone which you wish tested and compared with similar varieties from other localities we shall be glad to test for you free of cost, save the expense of the freight charges. If you will send us particulars as to the location and nature of your quarry, ledge or pit, material from which you wish us to test, we will mail you directions for sending the sample, which should weigh not less than thirty pounds. Our laboratory, which is on the ground floor of the Geological Building of Johns Hopkins University on Howard street, Baltimore, is open every week day, and we should be glad to show you at any time the methods used in testing road materials.

To make our Highway Report complete in every particular we have need of the information which your answers to the enclosed questions will give. It is practically impossible for us to reach every farmer in the state as we would like to do, but we shall try to have at least one of our circulars reach every neighborhood. It is earnestly hoped that every one who receives these questions will discuss them with his neighbor and return the same to us within a week after receiving them, with as complete answers as possible. We enclose an extra set, and should there be any one who you think would be interested, will you kindly give him the extra copy. We shall be glad to send circulars to other prominent farmers in your neighborhood, who may be willing to answer our questions, if you will send us their addresses. We hope you will answer the questions as fully as possible, but do not fail to send us such answers as you can, even though many questions must remain unanswered.

The information thus obtained will only be used as a whole, and will not be made public as coming from any individual.

If there is not room for the answer to any question in the space left for it you can put it either upon the back of the sheet or upon another piece of paper. All communications should be addressed to Maryland Geological Survey, Highway Division, Baltimore, Md. An early reply will oblige,

Respectfully yours,

Questions.

1. Name.
2. Nearest Post Office.
3. County.
4. What is the size of your farm?
5. What road or roads do you travel going from your house to the Post Office.

6. Distance to the Post Office.

7. Is the road a clay or sandy road, or has it been "piked" with stone, gravel or shells?

8. What repairs does this piece of road generally receive in each year?

9. Is a road machine used on the road?

10. Are the repairs of such a nature that the road is better because of them, or does the road remain about the same from year to year?

11. What in your opinion is the effect on the roads of the road machines or road scrapers?

12. Do you think it causes them to wear away faster?

13. In your neighborhood is it the custom to put the sod and other loose materials from the sides on the middle of the road?

14. Is this generally done with the road machine or by shovels?

15. To what extent and in what way have other roads in your vicinity been improved?

16. How many miles have been so improved?

17. Are you ever prevented from attending church, lectures, social gatherings or sending your children to school by the condition of the roads at any particular season of the year?

18. How many weeks during the year are the roads in your neighborhood—

(*a*) In a bad condition?

(*b*) In an impassable condition?

19. To what places do you haul your produce to ship or sell it?

20. What is the average distance in miles which you haul a load to market or to shipping point?

21. What does it cost you to haul an average load this distance?

22. About what is the average distance produce in your district is hauled in order to reach a market?

23. Are you obliged to haul over toll-roads?

24. What do you pay per year in tolls?

25. How many horses and mules do you keep?

26. How many horses and mules would you keep if the roads were in good condition all the time?

27. About how much weight in tons do you haul over the roads during a year—

(*a*) From your farm?

(*b*) To your farm?

28. What kinds of produce do you sell, and how much?

29. How many tons per horse do you generally haul—

(*a*) In winter?

(*b*) In spring?

(*c*) In summer?

(*d*) In fall?

30. What is the difference in cost of hauling when your roads are in bad shape as compared to when they are at their best?

31. Are the roads ever so bad that you cannot haul your produce to market or the shipping point?

32. Would it be to your advantage to haul at this time?

33. What would be your additional annual profit if you could market your produce at any season of the year and thus sell at times of high prices?

34. About how much do you spend in a year on repairs to your wagons?

35. How much less do you think this expense would be if the roads were in good condition all the year around?

36. What would you be willing to pay yearly for the satisfaction of driving over good roads independently of any other benefit?

37. How much increase in travel would there be in your neighborhood if the roads were good?

38. Would this increase in travel benefit your neighborhood?

39. How much annual profit would you get from this increased travel?

40. To what extent, if any, has the value of land increased per acre due to improvements on roads in your vicinity?

41. In your opinion would the value of farms be increased if the roads in their vicinity were improved in a substantial manner?

42. About how much do you think this increase would be per acre?

43. Do you use on your wagons tires as wide as 3½ inches?

44. Do most farmers in your neighborhood use tires as wide as 3½ inches?

45. Would you favor a plan whereby the State would aid the counties in the construction of roads?

46. Would you favor having such roads constructed under the supervision of the State Geological Survey?

47. If such roads were built do you think that they should be maintained by the State or by the counties?

A few weeks later the following letter was sent to those who had not replied to the earlier communication:

MARYLAND GEOLOGICAL SURVEY, JOHNS HOPKINS UNIVERSITY,
BALTIMORE, April 30, 1899.

DEAR SIR:—About three weeks ago there was sent to you a set of questions which you were kindly requested to answer. There was enclosed an addressed stamped envelope for their return.

Fearing the matter may have escaped your memory, I take the liberty of reminding you of it, and I earnestly request that you will give the questions your earliest attention. The information which can be derived from the answers will be of the greatest use and importance, as is shown by the large number already returned from many sections of the State.

Your set of answers is important toward compiling information in your district. If you cannot answer all the questions, answer those you can. Additional lists if needed will be mailed you on application.

I hope you will not allow this request to go unanswered.

Respectfully yours,

LETTER TO THE PRESIDENTS OF TURNPIKE COMPANIES OF MARYLAND.

The turnpike companies of the state were also asked to furnish information regarding their affairs, since the turnpikes are maintained at the expense of the people of the state in hardly less degree than the county highways. It was thought important that the people of the state should have a knowledge of the actual conditions, but it has been very difficult to secure the desired information, as the officers of the companies have in many instances been unwilling to answer the questions submitted. The fact should not be lost sight of that the turnpike companies represent vested interests which should not be disturbed, if at all, without an adequate payment on the part of the state or counties for the properties taken, yet the control of the public ways by private interests is a matter of serious concern. The questions asked were intended simply to place the real facts before the people and not to influence action on this important subject. Several states, notably New Jersey, have already taken action in this matter and have bought out many of the private companies to the great advantage of the public interests.

MARYLAND GEOLOGICAL SURVEY, JOHNS HOPKINS UNIVERSITY,

BALTIMORE, July 1, 1899.

DEAR SIR:—The General Assembly of Maryland, at its session of 1898, authorized the organization of the Highway Division of the State Geological Survey, and charged it to report on the condition of the roads of the State and the best methods of improving them.

We find that in 1818, Charles Goldsborough, then Governor of Maryland, made a report to the General Assembly on the condition of the turnpikes then existing, namely: The Baltimore and Reisterstown, the Baltimore and Yorktown, the Baltimore and Frederick, and the Cumberland turnpike roads, in which he incorporated answers received from the presidents of these roads to questions submitted by him. These dealt largely with the financial condition of the roads, and the answers gave the cost of construction, the amount of their stock, the sums received annually as tolls, the cost of maintenance, and the dividends declared for a number of years. We think it would be a matter of great interest to collect similar data regarding the turnpikes of to-day, for comparison, and therefore send you a series of questions, hoping that you will answer as fully as you are able or are willing to do. We do not intend to publish any information in separate form regarding the private affairs of turnpike companies, which they may not desire to make public, and therefore shall only use the answers you mark with X in compiling general statistics, without reference to your particular company.

Estimates will be of value to us where accurate answers cannot be given. The favor of a prompt reply, even though incomplete, will be highly appreciated.

Yours respectfully,

Questions.

1. Corporate name.
2. Under what law was charter taken out?
3. Length of road built.
4. Length of road on which toll is now charged.
5. Cost of construction of whole road including bridges.

*6. What bridges have been erected over considerable streams, and at what cost?

7. Has the road been bought out at any time, and at what cost?
8. What were the original amounts of bonds and stock issued?
9. What are the present amounts of bonds and stock outstanding?

*10. What are the gross receipts for the last five years?

*11. Cost of maintenance for the last five years.

12. Net profits for the last five years.

13. Proportion of gross receipts to operating expenses for the last five years.

14. Give figures of any other years that may furnish interesting comparison with these.

15. Do you collect monthly or annual tolls from any persons? If so what are the average amounts?

16. What are the present market values of the bonds and stock?

*17. What interest and dividends have been paid for the last five years?

18. Did your company ever pay dividends as high as eight per cent? When?

*19. In what condition is the road at present? How many gates, and for what time and distance of road have they been thrown open in the last five years?

*20. Under what grievances does the company labor which are within the power of the Legislature to remove?

21. Is there much evasion of proper tolls?

22. What do you think would be the annual receipts if these evasions could be stopped?

23. How much do you think is lost annually by dishonesty of toll-gate keepers?

*24. Can you form any estimate of the number of wagons loaded with produce or merchandise, or of the value of produce or merchandise wagoned on the road in the course of a year?

*25. In what manner would legislative interference most promote the interests of the road and at the same time those of the community?

26. What rates of toll do you charge? (If you have a printed list please enclose a copy.)

27. Would the owners like to sell the road to the State or counties at a reasonable price?

28. What would you consider a reasonable price?

Answers marked X will not be used with reference to a particular corporation, but only in compiling general statistics.

* Questions similar to those marked thus occur in the investigation of 1818.

LETTER TO THE GOVERNORS OF OTHER STATES.

Extensive correspondence was also entered into with officials of the various states in order that accurate knowledge might be gained regarding the conduct of highway affairs in other portions of this country. The following circular-letter was sent to the Governor of each state, requesting the desired information.

MARYLAND GEOLOGICAL SURVEY, JOHNS HOPKINS UNIVERSITY,
BALTIMORE, June 9, 1899.

SIR:—The Highway Division of the Maryland Geological Survey is collecting all information available concerning recent highway legislation in the United States to serve as suggestions in the formulation of highway laws for Maryland. It would be of the greatest help if you would have sent to this office copies of your State road laws and State highway reports if any such have been enacted or prepared. What has been the experience of your State in the employment of convicts on highway work; have they proved efficient workmen, and what is the general sentiment concerning their employment?

Yours respectfully,

Replies were received from nearly all the states, and Dr. Reid has discussed this subject very fully in a later chapter.

Upon the receipt of replies from the executives of the several states, a digest of the laws was made and the prepared statement returned for revision, accompanied by the following letter:

MARYLAND GEOLOGICAL SURVEY, JOHNS HOPKINS UNIVERSITY,
BALTIMORE, July 20, 1899.

DEAR SIR:—I thank you for the copy of the road-laws of your state. I have extracted from it the enclosed outline of the methods of the administration of your roads. Will you kindly glance over it and make any corrections or additions that you think proper.

Yours very truly,

LETTER TO HIGHWAY OFFICERS.

After all the information possible was secured in the manner above described there were still some states whose laws were not compiled and from which it was necessary to secure more definite information. The following letter, with the attached questions, was sent to the State Highway Boards or other officers connected with highway affairs.

MARYLAND GEOLOGICAL SURVEY, JOHNS HOPKINS UNIVERSITY,
BALTIMORE, July 20, 1899.

DEAR SIR:—We are making a report to the Maryland Legislature on the condition of the roads in the state and the best method of improving them; and we wish to add an account of the administration of roads in other states. We shall be greatly indebted to you if you will kindly answer the inclosed questions.

Yours very truly,

Questions.

1. Are roads administered by state, county or township officers? What are their titles.
2. Are they elected or appointed, and by whom?
3. Do they appoint road supervisors?
4. How is the road-tax levied, by state, county or township?
5. Is there a poll- and a property-tax?
6. Is it always spent in district where raised?
7. May it be worked out in labor?
8. Are there provisions for special tax or for issue of bonds for road-improvements?
9. Does law provide for the width of roads, and for wide tires to wagons?
10. What movement is on foot for the improvement of roads?
11. What improvement has actually taken place?
12. Additional remarks.

SAMPLE ROAD CONSTRUCTION.

The Highway Division of the Maryland Geological Survey has co-operated in the construction of two pieces of sample road. The first work was done in connection with the Office of Road Inquiry of the U. S. Department of Agriculture, and the second in co-operation with the officers of the Baltimore County Agricultural Society.

During the summer of 1898 the Office of Road Inquiry of the U. S. Department of Agriculture was requested by the officers of Baltimore county to supervise the construction of a piece of sample road in the vicinity of Fork P. O. Mr. E. G. Harrison, the road expert of that office, was detailed to the work, and the members of the State Highway Division co-operated with him in the subsequent opening of the road, which was made an occasion for bringing together many of the leading citizens of the state, when addresses relating to the importance of good roads were delivered on the ground. This road, which is more fully described by Mr. Johnson in a later

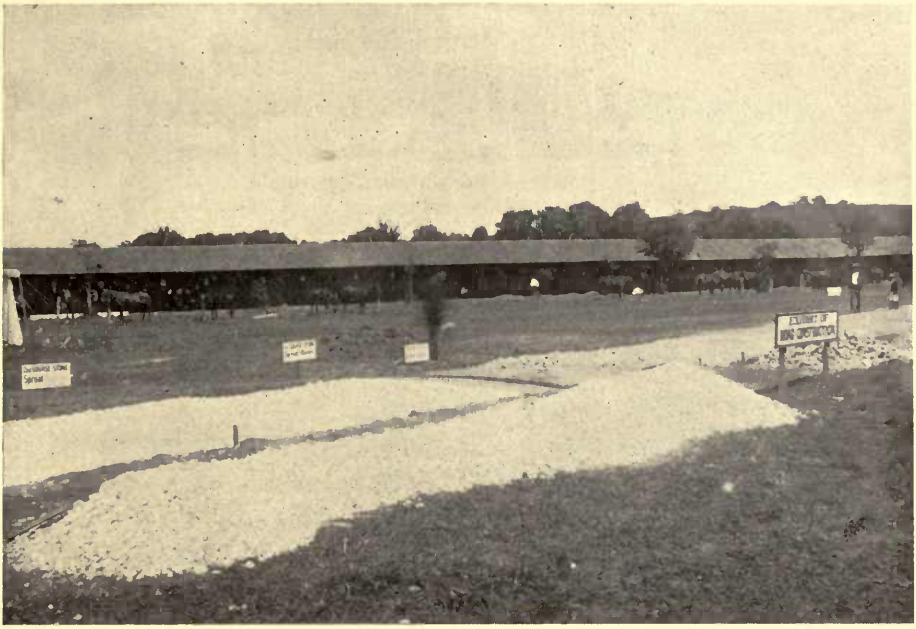
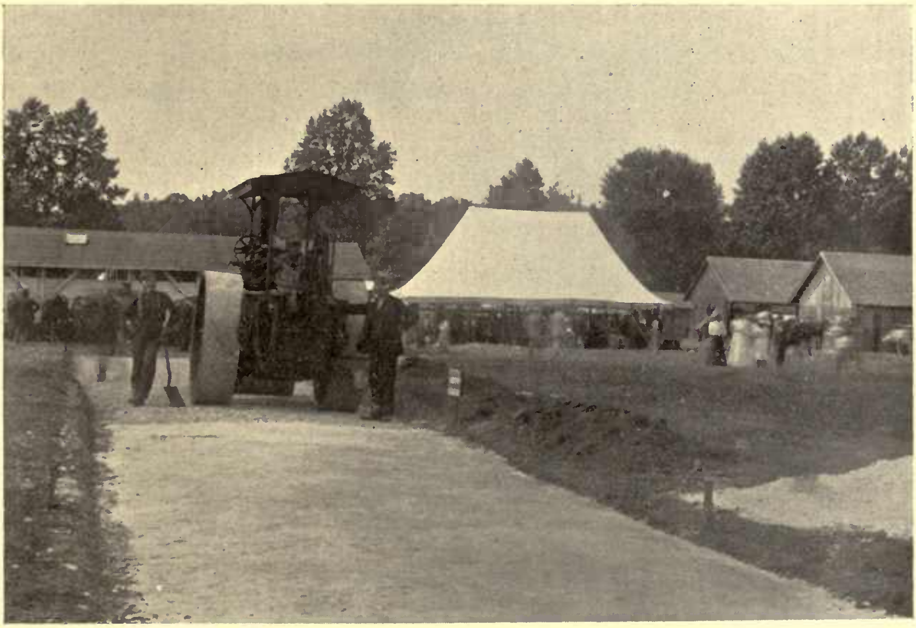


FIG. 1.—ROAD PARTIALLY CONSTRUCTED.



The Friedenwald Co.

FIG. 2.—ROAD NEARLY COMPLETED.

SAMPLE ROAD CONSTRUCTED UNDER SUPERVISION OF MARYLAND GEOLOGICAL SURVEY AT TIMONIUM FAIR, AUGUST 29—SEPTEMBER 2, 1899.

chapter, is about one-half mile in length with a width of twelve feet, and is thus sufficiently long to indicate to the people of the county the importance of a properly constructed highway.

The officers of the Baltimore County Agricultural Society requested the Highway Division of the Maryland Geological Survey to superintend the construction of a sample piece of road upon its grounds at Timonium during its annual fair, August 29 to September 2, 1899, which request was gladly responded to on the part of the officers of the Survey. A road one hundred yards in length was laid out, showing the different stages of construction from the properly prepared subgrade to the fully rolled surface. Several types of material were furnished for the road, fifty yards being constructed of slag contributed by the Maryland Steel Company, while the remainder was made of crushed stone secured from the marble quarry of the Beaver Dam Company and the gneiss quarry of the Peddicord Company. Part of this road was made fifteen, and part twelve feet in width. The steam-roller and other machinery used in construction were secured from Baltimore county. Many people visited the road during the progress of the fair and great interest was manifested in the latest and most approved methods which were exhibited in its construction.

Specifications for Highways.

Much preliminary work has already been done by the Highway Division in preparing plans for the permanent improvement of the highways of the state. Several leading lines of travel have been critically examined and in a few instances actual surveys have been made. The plats of these roads with detailed estimates of cost for construction will be laid before the General Assembly.

The publication of the plats and estimates already made is not thought desirable in this volume, as such special information would possess little of general interest, while the expense connected therewith would be far greater than any benefits that could possibly be derived. The specifications and working drawings will be laid before the proper officials as they are needed.

Proposed Legislation.

It will be necessary to enact additional legislation in order that the people of the state may derive permanent benefits from the investigations of the Highway Division. It would be entirely feasible to extend the present investigations to the construction of experimental or model roads, which should be located at convenient points in the vicinity of the several county-towns in order that the people may see in actual operation the most approved methods of modern road-construction. Such roads might be built either by the state independently or by the joint action of the state and the counties. Such a gradual extension of the work of the Highway Division would be more advisable than the attempt at a general construction of highways before the people thoroughly understand the most permanent and, at the same time, the most economical methods of road-building, directed and controlled by the best engineering skill. A knowledge of road-engineering has to-day come to be as well recognized and necessary for the most economical road-building as any other branch of engineering where serviceable structures are sought.

Before the state can actually enter upon a comprehensive plan of state road-building, in co-operation with the counties, it may be necessary to secure an amendment to the constitution, and if that should prove to be the case, two years at least would elapse before the work could be inaugurated; in the meantime the experimental work above described could be undertaken. In many ways such a period of model road-building would have many advantages, in that the people would thoroughly understand, before the succeeding session of the General Assembly, what kind of system they were desirous of permanently adopting. Most of the states now engaged in such schemes of road-construction have approached the question by similar stages and with the result that the state highways are meeting with almost universal approval on the part of the people. In the light of experience elsewhere it is to be distinctly urged that the people of Maryland enter upon state road-building cautiously and only after the best methods of work are thoroughly comprehended.

PART II

THE RELATIONS OF MARYLAND TOPOGRAPHY, CLIMATE AND GEOLOGY

TO

HIGHWAY CONSTRUCTION

BY

WM. BULLOCK CLARK

THE RELATIONS OF MARYLAND TOPOGRAPHY, CLIMATE AND GEOLOGY TO HIGHWAY CONSTRUCTION

BY

WM. BULLOCK CLARK

The diversified physical features of Maryland have so far-reaching an influence upon the many problems presented in highway-construction as to demand the careful consideration of the people of the state. The topography, the climate, and the geology of Maryland have been elsewhere discussed in great detail and an exhaustive treatment of these subjects is unnecessary in the present report. It is essential, however, to consider briefly their chief characteristics with especial reference to their effect upon road-building, and in so doing it will be apparent that those features which may be of advantage in one county may prove to be a positive disadvantage in another; that the same amounts of rainfall, for example, will produce very different effects in areas of high and low relief, or upon hard and soft rocks; and that the same temperatures will differently affect the foundation materials of the highways in the several districts of the state. It is evident, therefore, that the highway engineer must adapt his plans for road-construction to the physical conditions of the particular district in which he is engaged. In the subsequent pages some of the general and specific relations existing between the topography, the climate, and the geology on the one hand, and highway-construction on the other, will be discussed.

MARYLAND TOPOGRAPHY IN RELATION TO HIGHWAY CONSTRUCTION.

The state of Maryland forms a portion of the Atlantic slope which stretches from the crest of the Alleghanies to the sea, and comprises three more or less sharply defined regions that have been described elsewhere as the Coastal Plain, the Piedmont Plateau, and the Appalachian Region. These three districts follow the Atlantic border of the United States in three belts of varying width from New York southward to the Gulf. Maryland is, therefore, closely related in its topographical features to the states which lie to the north and south of it. Its central location on the Atlantic border renders the Maryland section perhaps the most characteristic of this broad tract. In crossing the three districts from the ocean border the country rises at first gradually and then more rapidly until it culminates in the highlands of the western portion of the state.

The relations which the surface characteristics of each county bear to highway construction need careful attention, since the manner in which the public ways are adjusted to the relief of the land becomes a question of much practical importance. A grade sufficiently great to thoroughly drain the highway is valuable, but anything beyond that becomes a constantly increasing impediment to travel. It is evident, therefore, that much skill is required by the road-builder in locating the road in order that the grades may be kept down to the lowest possible amount compatible with the other factors involved. It will be of value to consider the leading characteristics of Maryland topography throughout the various portions of the state from this aspect, and point out the manner in which the highways of each county have been and may still further be adjusted to the relief of the land.

THE COASTAL PLAIN.

The Coastal Plain includes the eastern margin of the Atlantic slope extending from the edge of the continental shelf on the east to the head of tide on the west, the latter reaching to a line extending across the state from northeast to southwest from Port Deposit, past Baltimore, to Washington. This region is divided into a submarine province and a subaërial province, the former extending from the edge of the continental shelf to the present continental border; the latter from the land-margin to the head of tide as above described. For our present purpose it will be unnecessary to consider further the submarine province.

The subaërial province, which includes the eastern and northern counties of the state, comprises nearly 5000 square miles, or somewhat over one-half the land area of the state. It is formed, for the most part, of level areas of lowland which extend with gradually increasing elevation from the coastal border, where the whole surface stands very nearly at sea-level, to heights of three hundred feet and more along its western edge. The region is cut quite to the border of the Piedmont Plateau by tidal estuaries, and the topography becomes more and more pronounced in passing inland from the coast. The Chesapeake Bay extends nearly across its full length from south to north, while the larger rivers and their tributaries deeply indent the country in all directions, making the coast-line of Maryland the longest of any state in the country. The drainage of the region, except near the margin of the Coastal Plain, and in some of the larger rivers which rise without the area, is consequent upon the present surface of the land, but has been considerably modified by oscillations in level. These oscillations have left the lower courses of the streams submerged, producing the Chesapeake Bay and the other tidal estuaries of the state.

The subaërial portion of the Coastal Plain in Maryland may be divided into a lower eastern and a higher western division, separated by the Chesapeake Bay. The former is known under the name of Eastern Maryland, or the Eastern Shore; while the latter is commonly referred to as Southern Maryland, or the Western Shore.

The *eastern division* includes the counties of Worcester, Wicomico, Somerset, Dorchester, Caroline, Talbot, Queen Anne's, Kent and Cecil. To this region most of the state of Delaware also properly belongs. Nowhere, except in the extreme north, does the country reach 100 feet in elevation, while most of it is below 25 feet in height. Both on the Atlantic coast and more especially upon the shores of the Chesapeake Bay it is deeply indented by bays and estuaries. The Atlantic coast especially shows very strikingly the result of sand-bar construction and the lagoons and inlets which are formed in consequence of it. The drainage of the region is simple, the streams flowing from the watershed directly to the Atlantic ocean and Delaware

Bay upon the east, and to the Chesapeake Bay upon the west. The position of the watershed along the extreme eastern margin of the area is very striking; in Worcester county for much of the distance it is only a few miles distant from the Atlantic shore, and as a result the streams which flow to the east are small in comparison with those which drain toward the west. Among the most important rivers which reach the Chesapeake Bay from this area are the Pocomoke, Nanticoke, Choptank and Chester, which all have their headwaters within the state of Delaware, and flow in a general southwest direction in sinuous channels.

The construction of highways throughout this eastern district is little influenced by the topography except along the river channels, since the intervening country stretches oftentimes for miles without any appreciable changes in elevation. Throughout the inter-stream portions of the country, therefore, the grades are insignificant, and a network of highways has been developed without any reference to the relief of the land. The position of the broad and oftentimes difficultly bridged streams has had a far greater influence upon the position of the highways than the character of the land surface. At the crossing of the channels of the various streams sudden, sharp grades often occur along the valley sides, and these increase gradually in amount from the southern to the northern portion of the Eastern Shore. South of the Choptank river these sudden slopes seldom present declivities of more than twenty-five feet below the general surface of the country; north of the Choptank a gradual increase occurs until slopes presenting elevations of a hundred feet or more are found along the stream channels of Cecil county, and the question of grading becomes an important factor. The numerous marshes bordering the Chesapeake and its estuaries, especially in the southern counties, often present very difficult problems in highway engineering that require especial treatment. These various factors will be considered more fully in a later chapter.

The *western division* includes the counties of St. Mary's, Calvert, Charles, Prince George's, Anne Arundel, and portions of Baltimore, and Harford. In elevation this region stands in striking contrast to the eastern division, since it frequently has an altitude of 100 feet even along its eastern margin. In lower St. Mary's county the land reaches an elevation of 100 feet on the Bay shore, which is gradually increased westward, until, near the border of Charles county, it slightly exceeds 180 feet. In southern Calvert county an elevation of 140 feet is found to the west of Cove Point and this gradually increases to the northward and northwestward, until near the southern border of Anne Arundel county the land rises above 180 feet. Throughout the western portion of this division in Charles, Prince George's and Anne Arundel counties the land gradually increases in height to the contact of the Piedmont Plateau, reaching 280 feet to the east of Washington and very nearly the same elevation in the area to the south of Baltimore. Outlying patches of the Coastal Plain, as determined by their geological characteristics, are found to the westward at still higher elevations. This western division is traversed by several rivers which flow from the Piedmont Plateau, among the more important being the Potomac, Patuxent, Patapsco, Gunpowder and Susquehanna. The course of the Potomac is especially striking. After flowing in a nearly southeast direction across the hard rocks of the Piedmont Plateau, it is apparently abruptly turned aside by the soft materials of the Coastal Plain, and takes a course for forty miles nearly at right angles to that which it formerly held. It turns again by a long sweep to the southeast and continues in that direction to the Chesapeake Bay. The local drainage of the western division possesses the characteristics which have already been described for the eastern section, in that the streams throughout Southern Maryland flow chiefly to the westward. For example, the watershed of the country lying between the Chesapeake Bay and the Patuxent river is situated but a slight distance from the shores of the former, so that most of the natural drainage of Calvert county reaches the Patuxent river. A still more striking exhibition of this is seen in St. Mary's, Charles and Prince George's counties, where the streams nearly all flow to the Potomac river, the watershed of the region approaching very close to the valley of the Patuxent. The same peculiarity in the drainage is found to the southward in Virginia and the Carolinas.

The highways of Southern Maryland have a very different relationship to the topography from those of the Eastern Shore on account of the greater elevation of the country, resulting in deep stream channels and sharp divides. It is a striking fact that the main roads have been located chiefly along the divides, a method of construction that is not confined alone to the leading lines but is also in evidence even in the case of the smaller tributaries. The chief lines of travel, for example, follow down the two peninsulas, one along the divide between the Chesapeake Bay and the Patuxent river, the other similarly situated between the Patuxent river and the Potomac river, while lateral lines of travel have developed along the smaller divides between the streams that flow into those channels. The persistency with which the highways are placed upon these divides, instead of along the valley lines, indicates that the construction of the roads must be conducted under far more favorable conditions in the former case than in the latter, although the almost universal location of the farm-lands of the district upon the high lands has doubtless also been a determining factor of no little importance. The fact that the roads can be built without any grading to speak of upon the divides, which has largely lessened the cost of their construction, and the added fact that the destructive effect of rainfall, except at the point where the roads pass downward from the divides to the main valley lines, has been insignificant, have doubtless been the chief causes, however, of their present location. Furthermore, the side valleys, as tidewater is approached, become marshy and unsuitable for permanent highways. The location of many of the small towns along the water-front, as well as frequent wharves, for shipping purposes, has rendered it necessary to continue the highways to tidewater, but, almost without exception, this has been accomplished along the projecting nose of the divide rather than along the valley bottom or sides.

The Piedmont Plateau.

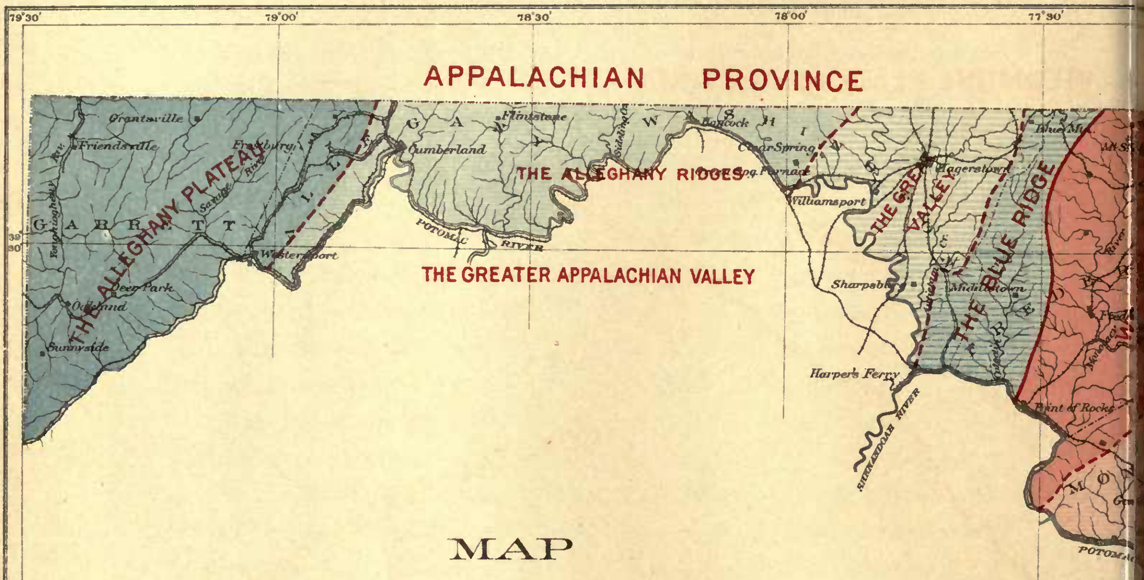
The Piedmont Plateau borders the Coastal Plain upon the west and extends to the base of the Catoctin Mountain. It includes approximately 2500 square miles, or somewhat over one-quarter of the land area of the state. It is about 65 miles in width in the northern portion of the region, but gradually narrows toward the south until it becomes somewhat less than 40 miles broad. It includes all, or a greater part, of Howard, Cecil, Baltimore, Harford, Carroll, Montgomery and Frederick counties. The region is broken by low, undulating hills which gradually increase in elevation from its eastern margin until they culminate near the central portion of the area in Parr's Ridge. This ridge divides the district into an eastern and a western division, the latter gradually sloping into the Frederick Valley. The major drainage of the area shows but little relation to the underlying rocks, but gives evidence of having been superimposed through a cover of sedimentary materials which may have been the westward extension of the present Coastal Plain, although more recent adjustments to the underlying rocks have taken place.

The *eastern division* of the Piedmont Plateau has, on account of its varied crystalline rocks and their complicated structure, a highly diversified topography. Along the eastern margin the land attains at several points heights exceeding 400 feet; while at Catonsville it reaches 535 feet above the sea-level. Towards the west and northwest the land gradually increases until it culminates in Parr's Ridge, which exceeds 850 feet in Carroll county. The drainage of the eastern division is mainly to the east and southeast. On its northern and southern borders it is traversed by the Susquehanna and Potomac rivers, which have their sources without the area, while the smaller streams which lie between them drain directly to the Chesapeake Bay or into the main rivers. Among the most important of these intermediate streams are the Gunpowder, Patapsco and Patuxent rivers, whose headwaters are situated upon Parr's Ridge. The Patapsco flows in a deep rocky gorge until it reaches the Relay, where it debouches into the Coastal Plain. All of these streams have rapid currents as far as the eastern border of the Piedmont Plateau, and even in the case of the largest are not navigable. The broad, fertile limestone valleys to which the present drainage has become partially adjusted are a striking feature of this area and are well represented to the north of Baltimore in the Green Spring and Dulaney's valleys.

On account of the complicated character of the stratigraphy, which cannot be discussed here, the valleys take different directions and are of very variable form and extent.

The leading highways of travel in the eastern division of the Piedmont Plateau largely converge toward Baltimore, the center of the traffic of this district, although many roads of scarcely less importance unite at the more populous county seats. These highways, with the exception of a few of the main turnpikes, have been similarly located with reference to the topographic features of the district as those of the western division of the Coastal Plain above described, and, although the underlying geological structure is very different in the two areas, the roads present many points in common. The highways of the Piedmont Plateau, as in Southern Maryland, are almost universally placed along the main divides except in the case of the broad, fertile limestone valleys which are in every instance traversed by main roads; while the more prominent river channels generally have highways along their bottoms. The highland roads commonly reach the lowlands by sharp descents along the projecting noses of the divides, as little attempt at grading has been made. Much greater irregularity in the direction of the roads is shown, however, in the Piedmont area than in Southern Maryland on account of the much more complicated structure of the district, the network of highways presenting a very complex pattern.

The *western division* extends from Parr's Ridge to the Catoctin Mountain. Along its western side is the broad limestone valley in which Frederick is situated and through which flows the Monocacy river from north to south, entering the Potomac river at the border line between Montgomery and Frederick counties. The valley near Frederick has an elevation of 250 feet above tide, which increases slowly to the eastward towards Parr's Ridge and very rapidly to the westward toward the Catoctin Mountain. Situated on the eastern side of the valley, just at the mouth of the Monocacy river and breaking the regularity of the surface outline, is Sugar Loaf Mountain, which rises rapidly from the surrounding plain to a height of 1250 feet. With the exception of a few streams which flow into the Po-



MAP

SHOWING THE

PHYSIOGRAPHIC PROVINCES

OF

MARYLAND

INCLUDING

DELAWARE AND THE DISTRICT OF COLUMBIA

SCALE

1:1,250,000. 20 Miles = 1 Inch

0 5 10 20 40 60

MARYLAND GEOLOGICAL SURVEY

WM. BULLOCK CLARK, STATE GEOLOGIST

1899

LEGEND

ALLEGHANY PLATEAU	WESTERN PIEDMONT PLATEAU
ALLEGHANY RIDGES	EASTERN PIEDMONT PLATEAU
GREAT VALLEY	COASTAL PLAIN, WESTERN SHORE
BLUE RIDGE	COASTAL PLAIN, EASTERN SHORE

A. Hoen & Co. Lith. Baltimore.

tomac directly, the entire drainage of the western district is accomplished by the Monocacy river and its numerous tributaries, the latter flowing in nearly parallel west and east courses from Parr's Ridge and the Catoctin Mountain. The deeper portions of the valley are considerably to the west of the center of the district, and as a result the streams upon the east are longer and of greater volume than those upon the west. The waterways at a distance from the main valley flow in marked channels, which are frequently deeply cut in the land.

The highways of the western division of the Piedmont Plateau present much greater regularity than those of the eastern division because of the simpler drainage lines of the district, the region being almost entirely drained by a single stream, the Monocacy river, and its tributaries. Much wider areas are also overlain by rocks of similar origin and structure so that the changes in the character of the highways are much less frequent although at times very pronounced. The highways in general follow the divides toward the main valley of the Monocacy, along which are the prominent lines of travel across the state from north to south. To the west the Catoctin Mountain rises as a barrier, although many roads extend along its base while some ascend its flanks to the low divides. Isolated highlands like Sugar Loaf Mountain also affect the regularity of the lines of highway construction.

The Appalachian Region.

The Appalachian Region borders the Piedmont Plateau upon the west and extends to the western limits of the state. It comprises about 2000 square miles, or somewhat less than one-sixth of the area of the state and has a width of about 115 miles east to west. It includes the western portion of Frederick and all of Washington, Allegany and Garrett counties. This area consists of a region of parallel mountain ranges with deep valleys which are cut, nearly at right angles, throughout much of the distance, by the Potomac river. Many of the ranges exceed 2000 feet, while some reach 3000 feet and more in the western portion of the mountainous area. The country illustrates in an exceptional manner the type of adjusted drainage. The Appalachian Region is divided into three distinct physiographic districts, based upon clearly defined geological differences; viz., an eastern (the Blue Ridge), a central (the Greater Appalachian Valley, including the Great Valley and the Alleghany Ridges), and a western (the Alleghany Plateau) division.

The *eastern division* comprises the area between the Catoctin and Blue Ridge mountains with a width of about fifteen miles from east to west along the Potomac, but gradually narrowing northward until it is not more than nine miles in width at the Pennsylvania line. Along the eastern border of this region the Catoctin Mountain extends from north to south, beginning in the highlands of Pennsylvania and reaching to the Potomac river at Point of Rocks. This range has an altitude of about 1800 feet in Maryland. Succeeding the Catoctin Mountain upon the west is the Middletown Valley, with an elevation of 500 feet at Middletown. The valley drains southward into the Potomac river through the Catoctin creek and its tributaries which receive their waters from the western flank of the Catoctin Mountain and the eastern slope of the Blue Ridge. The Blue Ridge of Maryland is a continuation of the South Mountain of Pennsylvania and extends as a sharply defined range from the northern border of the state to the Potomac river, which it reaches at Weverton. Its crest forms the border between Frederick and Washington counties. The Blue Ridge reaches its greatest elevation of about 2400 feet at Quirauk, not far from the Pennsylvania border. The Blue Ridge in Virginia is not the direct continuation of the mountains so-named in Maryland, but of a smaller range, the Elk Ridge Mountains, which adjoin them upon the west and which are pierced by the Potomac river at Harper's Ferry.

The *central division*, known as the Greater Appalachian Valley, which includes the Appalachian Mountains proper, is bounded upon the east by the Blue Ridge and upon the west by the Alleghany Plateau. It is divided into two subdivisions, the Great Valley upon the east and the Alleghany Ridges upon the west.

The Great Valley has a width of about twenty-five miles with an elevation slightly exceeding five hundred feet at Hagerstown, which increases somewhat to the northward near the Pennsylvania line but declines in the vicinity of the Potomac river. The Great Valley is often referred to in Maryland as the Hagerstown Valley from the well-known city of that name which is situated in the center of the district. The Antietam river and its tributaries occupy the eastern section of the valley and the Conococheague river and its tributaries the western, leaving the central portion of the valley somewhat higher than the sides. The western portion of this district, comprising the Alleghany Ridges, has a width of about fifty miles and consists of a succession of parallel sandstone ridges with intervening limestone and shale valleys.

"It is a complex chain of long, narrow, very level mountain ridges, separated by long, narrow, parallel valleys. These ridges sometimes end abruptly in swelling knobs, and sometimes taper off in long, slender points. Their slopes are singularly uniform, being in many cases unvaried by ravine or gully for many miles; in other instances they are trenched at equal intervals with great regularity. Their crests are, for the most part, sharp, and they preserve an extraordinarily equable elevation, being only here and there interrupted by notches or gaps, which sometimes descend to the water level, so as to give passage to the rivers [Potomac] . . . The ridges are variously arranged in groups with long, narrow crests, some of which preserve a remarkable straightness for great distances, while others bend with a prolonged and regular sweep. In many instances two narrow contiguous parallel mountain crests unite at their extremities and enclose a narrow oval valley, which, with its sharp mountain sides, bears not infrequently a marked resemblance to a long, slender, sharp-pointed canoe."[1]

Among the more important ridges in Maryland west of North Mountain are Tonoloway Hill, Sideling Hill, Town Hill, Green Ridge, Warrior Ridge and Martin's Ridge, the latter reaching 2000 feet and upwards in elevation. They are arranged in groups of three parallel and closely adjoining ridges on the eastern and western sides with more distant ridges in the middle of the district. The drainage of this area is altogether to the southward into the Potomac river. The deeper valleys in the eastern portion of the region have an elevation of about 500 feet in their lower portions near the Potomac river, but they gradually become higher toward the west. Evitt's creek at its mouth near Cumberland has an elevation of about 600 feet above sea-level.

[1] Rogers, H. D., Geology of Pennsylvania.

The *western division*, known as the Alleghany Plateau, forms the extreme western portion of the state, including western Allegany and Garrett counties. It is bounded upon the east by Dan's Mountain, the eastern slopes of which are referred to under the name of the Alleghany Front. To the west of Dan's Mountain the country descends into the broad synclinal represented in the George's Creek Valley, rising beyond into Savage Mountain, which is extended southward along the left bank of the North Branch of the Potomac river under the name of the Backbone Mountain. This high ridge, which throughout much of its extent constitutes the divide between the easterly and westerly flowing streams, is the highest portion of the state and reaches elevations at several points of more than 3000 feet. The Savage river alone penetrates this highland and to-day drains the district lying between Savage and Meadow mountains. The region to the west of the main divide forms a high plateau with gently undulating mountains rising from its surface. The main ranges to the west of Meadow Mountain are Winding Ridge and Laurel Hill which, however, at no point reach the high elevation attained by Savage and Backbone mountains. All of Garrett county to the west of Backbone and Meadow mountains has its drainage to the westward into the Ohio basin through the Castleman and Youghiogheny rivers, the two latter streams uniting beyond the limits of the state and sending their waters to the Ohio by way of the Monongahela river. This division of the drainage of the Alleghany Plateau has particular interest, since the waters flow, on the one hand, directly to the Atlantic ocean by way of the Potomac river, while in the other case they follow the circuitous route to the Gulf of Mexico by way of the Ohio and Mississippi rivers.

The highways of the Appalachian Region are much more profoundly affected by the topography than elsewhere in Maryland. The high, sharp sandstone ridges and the low limestone and shale valleys have controlled the main lines of travel to a remarkable extent. The National Road was, to be sure, built directly across the country without much reference to the topography, with the result that it is a constant succession of ascents and descents, although much engineering skill was manifested in surmounting difficult obstacles. In general, however, the highways run up and down the valleys, crossing from one to the other at the lowest point in the divides or following the channel of some stream which has been able to maintain its course through the sandstone ridges, as in the "narrows" of Will's Creek and in the gorge of the Savage river. The great trench of the Potomac affords many opportunities for connecting roads between the adjacent valleys without encountering the difficult grades of the mountains.

Conclusions.

From what has been said in the previous pages it is evident that the topography of Maryland has profoundly influenced the location of its highways; in fact, this has been so marked and of such a character that the highways of the state may be readily classified from the standpoint of their topographic characteristics. Far too little advantage has been taken, however, of these topographic conditions in the location of the ordinary roads; still, notwithstanding this fact, a system of public ways, more or less fully adjusted to the surface of the country, has gradually been developed. That such a method intelligently applied everywhere through the state would greatly benefit the highways hardly needs to be discussed. One has only to examine our Maryland roads to see how frequently advantageous locations with moderate grades have been ignored and poor positions selected to be convinced of the value of such a system. Although innumerable such instances may be cited, still the Maryland roads are, in general, much more fully adjusted to the topography than is the case in many other portions of the country. Especially is this true in the case of the older New England roads, which were built across country without any attempt to adjust them to the relief of the land. To-day, however, no more perfect system of adjusted roads has been projected than that which is being carried out under state supervision throughout New England.

Three types of adjustment of the highways to the topography are clearly evident in Maryland; first, in the eastern division of the Coastal Plain, where the adjustment is to the tidal estuaries and their tributaries and not to the relief of the land; second, in the western division of the Coastal Plain and in the Piedmont Plateau where the roads are located mainly upon the divides; and third, in the Appalachian Region, where the highways follow almost exclusively the trend of the north and south valleys, and cross the mountains either by the low divides or along the main streams which have continued to maintain their courses across the ridges.

This adjustment of the highways to the topography of the state, although often carried out with marked intelligence as regards the general conditions involved, presents commonly, as above described, glaring errors in detailed location. Frequently the introduction of a very moderate amount of grading would have made it possible for the road-builder to utilize the natural relief of the land. It is clearly evident that new locations better adjusted to the topography will have to be adopted along many portions of our main roads before our highways can be made of the greatest practical benefit to the agricultural and commercial interests of the state. Such adjustments, whether in the location of new roads or the re-location and grading of old ones, require above all else the introduction of intelligent engineering methods. These questions are fully discussed in later chapters.

The topographic maps which the Maryland Geological Survey is now engaged in making, in conjunction with the U. S. Geological Survey, for the counties of the state will exhibit by contour lines drawn at elevations of 20 feet around the hills and valleys the surface configuration of the country, and will afford to the surveyors employed by our county officials the exact grades which must be overcome; in short, these maps must prove of inestimable value to the state in the future location of the highways, as routes can be projected by a competent surveyor without the expense of a survey. It will in this way be very easy to compute the relative grades presented by several possible routes.

Other factors besides the adjustment of the highways to topography have often to be considered in an agricultural community. It not infrequently happens that the least advantageous location must be selected on account of the position of the farming lands. Where, as in eastern Maryland and certain portions of southern Maryland, the surface of the country is a broad, unbroken plain, and the farming lands are mainly situated upon the uplands, the needs of the land-owner alone would require the location of the roads there rather than in the valleys, while the reverse would be true in the limestone districts of the Piedmont Plateau and throughout the Appalachian Region, where the cultivated fields are distributed along the valley lines. The best topographic conditions for road-construction and the needs of the farmer do not always coincide in the Piedmont district outside the limestone belts, although the disparity is far less apparent in this area than in the Coastal Plain and the Appalachian Region.

MARYLAND CLIMATE IN RELATION TO HIGHWAY CONSTRUCTION.

The climate of Maryland is controlled not only by the general meteorological conditions that affect the whole eastern seaboard but by the physical features of the state itself, the Chesapeake Bay and its tributaries in the east and the Appalachian mountains in the west producing a marked influence upon the distribution of temperature and rainfall in the several counties. It is desirable to outline briefly the leading characteristics of our Maryland climate before referring to their effects upon highway construction. A detailed description of the climatic conditions of the state has been given in another place,[1] so that it will be unnecessary to state all the facts upon which the conclusions here cited are based. Like the topography, it will be found that the climatic conditions may be grouped in such a manner that the relationship of the climatic provinces to the physiography may be readily shown.

The vital elements of climate are the deviations which occur from seasonal averages, such as periods of extreme heat and cold, humid

[1] An exhaustive discussion of Maryland climate is given by Mr. F. J. Walz, Maryland Weather Service, volume i, pages 417-551. Most of the descriptions and tables given in this chapter are taken from Mr. Walz's article without further recognition than that here given.

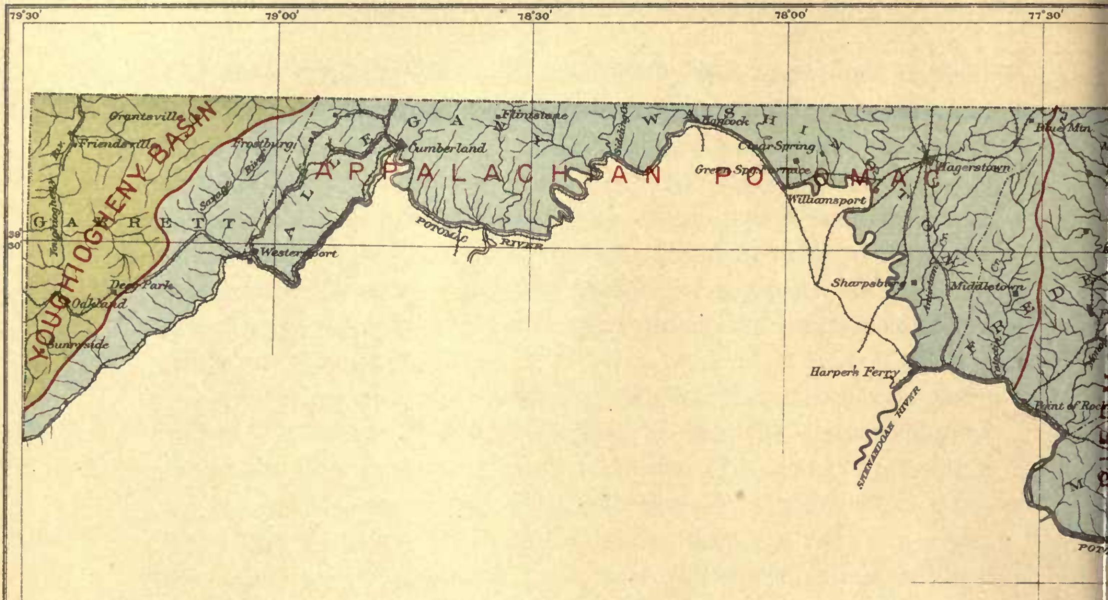
and dry air, liability to storms attended by wind, rain, hail or snow, and prevalence of fogs. Cyclonic and anticyclonic conditions, and the features connected with their irregular movements, also enter into the complicated study. To the irregular movements of transient pressure areas are traceable the quickly changeable phenomena known as weather. The part played by the permanent areas of high and low pressure is not so readily discernible for short periods, although they have a measurable value in determining the cumulative effects which we call climate.

Now, among these various kinds of climate, Maryland has its place, and as it is located in middle latitude and upon the western shore of the ocean, with a great continent to the west of it, and the prevailing winds westerly, its climate might be classed as continental. But while the prevailing winds are westerly, they are far from being universally so over this section, for, as is well known, winds can blow any day from any direction. Maryland's climate thus is really semi-continental. This variability in the wind direction is caused by the passage across the United States of cyclonic and anticyclonic areas. A close study of the characteristics, movements and frequency of these cyclonic and anticyclonic areas is of prime importance for a complete understanding of the climatic conditions of Maryland.

Pressure Area.

The permanent pressure systems influencing the climate of Maryland are: The high-pressure area which stretches across the Atlantic ocean between parallels of latitude 40° and 60° throughout the year; the low-pressure area extending over the North Atlantic in the vicinity of Greenland, which tends to fill up in summer; and the high-pressure area which forms over the northern Rocky Mountain plateau in winter, and in summer is succeeded by a low-pressure area in that region.

Transient pressure areas due to local conditions of increased or diminished air pressure form at irregular periods and frequently overspread large areas of country. These, too, result from physical causes and arise from the continued but never-ending endeavor to restore the atmospheric equilibrium.



MAP

SHOWING THE

DIVIDES AND DRAINAGE BASINS

OF

MARYLAND

INCLUDING

DELAWARE AND THE DISTRICT OF COLUMBIA

SCALE

1:1,250,000. 20 Miles = 1 Inch

0 5 10 20 40 60

MARYLAND GEOLOGICAL SURVEY

WM. BULLOCK CLARK, STATE GEOLOGIST

1899

LEGEND

OHIO DRAINAGE

CHESAPEAKE DRAINAGE

POTOMAC DRAINAGE

ATLANTIC DRAINAGE

A. Hoen & Co. Lith. Baltimore.

The results of these general and local atmospheric disturbances are shown in temperature and rainfall changes, both of which have a marked effect upon the highways.

Temperature.

The normal annual temperature for Maryland is between 53° and 54°. The principal modifying influences that determine the departures from this normal in the various climatic divisions of the state are latitude, water areas and elevation. The highest normal annual temperatures are found over the extreme southern counties of the Eastern and Western Shores. The influence of the Bay causes an appreciable, but not very decided, increase in annual temperatures along either side as compared with the level land areas closely adjoining. Over these latter areas the temperatures are very much the same, and differ but slightly from the normal for the entire state. The lowest normal annual temperatures occur in the western part of Garrett county, where they range from 46° at stations on the higher mountain ridges, to 48° in the plateau region lying to the north. Eastward from these higher elevations the increase in temperature is very rapid with the descent towards sea-level; a normal annual of 52° is reached in the western part of Allegany county, and an approach very nearly to the state normal is found in some of the valley depressions. No satisfactory records are obtainable for the annual temperatures of the Blue Ridge, although it is likely that the decrease of temperature for increase in elevation is about uniform with that found in the Alleghanies. Annual temperatures of 52° or below prevail over the northern portions of the Piedmont Plateau, and thence increase gradually towards the normal conditions found southward over the interior. In the extreme southern and eastern sections of the state the annual temperature rises to about 59°, due in part to exceptional local conditions.

There is considerable variability in the normal annual temperature, the normal annual maximum temperature for the state being about 63°, while the normal annual minimum temperature is 45°, a difference of 9° on either side of the normal annual temperature of 54°.

The following diagram shows the mean temperatures in the four climatic divisions of the state for each month of the year:

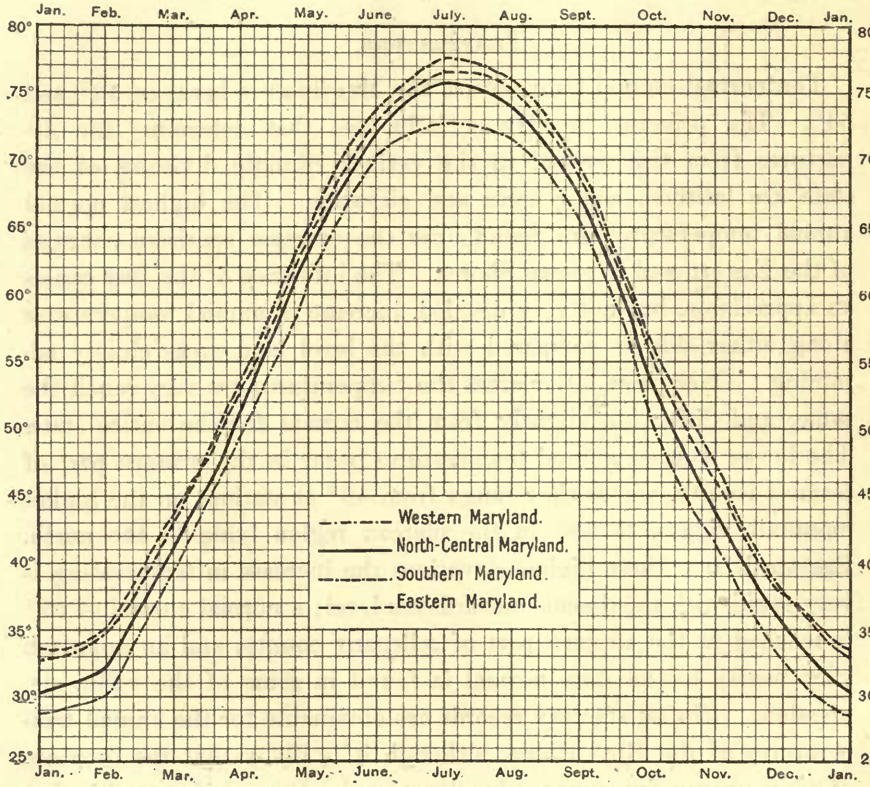


FIG. 1.—Mean temperatures in the four climatic divisions of Maryland.

Much variability is also manifested in the normal seasonal and monthly temperatures while the daily extremes of temperature are very great. The two following tables showing the highest and lowest recorded temperatures for each month and for the year at the leading stations in Maryland and Delaware are striking illustrations of the fact mentioned.

PRECIPITATION.

Perfectly dry air can be obtained by artificial methods, but in its natural and free state the vapor of water is always present. The capacity of the atmosphere for aqueous vapor is limited, and is decreased by cooling. When the point of complete saturation is reached, the excess of moisture is condensed into visible form, producing clouds, and if the process of condensation is rapid, the particles of water enlarge, and are brought to the surface of the earth by the force of gravity. The rate of condensation determines whether

HIGHEST RECORDED TEMPERATURES.
MAINLY FROM RECORDS FOR FIVE YEARS OR OVER.

STATIONS.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	July.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual.
Annapolis	61	63	68	87	94	95	97	94	98	85	69	64	98
Bachman's Valley	60	58	76	90	95	100	103	98	95	84	75	64	103
Baltimore	73	78	82	94	96	98	104	98	101	90	78	73	104
Charlotte Hall	66	70	83	97	95	100	102	99	100	88	78	70	102
Chestertown	63	61	79	87	92	94	97	93	90	83	75	65	97
College Park	62	68	82	92	94	100	105	98	101	88	78	69	105
Cumberland	70	66	84	94	98	101	103	101	97	87	86	68	103
Darlington	65	62	78	94	94	96	98	97	94	85	74	69	98
Deer Park	61	61	75	84	93	99	94	91	90	80	70	65	99
Denton	62	70	82	97	98	101	102	97	98	82	80	72	102
Easton	65	64	82	93	93	96	101	98	96	87	77	66	101
Ellicott City	60	65	78	88	89	96	101	93	95	87	76	66	101
Frederick	64	63	75	92	95	99	104	99	96	86	75	66	104
Hagerstown	62	62	82	92	98	98	98	100	95	88	77	66	100
Jewell	64	66	80	94	95	99	99	97	95	83	78	68	99
Laurel	64	61	80	94	94	99	104	98	100	90	77	67	104
Mardela Springs	70	67	80	92	93	96	98	100	95	88	77	67	100
McDonogh	64	59	75	90	91	94	95	94	91	82	74	68	95
Milford, Del	66	66	84	97	96	99	99	99	99	90	78	71	99
Millsboro, Del	65	68	82	99	97	98	98	98	95	87	78	68	99
Mt. St. Mary's	61	62	78	93	90	96	102	96	95	88	74	65	102
Newark, Del	56	61	73	92	92	96	98	98	97	86	75	63	98
New Market	62	61	79	93	93	99	105	98	96	85	83	65	105
Pocomoke City	69	70	81	93	96	99	101	100	96	91	81	74	101
Princess Anne	68	66	76	93	93	96	95	98	96	84	78	68	98
Seaford, Del	65	66	82	95	94	98	100	97	95	84	75	68	100
Solomon's	66	67	82	88	100	99	99	98	98	89	77	65	100
Sunnyside	61	64	75	87	90	92	93	90	91	82	73	65	93
Van Bibber	63	62	72	91	96	95	98	96	95	87	71	68	98
Woodstock	64	61	78	93	95	98	102	97	94	85	76	66	102
Westernport	65	66	81	92	96	102	107	99	98	88	78	65	107
Westminster	60	62	82	94	99	99	103	102	98	90	74	66	103
Wilmington, Del.	55	62	74	97	98	102	101	103	98	84	76	66	103
Washington	76	78	83	93	96	102	103	101	104	92	80	73	104
Extremes for each month	76	78	84	99	100	102	109*	103	104	92	86	74	109*

* At Boettcherville, near Cumberland.

the fall is in the nature of mist, light showers or heavy rain, and the conditions of temperature, electrical tension, etc., determine the character—whether rain, sleet, snow or hail. These four forms are included under the general term of precipitation. Dew deposits are frequently heavy, and a dense fog may appreciably dampen exposed surfaces. The amounts are usually so small, however, that they may be disregarded when speaking of precipitation measurements.

The normal annual amount of precipitation for the entire state of Maryland, whether falling as rain, hail, sleet or snow, is about 43 inches.

The greatest normal annual amounts occur over the western part of the Alleghany Plateau, where conditions favor both *frequency* and *intensity* of rainfall and snowfall—*frequency*, because it is the section of Maryland lying nearest to the main storm tracks of the eastern United States; and *intensity*, because the greatest elevations of the state are found there, and these, obstructing the flow of moisture-bearing winds, force them up the sides of the mountain slopes, lower the temperature, and consequently the vapor capacity, of the air; the result being rapid condensation and heavier rainfall than would occur over a more level country. At Sunnyside, in Garrett county, the average annual precipitation for the past six years is 53.5 inches, or

LOWEST RECORDED TEMPERATURES.

MAINLY FROM RECORDS FOR FIVE YEARS OR OVER.

STATION.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
Annapolis	5	− 6	....	24	40	..	58	52	40	33	25	....	− 6
Bachman's Valley	−11	−23	− 3	17	31	36	46	44	35	20	17	0	−23
Baltimore	− 6	− 7	5	24	34	47	55	51	39	30	15	− 3	− 7
Charlotte Hall....	− 1	....	0	25	37	41	49	52	40	23	18	5	− 1
Chestertown	5	− 9	16	25	37	43	54	51	41	30	22	9	− 9
College Park	− 2	−16	10	24	35	38	48	44	34	26	16	4	−16
Cumberland......	− 7	−12	6	25	33	45	52	50	35	22	14	2	−12
Darlington	− 8	−12	8	20	38	42	51	50	40	26	18	3	−12
Deer Park........	−23	−25	−13	6	20	30	32	31	22	4	− 6	−20	−25
Denton	−17	−14	15	25	37	43	50	50	43	27	21	9	−17
Easton............	− 1	−15	15	26	38	40	52	50	38	28	21	12	−15
Ellicott City......	− 8	− 8	18	21	32	48	51	53	45	28	19	6	− 8
Frederick	− 7	−10	0	25	33	39	50	45	37	25	19	0	−10
Hagerstown	− 8	−14	1	20	34	42	49	48	38	26	24	1	−14
Jewell	1	−14	11	23	38	45	53	50	41	28	21	8	−14
Laurel	− 4	−18	7	23	34	45	49	46	35	21	22	6	−18
Mardela Springs..	−10	....	15	24	37	42	51	50	39	26	18	11	−10
McDonogh.	− 3	−11	5	26	40	45	51	54	42	32	19	10	−11
Milford, Del......	6	−12	17	26	38	49	53	53	39	30	21	10	−12
Millsboro, Del....	−17	−10	12	22	35	40	51	50	37	29	18	6	−17
Mt. St. Mary's	−14	−15	11	21	37	42	51	50	40	22	13	6	−15
Newark, Del	− 1	−12	12	21	37	42	50	49	36	27	19	6	−12
New Market......	− 4	−14	5	21	33	45	52	49	38	25	16	3	−14
Pocomoke City...	8	− 4	18	27	40	46	55	55	42	33	21	11	− 4
Princess Anne....	1	−10	16	22	31	40	51	46	33	23	21	9	−10
Seaford, Del	− 5	−11	12	25	36	44	53	51	39	28	20	6	−11
Solomon's.........	4	− 5	18	28	41	49	57	59	46	35	23	11	− 5
Sunnyside	−24	−26	− 2	8	24	29	33	36	24	10	− 4	−17	−26
Van Bibber	− 1	−11	9	23	38	43	53	50	41	31	19	10	−11
Washington	−14	−15	4	22	34	43	52	49	38	26	12	−13	−15
Westernport.....	− 8	−13	− 3	19	30	36	41	42	28	16	15	− 6	−13
Westminster	− 7	−16	12	22	34	..	..	..	..	30	19	7	−16
Woodstock	−14	−13	− 4	22	34	40	..	45	34	23	15	3	−14
Lowest........	−24	−26	−13	6	20	29	32	31	22	4	− 6	−20	−26

over ten inches greater than the normal annual fall for the state. This station has an elevation of 2500 feet above sea-level, and is situated on the western slope of the Backbone Mountain—a ridge running southwest and northeast, with elevations of 3000 feet.

Just east of the Alleghany Plateau the annual rainfall decreases rapidly over an area including eastern Allegany county and the greater part of Washington county, or, more strictly, the Greater Appalachian Valley. A second area of diminished precipitation is found over upper St. Mary's county and the southern part of Charles county, and a third over narrow portions of Maryland and southern Delaware, bordering on the Atlantic. These three have a normal annual rainfall of 31 to 35 inches, and are the driest regions of the two states.

The normal annual precipitation increases east of the Blue Ridge, over the Piedmont Plateau. Parr's Ridge divides the plateau into two rainfall divisions; west of the ridge the annual amounts are about 40 inches, while east of the ridge there is a general increase to 45 inches.

A narrow area over which the normal annual fall is less than 40 inches lies just west of the Atlantic coast area already mentioned as one of the dry divisions, and a second limited area of this kind is found to embrace portions of Caroline, Talbot, Prince George's, Howard and Baltimore counties. With these exceptions, and that already noticed in portions of Charles and northern St. Mary's counties, the normal annual precipitation for the Coastal Plain is from 42 to 48 inches. The bands of greatest precipitation in this latter area include southern Anne Arundel county, and from southern St. Mary's county northeastward over portions of Dorchester and Wicomico counties.

The normal annual precipitation is divided throughout the seasons as follows: spring and summer will have about 11.5 to 12 inches, and fall and winter 9.5 to 10 inches.

The normal monthly, seasonal, and annual precipitation for the several districts of the state is shown in the table on pages 70-71.

The fluctuations in the normal rainfall throughout the year in the several districts of the state are graphically represented in Fig. 2.

DIVISIONS.	STATIONS.	No. Years Record.	Jan.	Feb.	Mar.	A
Alleghany Plateau.	Sunnyside	5–6	4.3	5.0	5.0	
The Greater Appalachian Valley.	Cumberland	26–28	2.3	2.7	3.0	
	Green Spring Furnace	5–6	2.4	2.9	2.6	
	Mean		2.4	2.8	2.8	
Central Potomac District.	Great Falls	8–9	2.9	2.9	3.0	
	Washington	25	3.5	3.4	4.2	
	Mean		3.2	3.2	3.6	
North Central District.	Frederick	20–24	3.2	3.0	3.0	
	Emmitsburg (Mt. St. Mary's)	20–29	3.1	3.2	4.1	
	New Market	9–13	2.6	3.3	3.7	
	Sandy Spring	7–8	3.5	3.4	4.1	
	Woodstock	20–28	3.5	3.4	4.0	
	McDonogh	17–18	3.0	3.1	3.7	
	Baltimore	47–51	3.0	3.5	4.0	
	Fallston	26–29	3.7	4.1	4.3	
	Woodlawn	11	3.1	3.6	4.2	
	Mean		3.2	3.4	3.9	
Anne Arundel County.	Annapolis	18–22	3.2	3.6	4.3	
	Jewell	8–10	2.8	3.6	4.8	
	Mean		3.0	3.6	4.6	
Southern District. Western Shore.	Charlotte Hall	4–6	2.8	3.2	3.1	
	Solomon's	7	2.6	4.0	3.2	
	Cherryfields	5–6	1.9	3.5	3.3	
	St. Inigoes	7–8	2.5	4.1	4.9	
	Mean		2.4	3.7	3.6	
Eastern Shore.	Chestertown	6–13	2.9	2.6	3.3	
	Easton	7–8	2.7	3.7	3.3	
	Mardela Springs	10–11	2.9	4.0	4.4	
	Mean		2.8	3.4	3.7	
Delaware and Atlantic Coast.	Dover, Del.	15–18	3.2	3.5	4.5	
	Milford, Del.	14–16	2.9	4.5	3.7	
	Millsboro, Del.	6	2.9	4.3	3.1	
	Mean		3.0	4.1	3.8	
Entire Section.	Mean		3.0	3.6	3.9	

* Recor

July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.	Spring.	Summer.	Autumn.	Winter.
6.2	3.6	3.1	3.4	4.3	4.0	53.3	14.8	14.5	10.7	13.3
3.4	3.1	2.7	2.5	2.4	2.2	33.7	8.8	10.0	7.5	7.2
3.8	4.3	2.8	2.9	2.9	2.3	35.4	8.4	10.9	8.6	7.5
3.6	3.7	2.8	2.7	2.6	2.8	34.6	8.6	10.4	8.0	7.4
3.6	2.6	3.1	2.3	2.8	2.8	35.2	9.7	8.7	8.1	8.6
4.6	4.0	3.7	3.1	2.8	3.0	43.5	11.4	12.6	9.6	9.9
4.1	3.3	3.4	2.7	2.8	2.9	39.4	10.6	10.6	8.8	9.2
3.7	2.8	3.4	2.5	2.9	2.9	38.9	10.4	10.6	8.9	9.0
3.5	3.5	3.6	3.8	3.9	3.0	43.2	11.8	10.9	11.3	9.3
4.1	4.3	3.8	2.8	4.5	2.5	42.2	11.0	12.0	11.1	8.4
5.1	4.9	3.3	3.7	3.1	3.4	45.2	10.0	15.0	10.1	10.3
3.6	4.1	3.6	3.4	3.3	2.7	42.3	11.2	11.3	10.3	9.6
4.0	3.2	3.5	2.7	3.0	2.5	38.2	9.3	11.1	9.2	8.6
4.7	4.1	3.6	3.1	3.3	3.2	43.3	11.3	12.4	10.0	9.6
4.5	4.9	4.3	3.6	3.8	3.4	48.3	12.0	13.4	11.7	11.2
4.3	5.7	4.0	4.0	4.0	3.0	47.8	12.1	14.0	12.0	9.7
4.2	4.2	3.7	3.3	3.5	3.0	43.3	11.0	12.3	10.5	9.5
4.8	4.6	3.7	3.8	4.3	3.4	48.2	12.9	13.3	11.9	10.2
7.0	3.4	3.7	3.7	3.3	2.9	47.9	13.9	14.1	10.7	9.3
5.9	4.0	3.7	3.8	3.8	3.2	48.0	13.4	13.7	11.3	9.8
4.0	2.5	1.3	3.7	2.1	2.0	*34.4	*10.5	9.0	*7.1	8.0
4.2	3.2	2.0	3.2	3.0	2.6	38.6	10.6	10.7	8.1	9.2
6.0	3.4	2.2	3.8	3.2	2.5	39.9	10.6	12.1	9.3	7.9
3.7	6.5	4.8	3.7	3.4	3.4	47.6	13.4	12.3	11.9	9.9
4.5	3.9	2.6	3.6	2.9	2.6	40.1	11.3	11.0	9.1	8.8
3.5	5.4	3.4	3.0	3.3	2.7	42.6	12.0	12.7	9.7	8.2
4.2	3.3	2.2	3.0	2.9	2.6	37.8	10.6	10.2	8.1	9.0
6.6	3.6	3.4	4.6	3.3	2.3	45.7	12.9	12.3	11.4	9.2
4.8	4.1	3.0	3.5	3.2	2.5	42.0	11.8	11.7	9.7	8.8
4.8	3.6	3.9	3.3	3.5	3.1	42.9	11.1	11.5	10.7	9.7
3.4	3.3	4.6	3.5	3.5	3.0	42.9	11.1	9.8	11.6	10.3
5.3	3.4	3.7	4.9	3.2	3.0	45.7	12.0	11.9	11.8	10.2
4.5	3.4	4.1	3.9	3.4	3.0	43.8	11.4	11.0	11.4	10.1
4.8	3.8	3.3	3.4	3.3	3.0	43.1	11.6	11.9	9.9	9.6

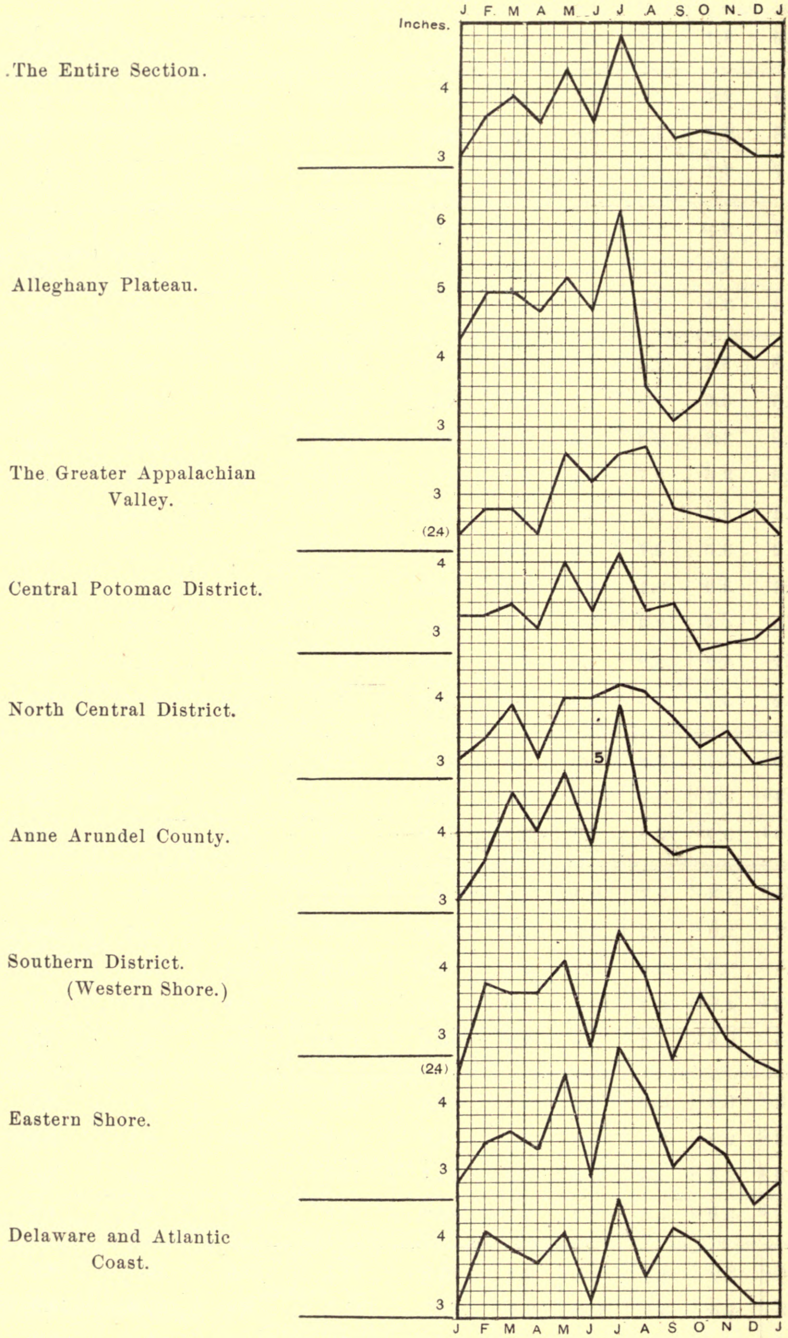
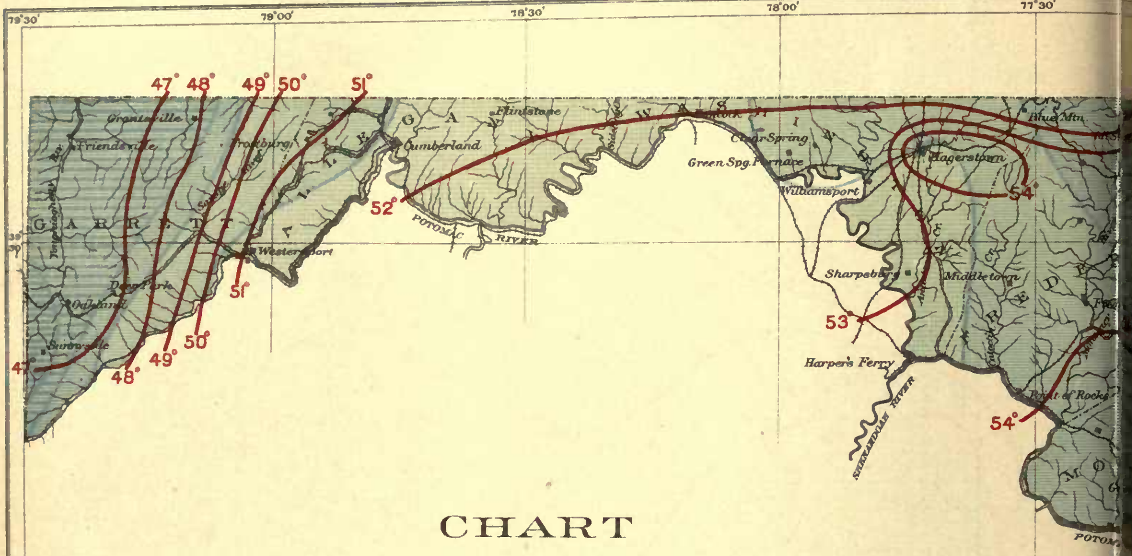


FIG. 2.—Fluctuations in normal rainfall.



CHART

SHOWING THE

NORMAL TEMPERATURE AND PRECIPITATION

FOR

MARYLAND

INCLUDING

DELAWARE AND THE DISTRICT OF COLUMBIA

YEAR

SCALE

1:1,250,000. 20 Miles = 1 Inch

0 5 10 20 40 60

MARYLAND GEOLOGICAL SURVEY

WM. BULLOCK CLARK, STATE GEOLOGIST

1899

LEGEND

TEMPERATURE IN DEGREES FAHRENHEIT

55° 55°

PRECIPITATION IN INCHES

30-35 35-40 40-45 45-50 50-55

A. Hoen & Co. Lith. Baltimore.

The lines of the diagram show the minimum precipitation in mid-winter with considerable increase in February and May and a very marked increase in July, while a uniform decrease in precipitation is shown in April. More or less variability in precipitation is shown in the different sections of the state.

The fluctuations in monthly and annual precipitation in the state in different years are clearly brought out in the table below:

GREATEST AND LEAST TOTAL MONTHLY AND ANNUAL RAINFALLS OCCURRING ANYWHERE IN STATE SINCE 1818.

January	11.2	Woodstock	1883
"	0.2	Washington	1872
February	8.8	St. Inigoes	1872
"	0.1	Fort McHenry	1864
March	12.8	St. Inigoes	1872
"	0.5	Cumberland	1872
April	13.0	St. Inigoes	1874
"	0.4	Fort McHenry	1847
May	12.3	Bachman's Valley	1898
"	0.2	Fort McHenry	1866
June	10.8	Frederick	1870
"	0.1	Mt. St. Mary's	1888
July	19.9	Jewell	1897
"	0.3	Fort McHenry	1869
August	15.9	Mount Airy	1873
"	0.3	Baltimore	1821
September	13.0	Fallston	1876
"	Trace	Fort McHenry	1884
October	11.0	St. Inigoes	1872
"	0.0	Taneytown	1892
"	0.0	Mount Airy	1874
November	11.0	Mt. St. Mary's	1881
"	0.1	Fort McHenry	1882
December	7.5	Mt. St. Mary's	1867
"	Trace	Jewell	1889
Annual	88.5	St. Inigoes	1872
"	20.0	Cumberland	1870

The fluctuations in Baltimore during the past twenty-eight years are given in the following figure.

Snowfall never fails completely in Maryland even in the warmest winters, although it may be reduced to insignificant proportions except

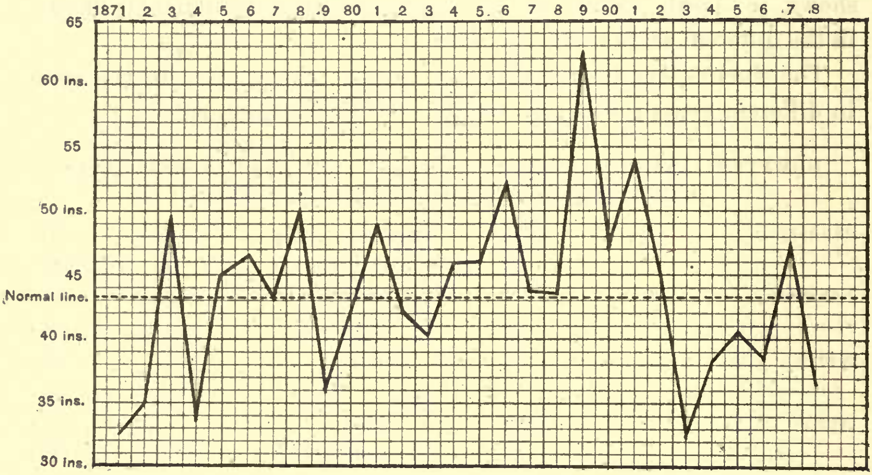


FIG. 3.—Fluctuations in annual precipitation at Baltimore, 1871–1898.

in the mountains. The average monthly amounts for the various climatic divisions of the state are shown in the table below:

AVERAGE DEPTH OF SNOW IN INCHES.

	Jan.	Feb.	Mar.	Apr.	May.	Nov.	Dec.
Western section........	12.0	8.9	9.2	3.1	1.8	3.2	5.2
N. Central section......	5.1	5.1	6.6	2.0	...	5.6	2.4
Southern section	5.4	4.0	1.0	1.4	...	2.5	2.3
Eastern section	4.6	4.1	...	1.5	...	2.5	1.9
Entire state	6.6	5.7	5.0	1.4	0.4	3.7	2.6

WINDS.

The prevailing winds in Maryland are northwesterly in winter, and during the summer months blow from a southerly direction, more generally from the southwest. The following tables show the prevailing wind direction for the several divisions for the past seven years:

PREVAILING WINDS.

	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sep.	Oct.	Nov.	Dec.
Western section	NW.	NW.	SW.	Var.	SW.	Var.	Var.	SW.	Var.	Var.	Var.	SW.
N. Central section...	NW.	NW.	NW.	NW.	Var.	Var.	SW.	SW.	Var.	NW.	NW.	NW.
Southern section	NW.	NW.	NW.	Var.	Var.	Var.	SW.	SW.	Var.	NW.	NW.	NW.
Eastern section......	NW.	NW.	NW.	Var.	Var.	SW.	SW.	Var.	Var.	NW.	NW.	NW.
Entire state.........	NW.	NW.	NW.	NW.	Var.	Var.	SW.	SW.	Var.	NW.	NW.	NW.

The direction of the wind depends upon the relative positions of the pressure areas with respect to each other and to Maryland. The velocity of the wind is determined by the intensity of the atmospheric disturbances. The only satisfactory records of the wind velocities for the state are those that have been made at Baltimore and Washington. The average monthly daily and hourly velocities of the wind, in miles, for Baltimore during the past twenty-eight years are given in the table below:

AVERAGE MONTHLY, DAILY AND HOURLY WIND MOVEMENT AT BALTIMORE.

Average.	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sept.	Oct.	Nov.	Dec.
Monthly	4609	4506	5499	5038	4636	4284	4147	3787	3931	4376	4413	4492
Daily.............	149	161	177	168	150	143	134	122	131	141	147	145
Hourly	6.2	6.7	7.4	7.0	6.2	6.0	5.6	5.1	5.5	5.9	6.1	6.0

The velocity of winds is extremely variable, and in times of great storms much destruction to property results, while the highways are swept bare of the finer loose particles. In the following table the maximum wind velocities in Baltimore during the past twenty-five years are given for each month, in miles per hour, whenever this velocity has been maintained for a period of five minutes or more at the rate given.

MAXIMUM WIND VELOCITIES AT BALTIMORE.

Jan. 1894	Feb. 1893	Mar. 1896	Apr. 1879	May 1893	June 1892	July 1893	Aug. 1888	Sept. 1892	Oct. 1878	Nov. 1891	Dec. 1898
48	45	50	60	43	42	42	45	38	45	48	54

The brief discussion of Maryland climate which has been given in the preceding pages has brought out the leading characteristics of the temperature, precipitation, and winds in the state, each of which has a controlling influence upon highway-construction and must be carefully considered by the road-builder.

General Effect of the Climate on Roads.

From what has been stated in the previous pages it will be observed that wide differences are found in temperature and rainfall in the various counties of the state, and that these differences must materially affect the construction of our highways. Professor N. S. Shaler of Harvard University, for many years a member of the Massachusetts Highway Commission and the author of "American Highways," presents this whole subject in a very lucid manner. He says: "As a roadway is of all constructions the most exposed to the action of the weather, the climate of the district in which it lies has a greater effect upon it than upon any other class of buildings. This effect is exercised by the rainfall, changes in temperature, and the winds. A secondary influence, arising from the above-mentioned natural conditions, is found in the character of the vegetation, which, under favorable conditions, may advantageously affect a road by covering the unused portion of its surface with a network of low-growing plants, such as the grasses.

"Under any conditions a road has to lie open to the rain. Where this comes gently, as is usually the case in Europe, it may not wash the surface of a well-graded way in a serious manner. When, however, as in this country, the rainfall, particularly in the central and western portions of the land, often comes in a torrential manner, the effect is, even on well-constructed roads, to wash out the dust which holds the stones together as well as to remove the divided portion of the rock, which should have a coating to keep the wheels and the shoes of horses from breaking the stone in a rapid manner. Thus the result of occasional heavy rains is in this country a more rapid wearing of the road-bed than occurs in the Old World. It is doubtful, indeed, if the Roman ways would have survived in this land in the manner in which they have endured in the regions where they were built.

"In almost all instances the ditches on either side of a road have to receive a large share of water which flows over the surface toward the way. Where, as in America, the rainfall may amount, as is often the case, to an inch or more an hour, a large part of the water, especially when the ground is frozen, flows over the surface, and much of it finds its way to these ditches. As will be noted hereafter, the waterways beside roads are an important part of the construction. The cost of their provision and maintenance is, on the average, much greater with us than in European lands. Furthermore, it is essential that the earth beneath a macadam way, where it is not provided with a pavement foundation, should be kept dry. It is desirable, indeed, in all cases that it should be protected from the invasion of water. The expense of underdrainage, such as is hereafter to be described, is exceptionally great in the case of American constructions.

"The well-known heaving action of frost, which is proportionate to the depth to which it enters the soil and to the water contained therein, is always a menace to the preservation of a roadway. This movement not only disturbs the whole construction, but it tends to force up the larger stones through the macadam or gravel, so that they disturb the bed in their ascent and encumber the way when they appear at the surface. In the Northern States of this Union, where the frost often enters the earth to the depth of three feet or more, the effect of freezing and thawing, often repeated several times in the course of a winter, is exceedingly injurious. To guard against it, it is necessary to provide for the removal of the water to a greater depth beneath the surface than is required on the continent of Europe or in Great Britain.

"The evils arising from the long-continued droughts which are so common in America are felt in several different ways. Where broken stone is used as road-material it is held together by the cementing action of the dust which lies between the fragments. Where the way is traversed by heavy wagons it almost always undergoes a certain breaking up of the bond. This is restored by a recementation process, which causes the dust, when wetted once, again to bind. It thus comes about that a road which is wetted at intervals, say no greater than a fortnight, will remain in a firm state, while, when subjected to traffic for a drought of a month or more in duration, it will be broken into a mere rubble. A conspicuous instance of this action came under the observation of the writer in the campaign of 1862 between the armies of Bragg and Buell in Kentucky and Tennessee. It was a season of remarkable drought, little or no rain falling for the term of seventy days. During this time the macadam roads of that district, which ordinarily are in excellent condition, were by the wagon and artillery trains brought almost to a state of ruin. The fragments of stone which ordinarily adhered firmly to one another were converted into pebbles, which ground up under the tread of the wheels. It was not until after the great rains which came on the night of the battle of Perryville that these roads began to return to a fairly passable state. Many of them, however, were so injured by the grinding up of the loose fragments that they were unserviceable until they were re-covered with broken stone.

"The effect of the winds on roads is to blow away the protecting covering of dust. If they be strong, the action may go so far as to remove the cementing material from between the exposed crevices. In general it may be said that the wearing of a road increases rapidly with the speed and continuity of the winds and the extent to which they blow in times of drought. The strong southwest winds so prevalent in this country, particularly in the Mississippi Valley in the summer, much increase the cost of maintenance of good ways.

"In a moderately humid climate, exempt from continuous summer droughts, creeping plants, nourished by the dust from the roads, which in most cases has a considerable fertilizing value, take hold on the shoulders and sides of the way in such a manner as to protect those exposed parts from washing or from the action of the winds. Where these conditions prevail, it is generally practicable to build a relatively narrow, hardened way with wide shoulders on either side onto which the passing teams can turn out, finding there, by virtue of the plant covering, a surface so firm that it will not rut from an occasional passage of wheels. If, however, the shoulders are overdry, as they are sure to become in an enduring drought, the plants are killed and the surface left exposed.

"The result of the above-mentioned climatal conditions is to make the construction and maintenance of good highways a matter of greater cost in the New than in the Old World. The conditions in the two realms are so far diverse that we need to be careful in adopting without revision the methods which have been successful beyond the Atlantic. In all cases these methods should be critically examined with reference to the climatal and other needs of this country."

Indirectly connected with the influence of the climate is the effect of forests on roads, and Professor Shaler further says in discussing these facts that "The effect of forests on the construction and maintenance of roads is considerable. Where these woods are deeply rooted, it is necessary to exercise a considerable amount of care in removing the woody material, not only the crowns and tap-roots, but also those of any size which penetrate downward; and this for the reason that the decay of the remains of the tree is apt to bring about harmful settlements of the foundation. The cost in general of carrying a road through thick woods is, so far as the preparation of the bed is concerned, at least twice as great as where it traverses an open country.

"The effect of a timber belt on either side of the road is sometimes to necessitate more careful drainage to insure the dryness of the subway. Where the hardened part of the construction is made of gravel the influence of the shade and of a plentiful contribution of fallen leaves is to preserve the layer from the excessive dryness which is likely rapidly to dessicate the surface of the wheelway. Moreover, the covering of leaves affords some protection against the impact of tires and hoofs, while the result of the decay of vegetable matter is to favor the cementation of the bed. In a less degree the shelter of a wood or of thick plantations on either side of the road, even that which is afforded by the ordinary spaced trees which are commonly planted beside ways, is helpful to macadam roads. Trees also diminish the ill effects of winds, retaining the dust on the road in a way that it would not be kept there if the road lies quite open to the blast. On these economic accounts, as well as for the grace which plantations afford, it is advisable to keep a way tolerably shaded, at least in such a climate as exists in almost all parts of the United States."

These statements by so eminent an authority as Professor Shaler indicate how important it is that the highway engineer should familiarize himself with the climatic conditions of the country in which his work is placed. From what has been said in previous pages it has been shown that the rainfall is much more excessive in some localities than in others, while the variations in temperature between the eastern and western sections of the state are very great, the much deeper frosts of the latter area requiring that far greater attention should be paid to the road-bed. The difficulties attendant upon highway-construction on these grounds in Maryland are, however, much less than in the area farther north to which Professor Shaler has more largely devoted his attention.

MARYLAND GEOLOGY IN RELATION TO HIGHWAY CONSTRUCTION.

The rocks of Maryland are of much significance to the road-builder. Not only do the physical characteristics of the materials composing the road-bed largely affect the permanency of the traveled way, but the character and distribution of the rocks of the several districts determine the quality of the road-metals which are actually placed upon the highways of the state. The relation, therefore, of geology to highway-construction is of such a nature that it is necessary to examine the questions connected therewith in some detail.

The Road-bed.

The character of the road-bed, or foundation, upon which the highway must be built, is of the greatest practical importance, and depends primarily upon the underlying geological formation. In a region like that of the state of Maryland where the rocks are of many kinds and often of small areal development, it becomes a matter of

MAP
OF THE
ROAD MATERIALS
OF
MARYLAND
INCLUDING
DELAWARE AND THE DISTRICT OF COLUMBIA

SCALE
1:1,250,000. 20 Miles = 1 Inch

0 5 10 20 40 60

MARYLAND GEOLOGICAL SURVEY
WM. BULLOCK CLARK, STATE GEOLOGIST
1899

LEGEND

PIEDMONT PLATEAU

THE TRAP ROCKS
- GABBRO
- PERIDOTITE AND PYROXENITE
- DIORITE
- DIABASE

THE GRANITIC AND QUARTZITIC ROCKS
- GNEISS AND QUARTZ-SCHIST
- GRANITE
- QUARTZITE
- TRIASSIC SANDSTONE

THE CALCAREOUS ROCKS
- MARBLE
- CRYSTALLINE LIMESTONE
- TRIASSIC CONGLOMERATE
- SHENANDOAN LIMESTONE

THE SLATE ROCKS
- PHYLLITE

APPALACHIAN REGION

EASTERN APPALACHIAN OR BLUE RIDGE DISTRICT

THE VOLCANIC ROCKS
- BASIC VOLCANICS
- ACID VOLCANICS

THE GRANITIC AND QUARTZITIC ROCKS
- GRANITE
- QUARTZITE

CENTRAL AND WESTERN APPALACHIAN DISTRICT

THE LIMESTONES
- SHENANDOAH
- NIAGARA, SALINA AND HELDERBERG
- GREENBRIER

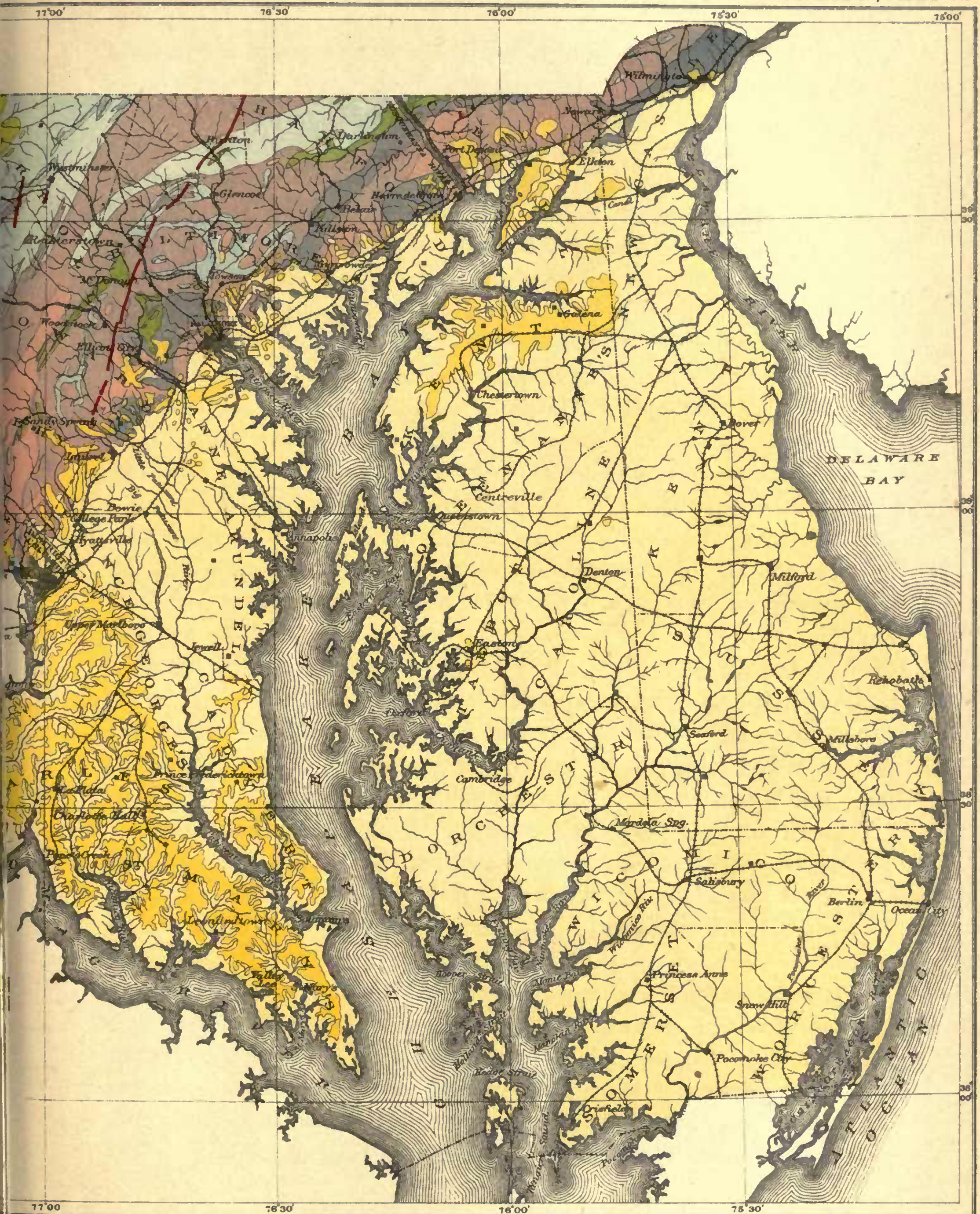
THE SANDSTONES
- JUNIATA-TUSCARORA
- ORISKANY
- POCONO
- POTTSVILLE

THE SHALES
- SHALES (INCLUDING MARTINSBURG, CLINTON, ROMNEY, JENNINGS, HAMPSHIRE, ALLEGHENY, CONEMAUGH, MONONGAHELA AND DUNKARD FORMATIONS)

COASTAL PLAI

GRAVELS AND IRON BEARIN
CLAYS AND UNCONSOLIDATE

MARLS OCCUR AS BEDS AN
VARIOUS PLACES IN THE
AND TERTIARY FORMATION
RESENTED ON THE MAP.



A. Hoen & Co. Lith. Baltimore.

necessity for the road-builder to frequently adjust his plans to changing conditions. The frequent alternation of sandstones, limestones, and shales in western Maryland and of granitic and trap rocks in central Maryland must be constantly considered by the road-master; while the varying gravels, sands and clays of eastern and southern Maryland afford still other conditions that are not less difficult to deal with.

When the surface layers of the rocks, whatever their lithologic characters, become disintegrated, as commonly occurs in Maryland, the residual materials are generally either clays or sands, or a variable mixture of the two. In level regions, especially where the streams have been unable to remove the unconsolidatd materials, the road-bed seldom rests upon solid rock; but at the higher elevations of the Piedmont Plateau and the Appalachian Region the more quartzitic rocks frequently reach the surface, and afford a solid foundation upon which a permanent road-bed may be constructed. The coating of residual materials when present in the elevated regions of the state is generally thin and always of varying thickness, since the rain and the streams are active agents on the steeper slopes in the removal of the unconsolidated products.

Maryland, like the states which lie to the south of it, differs very materially from our northern commonwealths in the absence of glaciation, which in that region swept from the surface of the country the residual materials, leaving the unaltered rocks exposed over wide tracts while burying adjacent areas under a cover of morainic debris. The more restricted areas of superficially unaltered rocks in Maryland are confined to the larger stream-channels and the steeper slopes, while the widely distributed disintegrated products are largely found *in situ* rather than transported to a distance as within the glaciated belt.

The question of drainage is of prime importance in the construction of permanent highways. When the under-materials are sands the water drains away quickly, but when, as is often the case, these materials are clays or clayey sands the natural drainage is slow and unsatisfactory. A road built upon such a plastic foundation as that which is afforded by clays readily goes to pieces unless special precautions are taken. A base of this character generally requires not only artificial draining at the sides, but also the introduction at times of costly pavements so as to keep the surface layer of broken stones and gravel from working down into the yielding road-bed. Professor Shaler, in his work upon American Highways, refers to the fact that such clayey foundations are commonly found in the most fertile agricultural regions, and that this adds largely to the cost of road-construction in those areas where good roads are most essential. Take, for example, the rich limestone valleys both in the Piedmont Plateau and in the Appalachian Region. They afford thick residual clays which are generally poorly adapted for highway-construction unless some precaution is taken as in the manner above-mentioned. The great value of the agricultural interests in these areas has rendered it imperative, however, to spend much money upon the highways, and they are frequently found to be among the finest in the state.

The Road Materials.

The rocks of Maryland afford a great variety of natural road-building materials. The central counties of the state, especially, are provided with materials of the highest grade, while the western and the eastern sections of the state are not without road-metals of value. There are few states in the Union in which the natural road-building materials are of equal quality or are more advantageously distributed, and yet Maryland has made comparatively little use of them hitherto.

THE PIEDMONT PLATEAU.

The rocks of the Piedmont area are the best in the state for the various uses of the road-builder. These rocks, as elsewhere described, are mainly crystalline or semi-crystalline, and embrace a great number of rock types of varying utility for highway-construction. They may be grouped into four main classes, viz., the trap rocks, the granitic and quartzitic rocks, the calcareous rocks, and the slate rocks.

The Trap Rocks.

The trap rocks, as shown by the tests given in later chapters, are the best road-building materials in the state, both on account of their

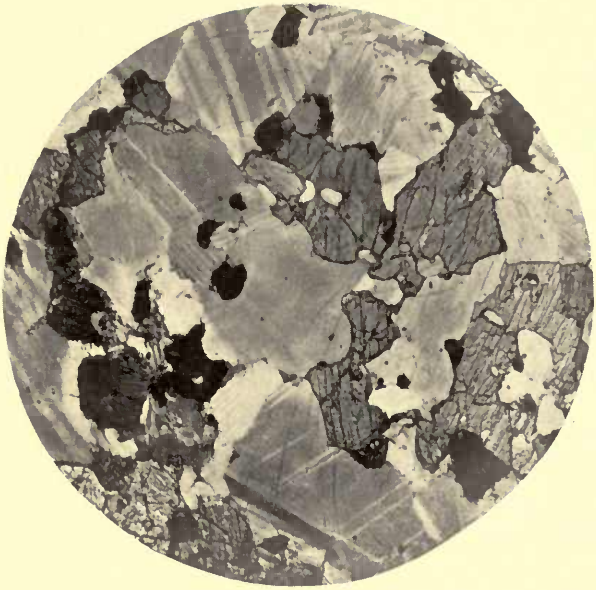
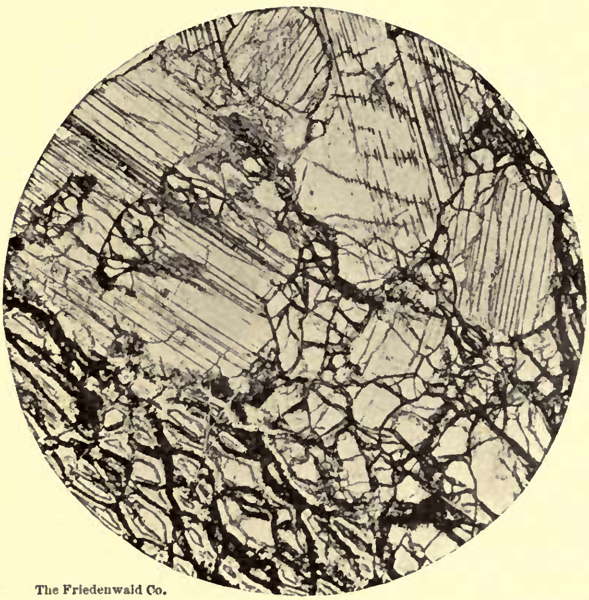


FIG. 1.—TRAP ROCK, GABBRO, BALTIMORE COUNTY.



The Friedenwald Co.

FIG. 2.—TRAP ROCK, SERPENTINE, HARFORD COUNTY.

PHOTOMICROGRAPHS OF ROCK SECTIONS.

resistance to wear and their fairly good cementing qualities. The trap rocks are highly crystalline with their constituent minerals firmly interlocked. They are also rich in iron, which is rendered available as a cementing medium. All of the trap rocks are of igneous origin, having been forced in a molten condition from considerable depths in the earth's crust into the positions which they now occupy. They are widely distributed throughout the seven Piedmont Plateau counties and occur in several well-defined varieties.

Gabbro.—The most extensively distributed and probably the most ancient of the basic eruptive or trap rocks which so abundantly intrude the gneiss complex is the gabbro or the "niggerhead" rock. There are three main areas of this rock within the limits of the state—the Stony Forest area of Harford and Cecil counties; the great belt or sheet which extends from north of Conowingo on the Susquehanna river in a south-southwest direction to Baltimore city; and the irregular, intrusive sheet which is mainly developed to the west of Baltimore, and extends thence as far south as Laurel.

The gabbro is a rather fine-grained aggregate of the minerals hypersthene, diallage, plagioclase (bytownite), and magnetite, with varying amounts of apatite and brown hornblende. The unaltered gabbros are unusually massive, heavy and dark-colored. With their alteration the color changes from a pale buff to the characteristic reddish-brown. By an increase in magnesia the gabbro passes by gradual transitions toward the rock types which include the peridotites and pyroxenites; or in alumina to rich feldspathic rocks; or in silica to others which have free silica forming blue grains.

The action of pressure which has caused the recrystallization of the gneiss and marble is also well marked in the gabbros. It has caused the iron constituent pyroxene to change to another green mineral called hornblende, and has in some cases left the rock as massive as at first, or in other cases rendered it schistose. The first is *gabbro-diorite*, the second *gabbro-schist.* The change has always been most complete where the mass of gabbro is smallest, as in the narrow beds which connect the larger areas. This change is well shown along the Bel Air Road near Baltimore.

The gabbro offers great resistance to the ordinary process of decomposition and hence it is strewn abundantly all over the area which it occupies in the form of boulders. It is at the same time so hard, so heavy, and so jointed that it cannot be quarried to any advantage as a building-stone, although the loose blocks are much used for constructing stone walls or foundations. It is admirably adapted, however, as a road-metal, although its firm interlocking texture makes it a difficult rock to work. These very qualities, which increase the expense of its preparation, add at the same time to its durability, and no more satisfactory road-metal can be secured.

PERIDOTITE AND PYROXENITE.—The second type of eruptive rock which penetrates the gneiss complex comprises the peridotite and pyroxenite. It is younger than the gabbro, but it is genetically closely allied to it. The two types are connected by many intermediate varieties; and these more basic rocks, which also break through the gabbro as well as through the gneiss, may be regarded as having resulted from a gabbro-magma which had become relatively poor in alumina, or in alumina and silica. The absence of alumina would prevent the formation of feldspar, and hence in the first case crystallization produced an aggregate of pyroxene (bronzite and diallage) called *pyroxenite;* while in the second case an aggregate of olivene and pyroxene with more or less magnetite produced what is called *peridotite.*

The two non-feldspathic eruptive rocks, pyroxenite and peridotite, are peculiarly subject to alteration, which is not, however, decomposition. Briefly it is this: the pyroxene, when it occurs alone, tends to pass into secondary hornblende, and this in turn gives rise to talc. This is the origin of the extensive beds of *steatite* in eastern Maryland and Virginia. The talc is always mixed with more or less pale, fibrous hornblende (actinolite) and chlorite.

When, as in the peridotite, olivene accompanies the pyroxene, especially if it is bronzite, the rock tends to form *serpentine* instead of talc. The serpentine also contains secondary hornblende formed from the diallage.

Both of the non-feldspathic eruptives are very intimately associated.

FIG. 1.—TRAP ROCK, DIABASE, MONTGOMERY COUNTY.

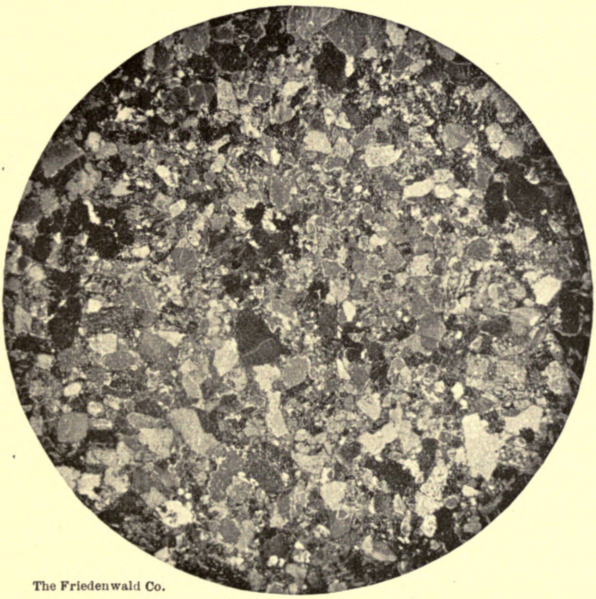


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FIG. 2.—GNEISS, BALTIMORE COUNTY.

PHOTOMICROGRAPHS OF ROCK SECTIONS.

They do not usually cover large areas, but occur in small lenticular patches. Varieties intermediate between the two extremes are common, so that the two alteration products, steatite and serpentine, are even more intimately mingled than the rocks themselves.

Peridotite and pyroxenite, with their alteration products, are found best developed in Cecil and Harford counties, extending as a long, narrow belt from the state line near Conowingo southwestward toward Forest Hill in Harford county. Other areas are found near Soldier's Delight and Bare Hills in Baltimore county, and also in several small, narrow belts in Howard and Montgomery counties. These rocks are somewhat softer than the gabbro, but contain a large proportion of iron, which acts as a valuable cementing medium. They afford important road-building materials in the areas in which they are found. The steatite and serpentine frequently wear away rapidly, however, and are thus less valuable than the unaltered rock for highway purposes.

Diorite.—The rocks included under this head are closely allied to the granites, and at first glance may easily be mistaken for them. They differ, however, in the character of their feldspar and in their darker color. They always contain a green hornblende, and biotite with orthoclase and plagioclase, sometimes the former and sometimes the latter in excess. Quartz is usually present, and the rocks then resemble the well-known tonalite from European localities. Under the microscope the diorites generally show evidences of the destruction of their constituents through dynamic action or through weathering processes.

The areal distribution of these rocks has not been fully studied, but they have been mapped in several small areas to the west of Washington on either side of the Potomac river. They are most extensively developed, as far as recognized, around Georgetown and near Cabin John Bridge. The quarries near the former place substantiate the view that these rocks represent ancient eruptive masses which subsequently have been greatly changed and recrystallized by the earth movements which have taken place since their formation. The exact time at which these rocks were intruded into the surrounding masses is not definitely known. They are clearly older than the youngest of the granites at Broad Branch and are younger than some of the older, more metamorphosed granites and granite-gneisses. It seems reasonably probable that they were erupted just before or just after the gabbros.

The diorites are not as rich in iron as the trap rocks previously mentioned, but are still valuable road-metals, although on account of their limited distribution they are much less important than the other varieties described.

DIABASE.—The diabase, the youngest of the trap rocks, is found distributed both in the eastern and the western divisions of the Piedmont Plateau extending from the Pennsylvania border in several long dikes which reach nearly across the state from north to south. In the western division of the Piedmont Plateau the diabase is found penetrating the Triassic sandstones and shales as well as the rocks of earlier age, the date of its intrusion being, therefore, very much later than that of the other representatives of the trap rocks. The diabase is probably late Triassic or perhaps post-Triassic in age.

In the eastern portion of the Piedmont Plateau the diabase intrudes the older crystalline rocks in Baltimore and Harford counties occurring as long dikes, broken at several points but preserving all the features of the rock found farther west in Frederick county. In the western portion of the Piedmont Plateau the diabase is found both in western Carroll and Frederick counties, being best developed near the Pennsylvania line in the vicinity of Emmitsburg, where the areal distribution is several square miles in extent. From this point several dikes can be traced southward, one of them continuing beyond the limits of Frederick county, nearly, if not quite, to the banks of the Potomac river.

The diabase is composed chiefly of the minerals feldspar (labradorite) and pyroxene (augite) with olivene and magnetite. The rocks penetrated have been at times considerably metamorphosed by the molten rock which was forced into their fissures, generally with a hardening of the beds by partial solidification and recrystallization. The diabase decomposes with considerable rapidity, although the surface is generally covered with large boulders of undecayed material, which shows characteristic weathering.

The diabase is an extremely important road-building material and has been used in the states to the north of Maryland much more extensively than any other of the trap rocks. This is perhaps to be accounted for from the much wider distribution of the diabase, although the readiness with which the rock can be worked makes it peculiarly valuable as a road-metal. It is generally hard, with excellent wearing and cementing qualities, and is to be highly recommended.

The Granitic and Quartzitic Rocks.

The granitic and quartzitic rocks are in the main of less value as road-materials than the trap-rocks, although some of the varieties are of importance in this respect. These rocks cover much larger areas than the trap rocks, and are generally more readily available for road-construction. They are found widely distributed in all the seven counties of the Piedmont belt and have been extensively quarried at various points as building material, so that much refuse is available for highway purposes.

Gneiss.—The prevailing rock of the Piedmont Plateau is the gneiss. It enters the state from the north in a very wide band, completely surrounding the Delta-Peach Bottom slate area, but its breadth rapidly contracts toward the Potomac. The remarkably irregular form of the marble areas which are intercalated in the gneiss complex shows how intricate the stratigraphy of the latter really is. Much of its apparent simplicity is due to the obliteration of its true bedding through secondary foliation. The Maryland gneiss embraces a great variety of types, which range from granitoid aggregates of feldspar and quartz on the one hand to nearly pure mica or hornblende schist on the other. All of these show considerable structural variation in the coarseness of their grain, the perfection of their parallel arrangement, etc. The gneiss is sometimes quite constant or homogeneous for considerable distances, but more usually it consists of differently constituted layers.

The gneiss everywhere shows, in spite of a frequent persistence of strike and dip, that it has been subjected to intense and repeated dynamic action. This is apparent in the larger features of its structure, and in its generally crumpled, gnarled and twisted character, and in the profound metamorphism, amounting to almost complete recrystallization, which has gone on within it. No certain traces of clastic origin have ever been detected in the Maryland gneiss, although its sedimentary character may be inferred from its rapid alternation of beds of different composition and from the nature of other rocks intercalated in it like marble and quartz-schist.

The color of the more massive gneisses varies from white to a dark gray or blue. The more micaceous and hornblendic varieties are dark brown or green. The mineral composition and structure are quite normal for gneisses elsewhere developed. Superficial exposures of the gneiss are very rarely fresh. This widespread decay extends also for a considerable distance below the surface, at least in an incipient form, as may be seen from the very rapid disintegration in road and railroad cuttings of rock that is sufficiently hard to require blasting.

The gneisses in their less quartzose varieties when not micaceous afford very fair road-building materials, although the frequently large percentage of quartz renders their cementing qualities generally inferior. They have not the resistance to wear possessed by the trap rocks, and, in general, must be regarded as of inferior quality to the latter. The wide distribution of the gneiss renders it locally available over a large area, and it can thus be used at times to advantage where the expense of transportation would debar the road-builder from employing the higher grades of rock.

Granite.—The granites of the Piedmont Plateau are eruptive rocks that intrude the gneiss complex in very much the same way as the trap rocks, and are among the most important materials from an economic standpoint in the state. They belong for the most part to a type known as *granitite*, and are generally of medium grain and of remarkably compact and homogeneous texture. They sometimes carry a considerable quantity of muscovite (Guilford), and are noticeable for the large and constant proportion of allanite which they contain, this latter mineral being frequently surrounded by a parallel growth of isomorphous epidote.

FIG. 1.—GRANITE, CECIL COUNTY.

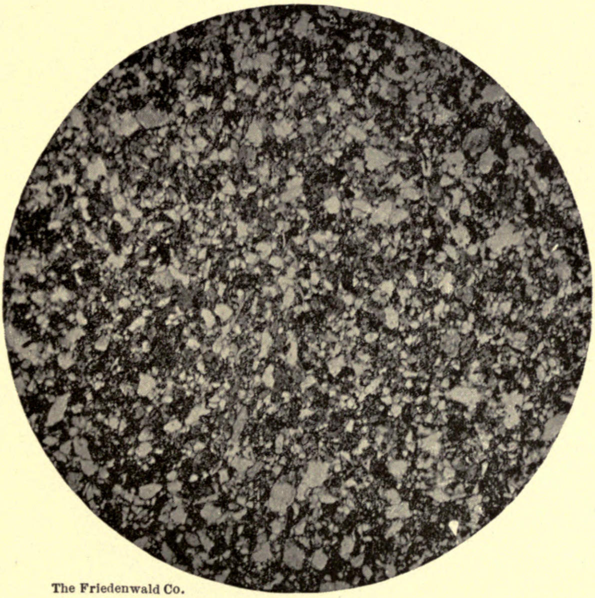

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FIG. 2.—SANDSTONE, MONTGOMERY COUNTY.

PHOTOMICROGRAPHS OF ROCK SECTIONS.

Variations in the structure of the granites are due to the development of poryphyritic crystals, as at Ellicott City and along the road from Meredith's Bridge on the Gunpowder river to Cockeysville. Other structural facies are due to secondary features, like foliation, produced by dynamic agencies.

The granites are probably partly younger and probably partly older than the other eruptive types, and are not connected with them, as those with each other, by intermediate facies. They represent entirely distinct epochs of eruptive activity. The evidence of their eruptive origin is most satisfactory and conclusive. They form intrusive bosses with diverging dikes and apophyses; they produce disturbance and crumpling in the rocks through which they break; they enclose fragments of the older rocks—gneiss, marble, quartz-schist, gabbro and pyroxenite—and finally they produce all the well-known phenomena of contact-metamorphism, both in these fragments and in the rocks which adjoin them.

The granites are extensively quarried for building and paving stones at Port Deposit, Woodstock, Granite, Ellicott City, and Guilford, where great masses of granite occur.

The gneiss of the Baltimore region is penetrated with a great abundance of dikes, veins, and eyes of the coarse-grained granite, known as *pegmatite*, which is locally known under the name of flint. Within the eastern plateau region the pegmatite appears to have been produced in two ways, at least we seem compelled by direct evidence to assume that certain occurrences of it are true eruptive dikes genetically related to the normal granite already described; while for other occurrences an aqueous origin by segregation appears more probable, although the proof is not as good as in the former cases.

The granites are very similar to the gneisses in many respects, although differing from them more or less widely in texture and mineralogical composition. As road-material they are very similar to the gneisses and possess much the same wearing and cementing qualities. They will also be found like them of value locally for road-building purposes, but are not to be compared as regards their durability to the trap rocks.

Quartz-schist.—This type forms but a small portion of the rocks of probable sedimentary origin included within the eastern division of the Piedmont Plateau. It is more interesting from its influence on the topography, since it causes the low ridge extending along the south side of Green Spring and Mine Branch valleys known as Setter's Ridge, than it is from its areal extent or even its mineralogical composition. The quartz-schist rarely attains any considerable thickness, but instead seems to be closely related to the underlying gneiss into which it grades by imperceptible transitions. Between the schist and the marbles there is a sharp break, and it has been considered probable that this formation is in some way the result of fumerole action in the gneiss. This conclusion is borne out by the mineralogical composition. The most abundant constituent is quartz, which occurs divided into fine beds of varying thickness by parallel layers of muscovite. In the micaceous layers are numerous broken crystals of tourmaline, whose fragments are separated along a single line as though they had been compressed and pulled apart by some earth movement.

The quartz-schist occupies so small an area in the Piedmont Plateau as to deserve little consideration from the standpoint of a road-metal. It may be used to some advantage locally in Baltimore county, but its large percentage of quartz renders both its wearing and cementing qualities inferior.

Quartzite.—Isolated areas of quartzitic sandstones are found developed along the eastern side of the Monocacy Valley in Frederick county, and single outliers also occur farther to the east in the valley of Deer creek in Harford county. The most extensive and characteristic deposit of this material in the Piedmont Plateau is found in Sugar Loaf Mountain near the boundary of Montgomery county. Here the sandstone is very homogeneous, fine-grained and compact, and is very light, frequently white in color. The massive sandstone strata of Sugar Loaf Mountain form a series of anticlines overturned toward the west. The formation continues toward the north in a few insignificant sandstone patches, while toward the south it soon disappears beneath the phyllite series. The Sugar Loaf sandstones pass on their eastern side upward by a gradual transition into the overlying deposits, which in their unaltered portion are somewhat shaly.

The quartzite is used locally with some success as a road-metal, but its cementing qualities are poor. It is inferior in several respects to the better grades of granitic rocks above referred to. It breaks down under constant and heavy wear to an incoherent sand and it does not possess any proper cementing medium.

Triassic Sandstones.—The red sandstones of Triassic age, known as the Newark formation, are much younger than the other members of the granitic and quartzitic series. They occupy a considerable area along the border of the Piedmont Plateau, beginning as a belt some ten miles in width in northern Carroll and Frederick counties. The formation gradually narrows toward the south, until in the region of Frederick its full width does not exceed one mile, while at one point directly to the west of Frederick the continuity of the beds is completely broken. Farther southward in western Montgomery county the belt of Newark deposits again broadens to a width of several miles.

The rocks of the Newark formation consist chiefly of red and gray sandstones and conglomerates of both siliceous and calcareous varieties. The finer-grained and deeper-colored deposits generally have their individual elements united by a ferruginous cement, while the calcareous conglomerate, which is largely made up of rounded limestone pebbles, is generally imbedded in a reddish calcareous matrix. All of the deposits present structures which indicate that they were formed in shallow water; the coarse conglomerates, the ripple-marked surfaces, and the tracks of animals all point indisputably to this conclusion.

The more ferruginous varieties of the Newark deposits afford good road-building material, the iron constituent acting as a valuable cementing medium. The large percentage of calcareous materials in the conglomerates renders them less enduring than the trap rocks, but still they may be employed to advantage locally. They are among the most valuable of the road-metals in this series of rocks, with the possible exception of some of the better grades of gneiss and granite.

The Calcareous Rocks.

The calcareous rocks of the Piedmont Plateau, which include the marbles and crystalline limestones, are used to some extent as road-materials, but in proportion as they become highly crystalline they lack those wearing and cementing qualities which are essential in a good natural road-building material. They are found covering considerable areas both in the eastern and western divisions of the Piedmont Plateau.

Marble.—The marble deposits of the Piedmont Plateau possess much of topographical and geological interest. There are few areas in Maryland where the dependence of topography upon the character of the underlying rocks is better shown than in the contrast between the flat valleys in the marble and abrupt ridges of adjacent gneisses and quartz-schists. Geologically the marbles are the youngest of the series, but their relations are greatly obscured by structural complexity.

The marbles, which are confined to the eastern division of the Piedmont Plateau, differ in texture and composition from the finer and more compact crystalline limestones of the western division. In the latter the impurities are in the form of thin, argillaceous bands, while in the former they are represented by layers of accessory minerals, including tremolite, white pyroxene, green muscovite, brown and black tourmaline, scapolite, quartz, pyrite and rutile, which correspond more or less closely with the original bedding planes. The marbles are often dolomites, frequently showing over 40 per cent of magnesium carbonate. The Baltimore county marbles are extensively quarried, either for burning or for use as a flux, or as a building stone (magnesian).

The marble refuse from the various quarries is at times employed upon the highways, but is much inferior to the trap rocks and the better varieties of the granitic and quartzitic rocks. Its texture is much too coarsely crystalline to form a permanent roadway.

Crystalline Limestone.—The crystalline limestone is confined to the western portion of the Piedmont Plateau and is mainly developed in Carroll and adjacent parts of Frederick counties. It is found in long narrow bands infolded in the phyllite and extends in a general northeast-southwest direction. These limestones upon examination are found to be highly crystalline, fine-grained marbles, which become more and more contorted, cleaved, and faulted as they are folded across their strike toward the east.

The crystalline limestones are, like the marble, in the main poorly adapted for highway purposes, although they have been used to a considerable extent locally in Carroll county. They are inferior to most of the rocks previously described from the western Piedmont district.

Shenandoah Limestone.—The Frederick valley is underlain by the limestones of the Shenandoah formation, which extend from north to south for a distance of twenty-five miles with an average width of about four miles. The limestone is blue or gray in color, with locally developed siliceous beds that resist the ordinary processes of decay much more than the purer limestones. These more highly siliceous beds afford excellent road-material on account of their resistance to wear. All of the limestones present excellent cementing qualities, and both in their harder and softer beds have been extensively used in road-construction. They frequently present a very dusty surface and in this respect they are inferior to the trap rocks above described, but in several features are superior to the other rocks of the district in which they occur.

Triassic Conglomerate.—The Triassic conglomerate, previously referred to in discussing the red sandstones, is largely made up of rounded limestone pebbles imbedded in a reddish calcareous matrix. These calcareous rocks are much less highly crystalline than the other calcareous beds and are therefore much better adapted for road-building purposes. They have not been largely used thus far, but the tests show that they contain much better cementing and wearing qualities than the marbles and crystalline limestones.

The Slate Rocks.

The slate rocks cover a considerable area in the northern and western portions of the Piedmont Plateau, but are poorly adapted for road-building purposes.

Phyllite.—The slaty and shaly rocks which compose much of the areas above described are indicated upon the map under the geological term of phyllite, although quite a variety of deposits varying all the way from slightly altered shales to well-defined schists is found. They are in the main highly argillaceous, although in places arenaceous, and apparently grade over into the quartzitic series earlier described. They are closely folded toward the east and the metamorphism of the beds, attendant upon the increasing disturbance to which they have been subjected, is so great that it is not always easy to distinguish the line of contact between them and the underlying and more ancient crystallines of the eastern Piedmont region.

The phyllites, from their argillaceous character, easily break down when subjected to wear, producing clayey materials, and are thus ill-adapted for highway purposes.

THE APPALACHIAN REGION.

The rocks of the Appalachian Region are not in general as well adapted to highway-construction as those of the Piedmont Plateau, although some of the limestones afford road-metals of more than ordinary value. The geological structure of the district is such, however, that the same deposits are frequently repeated so that the limestone formations are well distributed throughout the area. The sandstones and shales are much less valuable for highway purposes, although the more compact, quartzose rocks have been frequently employed. The igneous rocks, which are limited to the eastern division of the Appalachian Region, locally afford materials of value, but they have not been employed to any large extent upon the highways of the Blue Ridge district. The rocks of this area differ so widely from those of the central and western portions of the Appalachian Region that they will be independently considered.

THE EASTERN APPALACHIAN OR BLUE RIDGE DISTRICT.

The rocks of the Blue Ridge district may be considered under two different heads: first, the volcanic rocks, which include acid and basic volcanics with their metamorphosed products; and second, the quartzitic and granitic rocks, which include the Cambrian quartzite and the granite.

The Volcanic Rocks.

The volcanic rocks of the Blue Ridge area are generally classified as acid and basic volcanics, although both of these rocks are frequently much altered as the result of dynamic forces. The acid volcanics occupy an irregular area north and northeast of Middletown between the Blue Ridge and Catoctin mountains and extend nearly to the state line, while to the northwest of this main body are a few outlying masses. These rocks are close-grained mixtures of quartz and feldspar, which often show characteristic flow and other structures of lava, which at times are partly destroyed as the result of devitrification. These rocks have not been used to any extent as road-metals, and the high proportion of silica may render them unavailable for that purpose.

The basic volcanics occupy a much larger area in the Blue Ridge district than the acid volcanics, extending all the way from the Pennsylvania line to the Potomac river, although they are largely crowded out to the south by the numerous intrusions of granites. The original rock possesses the characteristics of a diabase, which has, however, lost everywhere in Maryland most of its characteristic features through metamorphism, which has developed a marked schistosity. The presence of amygdaloidal structure and textural variation, combined with the characters of the field relations, shows that these rocks were originally formed in the same manner as modern lavas which cooled slowly near the surface under conditions of low pressure. The fresh exposures of this rock are light bluish-green in color, and are usually covered with the schistose dull gray or yellow slabs which arise from weathering or by masses of quartz and epidote which lie scattered over the surface after the rest of the material has been removed. The rock is generally known under the name of *Catoctin schist.* It is much better adapted for highway purposes than the acid volcanics, since it contains a much larger percentage of iron which acts as a cementing medium. It has been used to some extent for the construction of highways in the northern portion of the area near the Pennsylvania line, and could be employed to advantage more widely as a road-metal.

The Quartzitic and Granitic Rocks.

The quartzitic and granitic rocks consist of quartzites and granites, the former constituting the crests of the Catoctin, Blue Ridge, and

Elk Ridge mountains, while the latter is chiefly confined to the central and lower portions of the Middletown Valley, occupying the region between the Blue Ridge and Elk Ridge ranges.

The quartzite is generally a fine, pure sandstone mainly composed of quartz grains which are well worn and washed quite clean of argillaceous materials. At times it contains a small percentage of carbonate of lime and at other times grades over into the sandy shales which compose the other members of the Cambrian series. The quartzites have been subjected to but little metamorphism, as the quartz particles which compose the deposits do not afford materials which admit of much alteration. Slight schistosity is evident in the southern part of the Catoctin Mountain. The quartzite, although locally used for road-purposes, is poorly adapted to that purpose, as the rock, after it is broken down under constant wear, does not possess sufficient cementing power to make it a valuable road-metal. It withstands the natural wear fairly well, but its other qualities are poor.

The granite of this area is found cutting the volcanic rocks above-described, and occurs as a series of long, narrow belts varying in width from a yard to six miles. It comprises a considerable area between the Catoctin and Blue Ridge mountains along the line of Catoctin Creek. The granite shows only a moderate amount of mica and is frequently garnet- or epidote-bearing, the garnet-bearing type being well exposed along the Potomac a mile to two miles east of Harper's Ferry. Here, as in the rest of the area, the granite shows marked evidence of dynamic alteration. The feldspars have been deformed and altered, first along the cracks, and then finally entirely into lenticles of quartz, muscovite, and chlorite. This final stage appears to be like a siliceous slate or schist, and is barely distinguishable from the end-products of similar metamorphism in the sedimentary rocks. The granite is fairly well adapted for road-purposes, but is inferior to many of the better grades of the same rock found in the Piedmont belt.

THE CENTRAL AND WESTERN APPALACHIAN DISTRICT.

The rocks of the central and western portions of the Appalachian Region differ materially from those of the Blue Ridge area and are

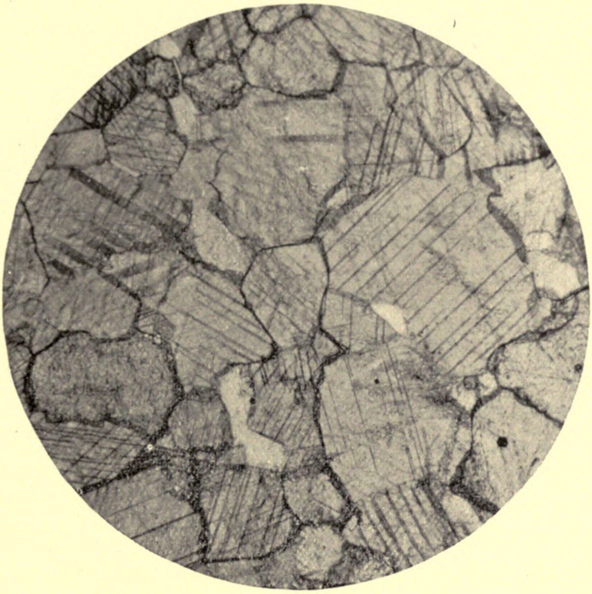

FIG. 1.—MARBLE, BALTIMORE COUNTY.

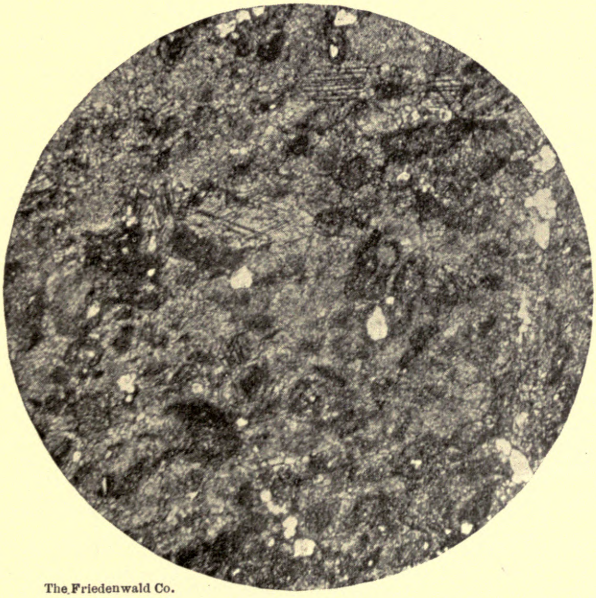

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FIG. 2.—LIMESTONE, WASHINGTON COUNTY.

PHOTOMICROGRAPHS OF ROCK SECTIONS.

confined exclusively to sedimentary rocks which, in general, have been but slightly changed from their original characters. They compose a series of alternating arenaceous, argillaceous, and calcareous deposits with interbedded seams of coal in the later formations. The rocks of this district may be divided into the limestones, the sandstones, and the shales, the first constituting the most valuable material for road-construction.

The Limestones.

The limestones are most prominently developed in the central portion of the Appalachian Region and form the floor of the Great Valley, extending as a broad belt from northeast to southwest from the Pennsylvania line to the Potomac river. The limestones are also found as narrower belts trending from northeast to southwest throughout both the district of the Alleghany Ridges and the Alleghany Plateau. These limestones are found at several different geological horizons from the Cambrian to the Carboniferous, and possess varying values for the purposes of highway-construction. The most important limestones are known as the Shenandoah, Niagara, Salina, Helderberg, and Greenbrier, although calcareous strata are found at several other horizons.

Shenandoah Limestone.—The Shenandoah formation forms the floor of a greater part of the Great Valley and is composed of a series of blue and gray limestones and dolomites in which locally sandy shales and slates are interbedded. At a few places in eastern and southeastern Washington county, beds of pure fine-grained white marble are also found. In general, however, the limestone deposits have been comparatively little altered, although the more shaly deposits show a more or less clearly defined schistosity. The decay of the limestone through solution has left an insoluble residuum of red clay through which protrude at times beds of the harder materials.

The Shenandoah limestone has been extensively used for road-building purposes through the Valley, and some of the best roads in the state are found in this locality. The less metamorphosed forms of this limestone possess most excellent cementing qualities, but, in general, its resistance to wear is poor. Some of the more compact and highly siliceous varieties of the limestone afford high-wearing tests, as indicated in the subsequent chapters of this volume. The more common characteristics of rapid wearing have produced in much-traveled roads a surface of dust that becomes often intolerable during dry and windy periods. On the whole, the Shenandoah limestone is to be highly commended for the Valley highways where the heaviest traffic is not present.

Niagara Limestone.—The Niagara limestone is repeated at several points in western Washington and Allegany counties, as the result of the denudation of the tops of the great anticlinal folds that are found in the Alleghany Ridges. Extensive occurrences of this rock are found along the Potomac to the west of Hancock and Cumberland and along the North Branch of that stream above the latter place. The rock consists of a compact blue limestone with interbedded shales. It has been used to some extent locally for highway purposes and affords good cementing qualities, although its wearing tests are not high.

Salina Limestone.—The Salina limestone is found throughout the same districts as the Niagara and is most accessible in the vicinity of Hancock and Cumberland. The rock is a magnesian limestone and has been extensively worked in the manufacture of cement products. It has been used to some extent as a road-metal and has the same advantages and disadvantages as the other Paleozoic limestones.

Helderberg Limestone.—The Helderberg limestone is also developed in the folds of the Alleghany Ridges between the Great Valley and the Alleghany Front, and like the Niagara and Salina, has been worked to some extent locally for highway-construction. It is a closely compacted blue limestone that presents the same general cementing and wearing qualities as the rocks above-mentioned.

Greenbrier Limestone.—The Greenbrier limestone is confined to western Allegany and Garrett counties, outcropping along the folds that extend across the state from northeast to southwest. The Greenbrier limestone, especially in the upper portion of the formation, is of compact structure and gray in color. Toward the base it is interbedded with shales. Its frequently arenaceous character gives it rather high-wearing test, and its cementing qualities are also good. It could be made an important source of road-material for the extreme western portion of the state, but has not been employed to any great extent.

Thin beds of limestone and calcareous shales are found scattered throughout many of the other formations, particularly in the middle and upper Devonian and Carboniferous formations, although seldom affording large deposits of limestone. They may be often made locally available for highway purposes.

The Sandstones.

The sandstones of the central and western portions of the Appalachian Region are found at several horizons and present very varied characters. Some of them have become so thoroughly changed from their original character as to become almost, if not quite, quartzitic, while others are still but slightly consolidated and have practically no value for highway-construction, as they rapidly break down into incoherent sand. The most important sandstones are in the Juniata, Tuscarora, Oriskany, Pocono, and Pottsville formations.

Juniata Sandstone.—The Juniata sandstone is limited exclusively in Maryland to an area in western Allegany county in the vicinity of Cumberland, and is best developed at the base of Wills Mountain. The highly ferruginous sandstones which compose this formation present, in their more indurated layers, materials that have some value for highway purposes, but of distinctly secondary value to the limestone of the same district.

Tuscarora Sandstone.—The Tuscarora sandstone upon the east enters into the formation of North Mountain, the most eastern ridge of the central Appalachians, and upon the west forms Wills Mountain, just to the west of Cumberland, and also occurs at several points in the intervening country. The rock is hard and massive, generally white or gray in color and consists for the most part of coarse quartz grains that have been so finely cemented as to produce a quartzitic aspect. Like the quartzites of the Piedmont Plateau and Blue Ridge districts, the Tuscarora sandstone has very good wearing qualities, but has little to recommend it from a cementing standpoint. It is used more or less locally upon the highways, but it is distinctly inferior to the better grades of limestone of the same area.

Oriskany Sandstone.—The Oriskany sandstone is confined, like the sandstone above described, to the central division of the Appalachian Region in western Washington and Allegany counties. It is typically a rather coarse-grained, somewhat friable rock, white or yellow in color. At times the coarser material passes over into a clearly defined conglomerate, while at other times, especially in the western portion of the area, the materials are fine-grained with here and there interstratified layers of coarser materials. The frequently soft nature of the rock, particularly in its surface exposures, renders it poor for highway purposes and it is not recommended.

Pocono Sandstone.—The Pocono sandstone occurs in a series of long, narrow belts which extend from northeast to southwest in western Allegany and Garrett counties. The deposit consists mainly of hard, thin-bedded, flaggy sandstones which are seldom coarse-grained, although in a few instances slightly conglomeratic. Locally the Pocono sandstone has been used to some extent as a road-metal.

Pottsville Conglomerate.—The Pottsville conglomerate, as the lowest member of the Coal Measures, forms the mountain ridges which border the coal basins. The Pottsville formation consists of beds of sandstone and conglomerates interstratified with sandy shales in which at times thin beds of coal are locally developed. The sandstones and conglomerates are mainly cemented by means of siliceous materials. These coarse materials are also frequently cross-bedded and are very irregular in both their extent and sequence. The Pottsville conglomerate and sandstones are used locally for road-purposes, and in their more indurated varieties have moderate wearing qualities, but, like most of the other sandstones, are low in cementing power.

The Shales.

The shales are found widely interstratified with the limestone and sandstone formations and also make up independently the greater portion of many of the other Paleozoic formations which have been described in earlier volumes of the Survey. The shales are poorly adapted for highway purposes, as their argillaceous character causes them readily to break down into clayey materials which, upon being wet, quickly change into soft mud, a character which indicates their origin. Where the underlying rock is loose shale it becomes necessary to construct the road of the harder sandstone or limestone, which have been already described. The shales are oftentimes locally employed on account of the ease with which they are worked, but possess no permanent value, since any highway to which they are applied becomes nearly impassable in wet weather.

THE COASTAL PLAIN.

The deposits of the Coastal Plain differ so widely from those which have been already described in the Piedmont Plateau and the Appalachian Region that we must look for the natural road-metals among materials of a very different character. In general, the deposits of the Coastal Plain are unconsolidated and possess but little natural cement in available form. Notable exceptions are found to this general rule in the more highly ferruginous sands and gravels and in the ledges of calcareous marls. These various deposits, on account of their local availability, may be advantageously used throughout certain sections of southern and eastern Maryland.

The Gravels.

The deposits of gravel are found at several geological horizons in southern and eastern Maryland, and have already been employed to some extent, particularly upon the roads leading to Washington. Far greater use can be made of these gravels than has been attempted thus far, as they possess very valuable wearing and cementing qualities when applied to highways upon which there is only moderate travel. The most important gravels are those of the Potomac, the Lafayette, and the Columbia.

Potomac Gravels.—The Potomac gravels, so-called, are found in the oldest of the geological formations of the Coastal Plain and outcrop along its western margin. They are generally arkosic and frequently ferruginous and thus compact readily when applied to the highways. Their distribution, however, is limited to small areas in Prince George's, Anne Arundel, Baltimore, Harford, and Cecil counties. Further exploitation of this material will undoubtedly result in its larger use in the areas named.

Lafayette Gravels.—The Lafayette gravels, which are of much more recent date than the Potomac gravels, are among the most important and widely extended road-building materials of southern and eastern Maryland, being found upon the high levels generally to the south and east of the Potomac deposits. The Lafayette gravels are more or less arkosic and generally highly ferruginous. They readily cement and wear well upon a highway where there is moderate travel. These gravels are especially well developed in Prince George's and Charles counties where considerable use has already been made of them upon the roads leading to Washington.

Columbia Gravels.—The Columbia gravels are of much more recent age than those which have been hitherto described and are found widely extended over southern Maryland and throughout the northern portion of the Eastern Shore. These gravels are frequently overlain to a depth of many feet by sands and loams so that they are not readily apparent, although their presence can be easily detected along the valley lines where the streams have cut through the overlying strata. The Columbia gravels are very variable in character, those of earlier date being better adapted for highway purposes than the later deposits. These older beds present, in their somewhat arkosic and highly ferruginous characters, a marked similarity to the Lafayette gravels and, like them, afford an unusually fine road-metal for highways where there is moderate travel. These materials around the head of Chesapeake Bay are very accessible to water transportation and will doubtless prove in the future of much value.

Gravels are found in some of the other formations of the Coastal Plain, but they lack the important cementing characteristics of those which have been described. Very widely extended gravels of late Columbia age are found over great areas in eastern and southern Maryland, but the absence of a ferruginous cement renders them of little value for highway purposes.

The Marls.

The marls of eastern and southern Maryland are found quite widely distributed in formations of Upper Cretaceous and Tertiary age and afford here and there deposits of sufficient moment to be of importance for highway purposes. The value of these marls is dependent upon the presence of the carbonate of lime which acts, as in the case of the limestones earlier described, as the cementing medium.

Cretaceous Marls.—The Cretaceous marls are confined exclusively to northern Kent and southern Cecil counties in the vicinity of the Sassafras river, but their availability for highway-construction is doubtful on account of the relatively low percentage of carbonate of lime which they contain. At some points they could doubtless be employed to advantage, in the absence of better materials.

Eocene Marls.—The Eocene marls extend across Maryland from northeast to southwest, occurring mainly in Kent, Anne Arundel, Prince George's, and Charles counties. Their most calcareous members are found in Prince George's and Charles counties, where hard ledges of indurated marl are frequently exposed along the valley lines. These hard limestone bands could be worked locally to advantage for highway purposes, but little attempt has been made to utilize them hitherto. They present all the essential characteristics of the limestones of western Maryland, although much less widely extended and, therefore, less available.

Neocene Marls.—Neocene marl is found in the district to the south of that of the Eocene marl and is mainly confined to Queen Anne's, Talbot, and Caroline counties of the Eastern Shore, and Calvert and St. Mary's of the Western Shore. Thick deposits of shell marl characterize several horizons in the Neocene, but the beds are seldom indurated, as is so often the case with the Eocene marls. Exceptions to this, however, occur in a portion of lower St. Mary's county, but more frequently the shells appear loosely compacted together and thus could be readily removed by pick and shovel and applied to the highways of the vicinity. This application of shell marl has taken place to some extent in the areas in which it occurs, but is far from universal.

The Sands and Clays.

The greater portion of the deposits of eastern and southern Maryland consists of interstratified sands and clays, which, like the soft sandstones and shales of western Maryland and the phyllites of the Piedmont Plateau, are poorly adapted for the purposes of highway-construction. These materials, which must have accumulated as sandy and muddy sediments upon the bed of the sea, require the application of the harder rocks if proper highways are to be constructed. On little-used roads a suitable mixture of sands and clays may oftentimes greatly benefit an exclusively sandy or clayey highway, but even such roads are of little value in the winter season, nor will they suffice for localities where much traffic exists. Too often in Maryland the highways, whether situated upon sand or clay or upon the surface portions of harder rocks which have become thoroughly weathered, are abandoned to these local materials and the resultant "dirt roads" become impassable for many months of the year.

MISCELLANEOUS MATERIALS.

Several sources of road-building materials are found outside of the geological formations which have been previously described. Among the more important that have found greater or less use in Maryland or elsewhere may be mentioned oyster-shells, furnace-slag, burnt clay and crude petroleum.

Oyster-Shells.—The vast quantities of oysters dredged and tonged annually in the Chesapeake Bay and its tributaries afford an almost inexhaustible supply of oyster-shells, many of which become available in the eastern and southern portions of the state for road-building purposes. They are very readily crushed by ordinary traffic when applied to the highways, and quickly become cemented to form a roadway of more than ordinary value. Such a highway is rapidly worn out, however, as the oyster-shells afford a low-wearing test and much less permanent roads result than those which are constructed of the higher grades of rock. It is doubtful whether it is not more economical in the end to import trap rocks or high-grade gravels into those sections of the state which to-day are exclusively employing oyster-shells. The wearing surface of the oyster-shell road becomes quickly ground to powder, which produces a disagreeably dusty surface and which requires the constant application of new shells to keep from rutting. There can be no doubt, however, that oyster-

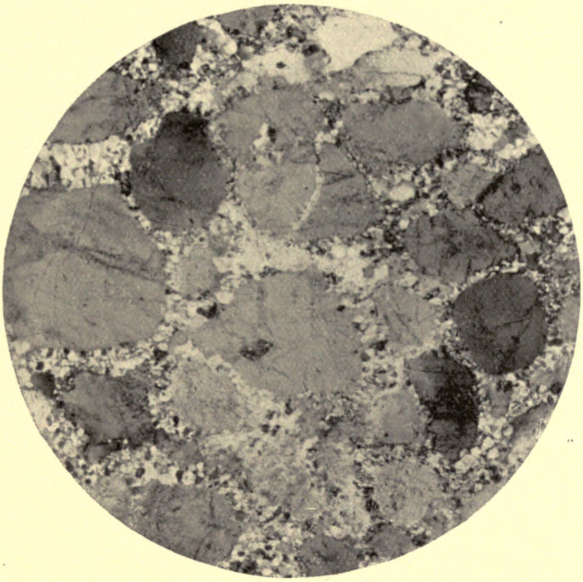
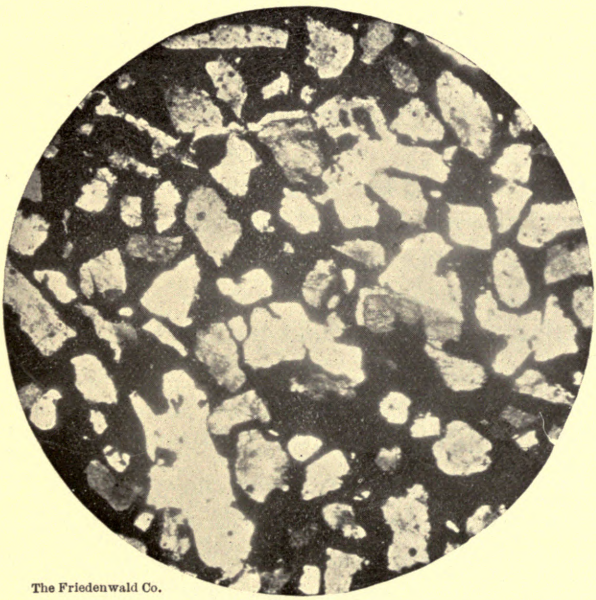


FIG. 1.—QUARTZITE, FREDERICK COUNTY.



The Friedenwald Co.

FIG. 2.—INDURATED GRAVEL, PRINCE GEORGE'S COUNTY.

PHOTOMICROGRAPHS OF ROCK SECTIONS.

shells afford a cheap road-building material for our lower counties where more expensive roads of permanent construction are not sought.

Furnace-Slag.—Furnace-slag has been found to be, under certain conditions, a highly satisfactory road-metal. It is not as valuable as the trap rocks, although its cementing qualities are excellent, except in the case of some of the materials from the old furnaces. These old slags break down quickly and are readily ground into fine dust and for these reasons are of little value in road-construction.

The slag from the present iron-furnaces, on account of the large amount of lime contained in it, is very valuable as a highway material. It compacts easily when rolled and forms an even, smooth surface; while the fine particles unite as a hard cement that grows firmer with time. The iron furnaces at Sparrow's Point afford material of this character that has already been demonstrated to be a valuable road-metal.

Burnt Clay.—Burnt clay has been employed as a road-metal in various portions of the West where no satisfactory rock is available. The clay is prepared, as described by Mr. Johnson in a later portion of this report, by burning at the sides of the highway, the hardened substance being broken into small fragments, and placed upon the road where it serves as a foundation. It is possible that this material might be found locally available in some of our Eastern Shore counties where natural road-metal is absent.

Crude Petroleum.—The attempt to use crude petroleum to keep the upper portions of the highways free from water and thus compact during wet weather has been pursued with some considerable success in other portions of the country, but no attempt has been made to introduce this method of highway improvement in Maryland. Maryland is so well provided with natural road-building materials, the utility and availability of which have been so thoroughly demonstrated, that it is doubtful whether the application of petroleum would prove as advantageous here as elsewhere. It would be interesting to experiment with this process and actually determine its utility on some of our Coastal Plain highways, however, before discarding it. It is possible that under certain conditions in some localities it might be found to be of value. This subject will be more fully discussed by Mr. Johnson on page 296.

Many other materials have, from time to time, been shown to be of value and have found use upon the public roads, but they can be considered of hardly sufficient general importance to be deserving of special consideration here, as few, if any, of them are of permanent value.

MANUFACTURED PRODUCTS.

It is hardly in place here to discuss the many manufactured products which are used on city streets or park highways where special conditions for highway-construction prevail. The plan of this report is rather to discuss the road-metals which may be made available upon the country highways and not those more expensive materials employed by our municipalities. The expensive pavements used in many of our cities and towns could not be made available for our country roads, and it is undesirable to go into the discussion of such pavement materials in the present report. Many of the Maryland road-building metals which have been above-described are admirably adapted as the basis of many of these manufactured products and are to-day being utilized for that purpose. This subject will be discussed in a report dealing with the materials of city streets, which it is the intention of the Highway Division of the Survey to prepare at an early day.

PART III

HIGHWAY LEGISLATION IN MARYLAND AND ITS INFLUENCE ON THE ECONOMIC DEVELOPMENT OF THE STATE

BY

ST. GEORGE LEAKIN SIOUSSAT

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THE BEGINNINGS OF HIGHWAYS IN MARYLAND.

"Rivers," said the philosopher Pascal, "are roads that move, and carry us whither we wish to go." "Yes," was the comment of another, "provided we wish to go whither they carry us."

A comparison of Augustine Herrman's map of Maryland with one of the present day will make evident the applicability of Pascal's saying, and the equal applicability of its subsequent modification, to the history of the development of highways in Maryland. Nowadays, the state appears dotted from border to border with cities, towns, and villages, bound together by a network of roads, great and small, that are the channels of intercourse of an advanced and prosperous commonwealth. The Maryland of Herrman's time was a fringe of scattered settlements, strung along the bayside and along the banks of the navigable rivers, with not a trace of connecting highways.

Transportation by Water.

The main highway of early Maryland was the Chesapeake, which is, says a chronicler of that time, "a bay in most respects scarcely to be outdone by the universe, having so many large and spacious rivers branching and running on both sides . . . . and each of these rivers richly supplied, and divided into sundry smaller rivers, spreading themselves out to innumerable creeks and coves, admirably carved and contrived by the omnipotent hand of our wise Creator, for the advantage and conveniency of its inhabitants, so that I have oft, with no small admiration, compared the many rivers, creeks and rivulets of water to veins in human bodies." [1]

With ready appreciation of the "advantage and conveniency" of these "roads that move," the early Marylanders traveled from landing to landing and from shore to shore in sloops and pinnaces, imitating the customs of the native Indians, "whose buildings and habitations," Captain John Smith had noted, were "for the most part by the rivers, or not far from some fresh spring." [2]

Instead of mileage, compensation for boat-hire was allowed to the delegates to the Assembly from Kent and Anne Arundel.[3] Indeed, travel to any considerable distance seems to have been exclusively by water; and for the first few years after the settlement at St. Mary's the word "road" must have had but limited significance in the colonial vocabulary.[4]

The earliest "roads" were mere paths from plantations to river landings, or from the settlements scattered along the rivers adjacent to the little capital at St. Mary's. When the colonies pushed further inland, and the streams no longer carried them whither they wished to go, more extensive highways became necessary. As yet, however, the construction and repair of roads was a matter of private concern; over a quarter of a century elapsed between the settlement at St. Mary's and the passage of the first road-law of the colony.

Early Ferries.

In the meanwhile, the influence of the topography of the country upon the progress of the colony is evidenced by the regulations con-

[1] Rev. Francis Makemy. A Plain and Friendly Persuasive. London, 1705, p. 5. (See Fiske's Old Va., vol. ii, p. 206.)

[2] Pinkerton's Voyages, vol. xiii, p. 35.

[3] Maryland Archives, vol. i, Assembly Proceedings, pp. 143 and 284.

[4] What is probably the earliest mention of a road in Maryland bears date March, 1643, when Father Philip Fisher, one of the Jesuit Missionaries, writes to his Provincial, or Superior, as follows: "A road by land through the forest has just been opened from Maryland to Virginia. This will make it but a two days' journey, and both countries can be united in one mission." [Neill, Maryland in the Beginning, p. 49.] This is, of course, described too indefinitely to be identified or located at the present day, but the reference is interesting as showing the early intercourse between the sister colonies.

cerning ferries. When a line of communication crossed a river or stream a ferry was often necessary and legislation upon this subject preceded that concerning highways or bridges. As early as the session of the Assembly that met at St. Mary's in 1637-8, a number of absentees were excused from the fine for non-attendance "for want of passage over St. George's [St. Mary's] River," a want that was supplied by the establishment of a ferry at the next Assembly.[1] As the settlements spread, other ferries were established; and in 1658 a general law was passed requiring each county to maintain at least one ferry.[2]

Contemporary Highway Legislation.

When the colonial settlements had expanded to such a degree that management of the highways could no longer be left in private hands there were two sources, at least, upon which the lawmakers might draw for effective road-legislation. These were the law of the neighboring colony of Virginia and the law of England.

The first road-law of Virginia left the regulation of highways to the discretion of the Governor and Council, or the Commissioners of the Monthly Courts, or the parishioners of each parish.[3] This was supplemented twenty-five years later by an act giving the jurisdiction over the roads to the county courts, with the provision that "the course used in England" should be followed.[4] The English law was itself at this time in a primitive state. In feudal times care of the roads was included in the tenant's *trinoda necessitas*, or three-fold service: the duty of making an expedition against the enemy; the construction of fortifications; the repair of bridges (and roads). By the growth of custom the care of the highways devolved upon the respective parishes, while the repair of bridges was referred to the county at large. In early times it was not incumbent on any particular officer to call the parish together and set upon them this work; therefore, later surveyors of the highways for each parish were ordered to be chosen by the constable and church wardens of that parish.[5]

[1] Maryland Archives, Assembly Proceedings, vol. i, p. 78.
[2] Maryland Archives, Assembly Proceedings, vol. i, pp. 375-6.
[3] Hening's Statutes, vol. i, p. 199 (1632).
[4] Hening's Statutes, vol. i, p. 436 (1657-8).
[5] Blackstone's Commentaries, p. 358.

THE FIRST ROAD-LAW OF MARYLAND.

The first road-law of Maryland was passed in 1666; it was entitled "An act for making high wayes & making the heads of Rivers, Creekes, Branches and Swamps passable for horse and foote."[1] This act ordered that the commissioners of each county should "upon the 20th day of October next ensuing meete together in their Respective Countyes to consult of what high wayes are fitt to be made." They were also to appoint overseers of the roads and to levy tobacco or labor to be assessed equally upon the taxables of each county. Fines were provided for the non-performance of these duties either by the overseers or by the laborers whom they summoned.

The act of 1666 continued in force, with but slight modifications, till 1696. However, the "highwaies or necessary Paths" for which it made provision were little more than tracks through the forest; and the enactors had in view the direction of travelers rather than the construction of roads. Transportation by wagons was as yet unknown. Thus the road-overseer had little to do but cut away the underbrush, fell obstructing trees, and drain the worst of the marshes so that the horse or mule laden with panniers full of tobacco would not stick fast in the low and swampy ground.

A local road-act "for amending the wayes out of Charles County into the City of St. Mary's," passed eight years after the general law of 1666, testifies to the primitive life the colonists then were leading.[2] The passage over the head of "Wiccocomico River" had become hardly passable since the building of the mill there, and the overflowing of the stream. The way was therefore dangerous for passengers and its condition even imperiled the security of the Province against an insurrection of the Indians "who live in great Numbers in that Country." Charles and St. Mary's counties were equally assessed for the construction of a highway "passable for horse and foote over such place of Zachiah Swampe within Two miles of the said Mill upward as shall seme most convenient" to their Justices. The road thus provided for became one of the most important in

[1] Maryland Archives, vol. ii. Assembly Proceedings, p. 134.
[2] Maryland Archives, vol. ii. Assembly Proceedings, p. 408 (1674).

southern Maryland; it is probably to be identified with the present road from Leonardtown through Allen's Fresh and Chaptico to Port Tobacco.

Hardships of Travel.

Concerning the actual state of the highways during this period but little information is to be found. Enough remains, however, to convince one of the hardships of traveling in these early times. Some idea of the difficulties due to the lack of roads may be gathered from the journal of a voyage made by Augustine Herrman, the author of an important map of Maryland. In 1659, Peter Stuyvesant, the Director-General of the New Netherlands, sent Herrman and Resolved (or Roosevelt) Waldron as Commissioners to Governor Fendall of Maryland to confer concerning an alleged attack upon Dutch possessions by Colonel Utie of Maryland. Herrman and Waldron left New Amstel, now Newcastle, in Delaware on September 30, and walked through the woods, part of the way without a path, to the river Elk. Here they embarked in a boat procured from the Indians, and, after rowing nearly all night, arrived on October 2 near Sassafras. Thence they rowed to Kent Island, where they abandoned their first boat, which now leaked wretchedly, and secured another from a Captain Wike or Wickes, one of the magistrates of the island. After a fine run to Billingsly Plantation, "at the cleft" or cliffs [of Patuxent], on October 6 they arrived at Colonel Coortsey's house upon the Patuxent, and on the following day they went nine miles by land to Secretary P. Calvert's.[1]

Even the establishment of a general road-law seems to have given little or no relief. Six years after the passage of the act of 1666, the celebrated Quaker, George Fox, describes his progress from the Eastern Shore of Maryland to the North as "a tedious journey through the woods and wilderness, over bogs and great rivers." "We took horse," he writes, "at the head of Tredaven Creek, and traveled through the woods, till we came a little above the head of Miles River, by which we passed, and rode to the head of Wye River; and so to the head of Chester River; where making a fire, we took up our lodgings

[1] Hazard. Annals of Pennsylvania, pp. 287, 290 (Philadelphia, 1850).

in the woods. Next morning we traveled through the woods till we came to Saxifrax River, which we went over in Canoes (or Indian boats,) causing our horses to swim by. Then we rode to Bohemia River: where in like manner swimming our horses, we ourselves went over in Canoes. We rested a little while at a plantation by the way, but not long, for we had thirty miles to ride that afternoon, if we would reach a town; which we were desirous to do, and therefore rode hard for it. . . . The town we went to was a Dutch town, called Newcastle."[1]

The slowness with which changes in the methods of transportation were brought about may be illustrated from the fate of a petition made by some of the inhabitants of St. Mary's county to the General Assembly of the Province, upon the occasion of the removal of the capital from St. Mary's City to Annapolis. The fifteenth article of this petition set forth that "the petitioners suspected the chief dislike of the location of the capital at St. Mary's to be on account of the inconvenience of its situation, because the gentlemen, the members of the house, have been forced to their great trouble oftentimes to travel on foot from Patuxent to St. Mary's and so back again." To remove all cause for such an objection, the inhabitants of St. Mary's bound themselves to procure "a coach or caravan or both to go in all times of public meetings of Assemblies and provincial Courts, etc. every day daily between St. Mary's and Patuxent River and at all other times once a week."[2] This magnanimous proposal did not meet with the respect it deserved, for the House rather rudely observed that "The petitioners offer fair as they have done formerly, but never yet performed any, and this House believes that the Gen'l Welfare of the Province ought to take place of that Sugar Plum and of all the Mayor's Coaches, *who as yet never had one!*"[3]

The County Courts and the Roads.

To the County Courts, or Commissioners—for the terms were interchangeable—were intrusted the construction and maintenance of the

[1] Journal of George Fox, vol. ii, pp. 108-9.
[2] Upper House Journal, 1694, p. 768.
[3] Upper House Journal, 1694, p. 772.

highways. The records of the proceedings of these bodies contain a great deal of interesting information in regard to the development of the roads, but this information is unfortunately neither so complete nor so uniform as might be wished. The records of some of the counties have been destroyed by fire; many others, though extant, are seriously damaged through carelessness; or the worthy scribes themselves, in many cases, have taken but small pains to detail their proceedings upon road-matters. But the most serious difficulty for the historical student results from the practice of recording and mentioning roads by the names of the *persons* near whose lands they passed, instead of the names of the *points* or *places* through which the road ran. The reason for this is obvious; highways could not be described as running from town to town at a time when, with very few exceptions, there were no towns.

ST. MARY'S AND CALVERT COUNTY RECORDS.

Direct sources for the early history of highways in St. Mary's and Calvert counties are no longer obtainable, because the court records of these counties have been burned. Some information may be gained from the proceedings of the Assembly, which now and then busied itself with matters of local importance, providing, as was shown above,[1] for the construction of a main road from Charles county to the capital. It is probable, moreover, that the methods of highway administration here were identical with those of Charles county, of which the records have fortunately been preserved.

CHARLES COUNTY RECORDS.

The records of the County Court of Charles county now rest securely in the Record Office at Annapolis. From these records it appears that in 1666 "each respective Constable of Charles Countie" was by warrant ordered "to appoint good, able and sufficient men overseers of y^{e} works to be performed by virtue of y^{e} said Act (1666) and also to hire procure and provide for them sufficient Labourers and Labouring tools and other necessaries for y^{e} performance of y^{e} works

[1] P. 112.

intended in y^e said Act." The overseers thus appointed were ordered to "repaire to the next commissioner inhabiting nearest to you for such orders and directions to be given you as shall be needful for y^e discharge of your duties herein. Whereof faile not as you will answer &c." [1]

This certainly seems a good beginning. Unfortunately, however, no more entries are to be found for the space of twenty-four years.[2] The work went on during this time, no doubt, and overseers were annually appointed, but the clerks neglected to keep a detailed record of road affairs.

BALTIMORE COUNTY RECORDS.

In the records of the Baltimore County Court the earliest entry of interest, which bears the date March 6, 1682, recites that the jurors for Baltimore county "do present the overseers of the highways of Gunpowder Hundred and the overseers of the highways of Patapsco for not making the highways passable for man or horse." The overseers of Spesutie Hundred, farther north, were also presented.[3] These drastic measures seem to have been efficient, for at June Court the delinquent overseers were excused "by Reason of there Amend^mt of y^e sd Highways." [4] Several other orders in reference to roads in particular localities were given at different times by the Court.

The regulations concerning ferries, the management of which, like that of the roads, was in the hands of the County Commissioners, are often serviceable in determining the principal courses of travel. At November Court, 1683, for example, provision was made for ferries over the Patapsco, Gunpowder, and Bush rivers;[5] this and subsequent entries make it certain that by 1685 there was a continuous road or roads laid out from the Patapsco to the Susquehanna.[6] Not more than five years later, the Court ordered that these roads should be

[1] Charles County Court Proceedings, Liber C, pp. 84-86.

[2] Some orders are indexed for the year 1684, but this volume is missing.

[3] Balto. Co. Court Proceedings, Lib. D, p. 103.

[4] Balto. Co. Court Proceedings, 1683, June. These are preserved without much arrangement, in the Record Office, in Baltimore.

[5] Balto. Co. Court Proceedings, Lib. D, 103.

[6] Across the Susquehanna, in Cecil County, was Susquehannah Manor, granted to George Talbot, in 1680. This region was as yet thinly settled.

made passable for carts. In 1692 the usual procedure was varied by an order "that from henceforward the persons above-mentioned their Ma^{ties} justices Doe grant out their warrants and appoint what overseers they think good for clearing the highways in their respective hundreds, as they shall think fitt." Two years later the overseers were ordered to take with them "Every tythable in their hundred for the making of good highways thirty foote wide, not leaveing Loggs, Brush or Roots, appearing above ground, or young Saplings in the said Roades."[1] "Good and sufficient bridges for man and horse to pass over" were also to be constructed.

After these praiseworthy beginnings the energy of the Baltimore County Commissioners seems to have suffered a relapse, since very few entries are to be found for a considerable time. Two noteworthy items there are, however; one under 1695 gives directions to clear the road from the Courthouse to the Great and Little Falls of Gunpowder;[2] the other, in 1711, orders the construction of a "very fair and spatious Road directly leading out of the Main Road to this town of Joppa."[3]

THE HERRMANS AND THE ROADS OF CECIL COUNTY.

The beginnings of highway-construction on the Eastern Shore, at least in the northern part of it, seem to have been the care of a single family. Augustine Herrman, to whom reference has already been made, received in 1662 the grant of Bohemia Manor from Cecilius, Lord Baltimore.[4] The location that Herrman chose for his plantation was an additional proof of his intelligence. Bohemia Manor, bounded on the west by the Elk river, and St. Augustine Manor, a later grant, bounded on the east by the Delaware river, together spanned the Eastern Shore peninsula at about its narrowest point, and the idea of connecting the navigable waters on the west and east by a road had occurred to Herrman even before he received his grant.[5] In 1671 the authorities at New York ordered their deputies at New

[1] Balto. Co. Court Proceedings, 1694, Nov. Ct.
[2] Balto. Co. Court Proceedings, 1695.
[3] Balto. Co. Court Proceedings, 1711.
[4] Johnston. History of Cecil County, p. 38.
[5] Hazard. Annals of Pennsylvania, p. 321.

Castle to clear one-half of a road from that place to Herrman's plantation, the Marylanders having offered to clear the other half.[1] Another road, constructed about this time, connected Herrman's plantation with that of his sons on the Delaware.[2]

The settlements in this part of the Province increased rapidly, and in 1674 the lands lying between the Susquehanna and the Chester rivers, which had been hitherto a part of Baltimore county, were erected into a new county under the name of Cecil.[3] The Cecil County Court took up the work of the Herrmans and devoted much attention to the making of roads. An interesting example of these old Cecil roads is that known as the "Old Choptank Road," which formed the dividing line between Bohemia and St. Augustine Manors. "It was originally," says Johnston, "an Indian path that led from the Choptank river along the dividing ridge between the two bays, probably far up into Pennsylvania, but was laid out and cleared from the head of St. George's creek to the Chester river, twelve feet wide, for a cartroad, in 1682, by Casparus Hermen and Hugh McGregory, who were appointed for the purpose by the Court." By 1714 it had fallen into disuse.[4]

An Early Mail-Route.

Perhaps because of the greater density of population on the upper Eastern Shore at this time, and the existence of better roads, the route down the Eastern Shore peninsula became the favorite line of travel from Philadelphia southward, and when, under the general stimulation that followed the removal of the capital from St. Mary's to Annapolis, the Assembly established a public post, the peninsula route was selected.

Previously ordinary letters relating to public affairs had been for-

[1] Johnston. History of Cecil County, p. 76.

[2] Johnston. History of Cecil County, pp. 78-9.

[3] McMahon. History of Maryland, p. 92.

[4] Johnston. History of Cecil County, p. 187. A strip of land five or six miles wide across this peninsula at its narrowest point might well be selected to represent the steps in the development of methods of transportation: Indian trail, cartroad, stage-route, turnpike, canal and railroad.

warded from house to house.[1] Upon occasions of unusual importance communication with the neighboring provinces was carried on by means of "expresses," or mounted postmen. A great advance upon the earlier methods was made by the establishment in 1695 of a regular post. It was ordered that the route "begin at Newton's Point upon Wicomico River in Potomack and so to proceed on to Allen's Mill, from Allen's Mill to Benedict Leonard Town, from Benedict Leonard Town over Patuxent to Mr. George Lingan's, from Mr. Lingan's to Mr. Larkin's and so to South River and Annapolis. From thence to Kent and so to William Stadt[2] and from thence to Daniel Toas's[4] and so on to Adam Petersen's and from thence to New Castle and so directly to Philadelphia."

A "sallary" of fifty dollars was allowed Mr. John Perry, "the post," for carrying "all public messages and Paquettes eight times a year betwixt Potomack and Philadelphia."[5]

On special occasions Mr. Perry seems to have acted as "express" to points not included in his usual route. He survived his appointment only three years; whether his disease resulted from the exposure to which his duties subjected him is not known, but after his death the system seems to have been abandoned by the Maryland Legislature.[6] It is probable that the Pennsylvania authorities maintained a similar post-route for some time.[7]

The Law of 1704 and its Supplements.

The year 1696 saw the enactment of a new road-law entitled "An Act for the better clearing of the Roads, and directing all Travellers through the Province."[8] This was the first important advance upon the early law of 1666, which had been reënacted from time to time,

[1] Assembly Proceedings, vol. i, p. 415, April-May, 1661. (See also subsequent laws.)

[2] Probably not far from Mount Pleasant.

[3] Oxford.

[4] On Chester river.

[5] Upper House Journal, May 14, 1695, p. 809.

[6] McMahon, History of Maryland, p. 266.

[7] See Watson's Annals of Philadelphia, vol. ii, p. 391; vol. iii, p. 47 (Philadelphia, 1890).

[8] Bacon's Laws of Maryland, 1696, chap. xxiii.

with but little amendment. The text of the act of 1696 is not to be found in the Journals of Assembly nor in Bacon's *Laws of Maryland;* but lengthy quotations from it, transcribed in the records of Charles County Court, indicate that its provisions were practically the same as those of an act passed eight years later, in 1704,[1] bearing the same title as the law of 1666.

The act of 1704, the text of which has been preserved, constituted, with a few amendments, the road-law of the Province of Maryland for the next half century. By its provisions all public and main roads were to be hereafter cleared and well-grubbed, fit for traveling, twenty-foot wide; and good and substantial bridges made where such were necessary, at the discretion of the County Courts. Once a year the latter were to "ascertain[2] and set down" in their records what were the public roads of their respective counties and to appoint overseers of the same. Any person altering or changing such public roads without the leave of the Governor and Council, or the County Justices, was to be fined 500 lbs. of tobacco. The same fine was provided in case any overseer so appointed should neglect to clear the roads under his charge. Every laborer who refused to serve the overseer and every master of servants, who, upon summons from the overseer, refused to send all his taxable male servants to assist the overseer, was to be fined; every laborer 100 pounds of tobacco, and the master 100 pounds for every servant named and not sent. The clerk of the county was ordered to issue to the overseers appointed, warrants which should be delivered to them by the sheriffs of their respective counties. If clerk or sheriff was delinquent in this respect he was mulcted 1000 pounds of tobacco.

That highways were still in a rudimentary state, and that it must have been easy to lose one's way, appears from the fifth section of this act, which is so curious that it had best be quoted exactly.

"V. And that all the Roads that lead to any Ferries, Court-house of any County, or to any Church, or leading through any County to the port of *Annapolis*, shall be marked on both Sides the Road with Two Notches; if the Road lead to *Annapolis*, the Road that leads there, at the leaving the other Road, shall be marked on the Face of the Tree, in a smooth Place cut for

[1] Bacon's Laws of Maryland, 1704, chap. xxi.

[2] Establish with certainty.

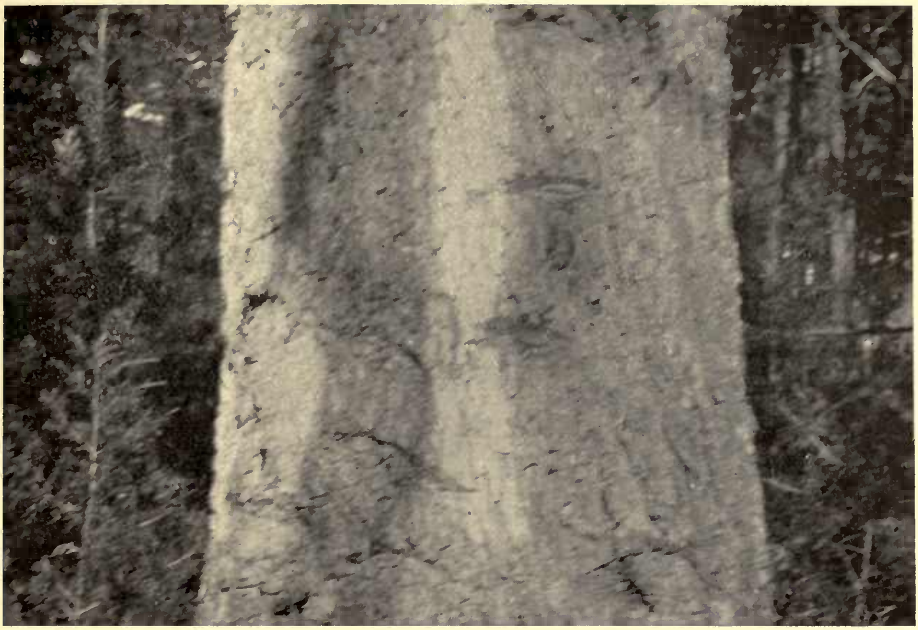


FIG. 1.—VIEW OF NOTCHES ON TREE.

The Friedenwald Co.

FIG. 2.—VIEW OF ROAD WITH NOTCHED TREE.

THREE-NOTCH ROAD IN ST. MARY'S COUNTY.

that Purpose, with the letters A A set on with a Pair of Marking-Irons, and coloured; and so with Two Notches all along the Road; and where at any Place it leaves any other Road shall be again distinguished with the Mark aforesaid, on the Face of the Tree, with a Pair of Marking-Irons, and coloured as aforesaid. And any Road on the Eastern Shore, in Talbot County, that leads to the Port of William-Stadt [Oxford] at the entering of the same, and on parting with or dividing from any other Road, shall be marked on the face of a Tree, in a smooth Place cut for that purpose, with the letter W, and so with Two Notches all along the Road. And the Roads that lead to any County Court-house, shall have Two Notches on the Trees on both Sides of the Road as aforesaid, and another Notch a Distance above the other. And any Road that leads to a Church, shall be marked at the Entrance into the same, and at the leaving any other Road, with a Slip cut down the Face of the Tree, near the ground. And any Road leading to a Ferry, and dividing from other public Roads, shall be marked with Three Notches of equal Distance at the Entrance into the same. And these Rules and Methods, the several Justices of the County Courts, shall, from Time to Time, give in Charge to the Overseers of the Highways, by them to be appointed for that purpose; who are likewise enjoined carefully and strictly to observe and perform the same, under the Penalty aforesaid."

Survivals of this manner of directing travelers appear in the various "Notch Roads" still to be found in some counties of the state. Along at least one of these, the "Three Notch Road" in southern Maryland, notches, some of a remote date, may still be discerned in the bark of many of the oldest oaks as shown in Plate XII.

A considerable advance in methods of construction is indicated by the detailed provisions as to the width and the "grubbing" of the roads and the erection of bridges.[1] The use of carts for freight transportation by land was becoming more general in the thickly settled parts of the Province, although travelers still journeyed almost exclusively upon horseback.

Although the provisions of the act of 1704 are more detailed than those of the law of 1666, the general principle of procedure was not materially altered; overseers were still appointed by the County Courts. One important difference, however, was that while the

[1] The overseers of the highways were frequently hindered in repairing bridges by the refusal of the owners of the adjacent lands to permit them to cut trees for that purpose. Therefore, in 1724, the overseers were authorized, by a law [chap. xiv], supplementary to that of 1704, to make use of any trees, except those fit for clapboards or cooper's timber, for building or repairing any bridge maintained at a public or county expense; *i. e.*, for which appropriations were made distinct from those for highways.

earlier act authorized the County Court to levy tobacco or labor to be assessed equally upon the taxables of each county, the later law imposed a *fine* for non-attendance when summoned by an overseer to work upon the highways. The recovery of these fines proved vexatious. Hence in 1723[1] the prosecution of such fines in the County Court was stopped and the determination of the penalty left to any one justice who must keep a list of such determinations and return the same every year to the Court, to be levied on execution by the sheriff, if unpaid.

THE ROADS "ASCERTAINED."

Another important innovation of the act of 1704 was the requirement that the justices should once a year "ascertain and set down" in their records the public roads of their respective counties. Occasionally, when the County Clerk was not too much occupied, this order was obeyed, but such entries are few and scattered. In view of the rarity and local interest of these "ascertainments" of roads, the following have been transcribed:

CHARLES COUNTY.

"The Publick Roads of Charles County Nominated (September 14th, 1697)."

"From Newton's Point to Pyskyawaxon to William Marshall's and from thence to William Thompson's and soe to ye head of Port Tobacco Creek; thence to Nangemy Mill, and from ye said Mill to Mr. Randolph Hinson's and so round to Mattawoman, and from thence to ye head of Port Tobacco Creeke again, and thence to ye Court-house of this County, and from ye aforsd William Marshall's to ye Mill at ye head of Wicomico River, and so over ye head of ye said River down to Budd's Creek and from ye Mill at ye head of Wicomico River aforesaid up to ye Court-house of this County, and from ye Court-house ye road that goeth to Piscattaway to ye uttmost bounds of the County and out of ye said Roade about three miles above ye Court-house a new Roade to be Cleared betweene Henry Dreydens Quarter & Richard Brightwells Quarter to goe to Annapolis to ye bounds of Prince George County, and from ye Court-house ye Roade to ye bridges over Zachyah Swamp, and from thence to Widdow Walters, and from thence to Benedict Leonard Town, and from thence up to James Bigger's and from Budd's Creek to ye bridges over Piles his fresh branch and from thence up to Major Boaremans Quarter and soe to ye utmost bounds of ye County towards Annapolis that way."

[1] Bacon's Laws of Maryland, 1723, chap. xvii.

CECIL COUNTY.

"The Court ascertains all ye publique Roads of this Coty Vizt.

Nov. ye 16, 1710.

"From ye Cort house to ye ferry of Bohemia ye one leading directly to Franklins point ye other by ye way of ye white Marsh, & soe to Broxsons by ye way of Mr. Norris's Mill & another leading by ye way of John Runnington's to ye head of Bohemia, another from ye Cort house to ye head of Sassafras, Another from Wm. Davis's to ye Cross Paths nigh ye head of Bohemia, another from sd Crosspaths to Vanbebbers Mill & from thence to Jno Chicks & from thence to Smith's Mill & from thence to Susquehannah ferry, from thence to Turkey point to Smith's Mill, from Turkey Cock hill to the head of North East River from ye North side of Bohemia ferry to John Chicks from ye Maine Road where it strikes of upon ye Manner Road to ye head of Back Creek, above where Hanse Marens formerly lived & from thence the highest way to Smith's Mill ye road from ye northside of Bohemia ferry to Elk Ferry, and from ye northside of Elk ferry to ye head of North East River."

ANNE ARUNDEL COUNTY.

August Court, 1734.

"The following Roads are Deemed and ascertained by the Justices of this Court to be publick Roads (Viz), from Annapolis over Severn Bridge to Patapsco Ferry from Annapolis to Huntington, from Annapolis to Elk Ridge from Annapolis round the head of South River From Appapolis to South River ferry from Severn Bridge to Bells Mill from Elk Ridge Road to Indian Landing From Bells Mill to South River Ferry from South River Ferry to Queen Annes Ferry from South River Ferry to the Bay Side Road that leads to fishing Creek and from South River Ferry the Road that leads through the Mannour from Severn Ferry to Long Bridge by the Chappel to the Mountain, from Severn Ferry round the head thereof from Patapsco Falls to Rowle's from Deep Run to Patapsco ferry from London Town to Pigg point Ferry from London Town to Lyons Creek from the head of Road River Hundd to Queen Annes Ferry from Henry Ridgeley's to the landing at Patapsco at the Mill thereof from William Ridgeley's to the said Landing at the head of Patapsco from Catlins old fields to Carrolls Mannour From Catlins Old Fields to the Locust Thicket."

The Ferries are ascertained as follows:

"South River from Crown Point to the usual landing at London Town. from Hughes Landing to Moals & Giles Points. Patapsco. Pigg Point."

Early "Rolling Roads."

Two years after the removal of the capital to Annapolis the Assembly, as a part of their scheme for developing Annapolis into a thriving port, ordered the construction of four "rolling roads" for the transportation of tobacco in cask into the town. Provision for some of these "rolling roads" was made by nearly every County Court. "In order to pass the tobacco hogsheads safely over the 'rolling roads' it was necessary that they should be made and hooped in the strongest manner; the tobacco after being dried and stripped from the stems was packed tightly in the hogsheads and 'headed' up; these were then rolled over and over by two men to each hogshead, to the place of shipment. The 'rolling roads' were generally of a roundabout description, from the necessity of avoiding hills, and though long out of use, could be distinctly traced on Elkridge, after 1820. Several roads of this description are still distinguishable in Harford County."[1] Later, these casks were fitted with shafts and hauled by oxen.

Exemptions from Highway Service.

An interesting feature of the road-law of the Province lay in the provisions concerning exemption from labor upon the roads. To encourage the manufacture of iron, the Assembly in 1732[2] ordered that no white man or slave, employed about any iron work (unless he was also employed in raising tobacco), should be obliged to work upon the roads or bridges. This privilege was abused; so in 1736[3] exemption from labor on the roads was restricted to those constantly employed in iron-works. The law was later amended, in 1750,[4] by requiring the owners of iron-works to send for road-work one out of every ten laborers they employed. Later, owners of water-mills were obliged to see to the repairs of the roads that crossed their property, but were exempt from other work upon the roads. On the other hand, overseers of the highways were excused from jury service while in pursuit of their official duties.[5]

Note.—The preceding extracts and references include all the legislation concerning highways enacted during the seventeenth and the first half of

[1] Tyson, M. E. A Brief Account of the Settlement of Ellicott's Mills, p. 25 (Baltimore, 1865).

[2] Bacon's Laws of Maryland, 1732, chap. xvii. This work includes the laws passed prior to 1764.

[3] 1736, chap. xvii.

[4] 1750, chap. xiv.

[5] 1715, chap. xxxvii.

the eighteenth centuries, with the exception of occasional laws such as that of 1750 (chap. xv), to empower the Justices of Prince George's County Court, "to treat and agree with an undertaker or undertakers, to stop a breach now made, across the main road in Queen Anne Town." The use in this case of the word "undertaker" in the sense of "contractor" is interesting.

COMMERCIAL GROWTH AND THE "WESTWARD MOVEMENT."

MARYLAND TOWNED AND "UNTOWNED."

The "ascertainments" of the seventeenth century in the Maryland County Court records impress one with the decidedly local character of the roads of that period, and the absence of the extensive highways of later times. A similar contrast with present conditions is to be seen in the dispersion of the colonial population and the non-existence of the many towns that are now to be found throughout the state. Both these contrasts, it will appear, have the same explanation.

The colonists early felt the lack of some depots, or centers of commerce, and endeavored to supply them. A description of Maryland written in the year 1670-1 states that—

"The Inhabitants (being in number at present about 16000) have begun the building of several *Townes*, which in a few yeares 'tis hoped may come to some perfection; as *Calverton*, *Herrington* and *Harvy-Town*, all Commodiously seated for the benefit of *Trade* and Conveniency of *Shipping;* but the principal Town is *St. Maryes*, seated on *St. George's* River, being beautified with divers well-built *Houses*, and is the chief place or seate of *Trade* for the *Province*."[1]

Soon the Legislature took up the idea, and within a few decades after 1683 ordered the erection of over one hundred "towns," all upon tidewater.[2] Within a quarter of a century, however, most of them had disappeared; some, indeed, had never actually existed; some

[1] Blome, R. "A description of the Island of Jamaica; with other Isles and Territories in America, to which the English are related." London, 1672, p. 165.

[2] Bacon's Laws, 1683, chap. v.

died a lingering death; some were "untowned," as a subsequent act expressed it, by the Assembly. That these *fiat* towns should fail was inevitable. "The innumerable rivers and creeks," says Dr. Wilhelm, "that ramify the state like the arterial system of the body caused the canoe and the pinnace to supersede the cart and the carriage, and prevented the growth of the cross-road settlements as in the other colonies, and forced the planters to do their merchandising at the tide-water settlements."[1] Not until the colonists had sought new lands away from the waterside could roads take the place of rivers, and, concentrating at points of vantage, foster in a natural growth the towns which refused to spring into life at the bidding of the Legislature.

The Westward Movement.

During the royal government of the province "immigration, the principal cause of the rapid increase in population of the colony during the preceding era, had in a great degree ceased."[2] In the second quarter of the eighteenth century settlement commenced anew.

Just as in 1730 the settlements in Pennsylvania had pushed beyond Lancaster, so, too, in Maryland the "westward movement" had begun. Prince George's county, set off from Charles in 1695,[3] was in its turn reduced to definite limits by the separation of Frederick county in 1748.[4] In the meantime the gradual growth westward of the colonial settlements is seen in the records of the Prince George's County Court.

Coincident with this growth came the extension of lines of communication. At November Court, 1712, the overseer of the New Scotland Hundred was directed to lay out and clear a road from the forks of the east branch of the Potomac to the upper lands of Rock creek. Sixteen years later the inhabitants of Monocacy Hundred petitioned for a road from the ford of Monocacy to the house of Mr. Nathan Wickham. In 1739 Meredith Davis claimed pay for keep-

[1] Wilhelm. Local Institutions of Maryland. The Town, III. J. H. U., Studies in Historical and Political Science, p. 405.

[2] McMahon, History of Maryland, p. 273.

[3] McMahon, p. 92-3. Bacon's Laws, 1695, chap. xiii.

[4] McMahon, p. 94. Bacon's Laws, 1748, chap. xv.

ing a ferry over Monocacy on "the wagon road that comes by John Stull's to Monacosy."[1] And in the same year there was presented to the Assembly the petition "of several Inhabitants at and above Monocasy Creek," "others at and about the Blue Ridge alias Chenandore Mountain," others "about Monocasy above the Mountains of Potomac River," and still others of "Potomac River on the back parts of Virginia," praying that "a good wagon road might be made at the public charge from the several places aforementioned to the city of Annapolis . . . for the more easy carriage of their grain, provisions and other commodities." The economic importance of such a connection was apparently not appreciated by the Lower House, which delayed consideration of this petition to another session.[2]

The Monocasy [Monocacy] Road.

The section of Maryland mentioned in the petition just quoted had for some time been connected with Philadelphia by an important route of travel and traffic known as the Monocasy Road. This led from the western part of Virginia across the Potomac near the mouth of Conococheague creek, passing near Frederick and through Monocasy, a German settlement supposed to have been near the town now called Creagerstown, to the Pennsylvania line.[3] It is said that this road was originally an old Indian trail, later used extensively for pack-horse travel and by missionaries as a route connecting the western part of Virginia with the German settlement in Pennsylvania.[4] In 1739 the Monocasy Road, or certainly the Pennsylvania part of it, was laid out as a wagon-road, connecting at Lancaster with the road from Philadelphia. From Lancaster it ran westward, crossing the Susquehanna at Wright's Ferry, now Wrightsville, thence through the settlement upon the Big Codorus, afterwards laid out as York, thence through Hanover, crossing the Maryland line near Kreutz-

[1] The Records of the County Court of Prince George's county repose in the attic of the Courthouse at Marlboro, mixed up with a ton or so of old paper, cases, accounts, etc.

[2] L. H. Journals, 1720 to 1739, May 14.

[3] Schulz. First Settlements of Germans in Maryland, pp. 5-6.

[4] Gibson (Ed.). History of York Co., Pa., p. 321.

miller's Mill on Conewago creek, and so to the Potomac as described above.[1]

This early connection with Philadelphia had done much to develop this part of Maryland. In 1745, the town of Frederick was laid out on lands belonging to Daniel Dulany of Annapolis, who had the economic welfare of Maryland much at heart. Other settlements had preceded this, and many followed. The soil was excellent, and one might see "turkish corn [maize or Indian corn] almost without manure, with stalks ten and more feet long."[2] Soon highways were cleared between Frederick and Annapolis and between Frederick and Baltimore.[3]

Travel North and South.

Meanwhile closer and more frequent communication was being established between Maryland and her neighbors on the north and south. Between the years 1705 and 1748 no less than fifteen ferries across the Potomac river into Maryland were established by the Assembly of Virginia.[4] From Philadelphia, Jonathan Dickinson writes, in 1717:[5] "We have a settled post from Maryland and Virginia unto us, and goes through all our northern colonies, whereby advices from

[1] Gibson (Ed.). History of York Co., Pa., p. 514. It is probably the Monocasy Road that is set down on the map as the "Great Philadelphia Waggon Road." In the Post Map of New England, New York, New Jersey and Pennsylvania, by Moll, dated 1730, which is one of the earliest to contain any indication of roads, this highway is continued only as far south as the Maryland line. Not much later it was paralleled by one from Winchester in Virginia to Shippensburg, Pa., across Maryland, further to the west.

[2] Schulz. First Settlements, etc., p. 7.

[3] Ibid., p. 12.

[4] See Hening's Statutes at Large, passim, and especially the Ferry Act of 1748, vi, Hening, 18. Some of the more important of these Ferries were:

1705. Col. Wm. Fitzhugh's in Stafford Co., Va.
1720. From Col. Rice Hoe's to Cedar Pt., Md.
1732. From just below Quantico Creek to Col. Geo. Mason's in Md.
1740. From Dieg's Neck, Prince William Co., Va., to the lower side of Pamunky in Prince George's Co., Md.
1744. Evan Watkins, opposite mouth of "Canagochego."
1745. Wm. Clifton, Fairfax Co., Va., to Prince George's Co., Md.
1755. From land of Thos. Swearingen in Frederick Co., Va.
1755. From land of Lawrence Washington in Stafford Co., Va.

[5] Watson. Annals of Philadelphia, vol. ii, p. 392.

Boston unto Williamsburg in Virginia is complete in four weeks, from March to December, and in double that time in the other months of the year." Ten years later, "the mail to Annapolis is opened to go once a fortnight in summer and once a month in winter, via New Castle &c., to the Western Shore, and back to Eastern Shore; managed by William Bradford in Philadelphia, and by William Parks in Annapolis."[1]

Maps, newspapers and almanacs likewise make clear the constant increase of travel. The maps are more detailed. Another map by Moll of the same date (1730) as that mentioned above shows very roughly the post-road from Philadelphia across the Susquehanna and by the heads of the other rivers to Annapolis, thence to Marlboro, thence to Stafford C. H., in Virginia.

The maps of Evans (1749)[2] and of Fry and Jefferson (1757) indicate the main lines of travel through Maryland, and show that a considerable choice of route was possible. Also the Maryland Gazette contains many advertisements illustrating the increase of intercolonial communication.

In Evans' map the post-road runs from the Potomac to London Town, passing near Annapolis, with branches to and from that city, forming a triangle; then across the Magothy, with one branch passing around the head of Patapsco by Elkridge, and another crossing the Patapsco directly, and meeting the first at New Town; thence to Joppa, the mouth of the Susquehanna, Northeast, and Hollingsworth, whence one branch goes to Ogle Town, Pennsylvania, and another to New Castle, Delaware. Another road branches off just west of the Delaware line, and runs south to Georgetown, upon the Sassafras, and thence to New Town.

Fry and Jefferson's map shows some variations from the others. The post-road crosses the Potomac at Belhaven, or Alexandria, and so to London Town and Annapolis. This is met at the Patuxent by another road frôm Charlestown [Port Tobacco] passing through Upper Marl-

[1] Watson. Annals of Philadelphia, vol. ii, p. 392.

[2] Mathews. Maps and Map-makers of Maryland. Maryland Geol. Survey, vol. ii, pp. 337-488.

boro. The route is then similar to Joppa, passing to the northwest of the old site of Baltimore Town upon Bush river, then to the Susquehanna, Principio, Charlestown and New Castle. The route down the Eastern Shore is also given.

In June, 1729, John Carnan, at Bohemia Landing, advertises that in addition to a sloop and hands for the trade of the Chesapeake Bay, he likewise keeps carts and horses for carrying goods by land between the two bays of the Delaware and Chesapeake, that is, between Apoquinomy and Bohemia Landing. At a later time,[1] William Clifton, of Fairfax county, Va., declares that all persons "may there be assured of a ready Passage over Potomack River, and Good Entertainment for Man and Horse; and as the River is narrower in that part than below it may reasonably be allowed the most convenient and short road from Annapolis to Williamsburg." The distances are given as follows:

		Miles.
Annapolis	to South River Ferry	4
thence	" Queen Anne	9
"	" Marlboro	9
"	" Broad Creek	16
"	" said Clifton's Ferry in Va.	2
"	" Occoquan Ferry	16
"	" Acquia	18
"	" Fredericksburg Ferry	16
"	" Caroline C. H.	20
"	" Burk's Ordinary	13
"	" New Castle	27
"	" New Kent C. H.	20
"	" Fremeaux Ordinary[2]	14
"	" Williams	16
In all		200

Poor Richard's Almanac for 1733 gives "A Description of the Highways & Roads From Annapolis in Maryland to Philadelphia," 145 miles thus accounted:

[1] Maryland Gazette, 1746, August 19.
[2] Inn or Hotel.

			Miles.
Annapolis	to	Patapsco Ferry	30
thence	"	Gunpowder Ferry	20
"	"	Susquehanna	25
"	"	Principio Iron-works	3
"	"	North East	6
"	"	Elk River	7
"	"	New Castle	17
"	"	Christine Ferry	5
"	"	Brandywyne	1
"	"	Naamans Creek	9
"	"	Chester	5
"	"	Derby	9
"	"	Philadelphia	8

The Development of Northern Maryland.

With the development of the means of intercourse came thicker settlement. The northern part of the province now began to be settled rapidly. An extensive tobacco trade made the town of Joppa on the Gunpowder river for many years the commercial center of northern Maryland, and the numerous "Joppa roads" testify to the importance of these highways to the development of the town. The decline of Joppa was due to a variety of causes, one of which was the natural advantage in situation possessed by Baltimore, which owes its later development to influences similar to those that had built up the older port.

Settlements increased also upon the borderland between Maryland and Pennsylvania, the debatable ground of Maryland history. About 1741, a way was opened between the settlement on the Conewago, Hanover, and that on the Patapsco, Baltimore Town.[1] This is the road shown on the maps as "Patapsco Road" and probably followed in the main the route of the present Hanover-Reisterstown-Baltimore road, with a branch road running to Elkridge. The settlers in York, Pennsylvania, also saw the advantage of communication with the Chesapeake. "The people," writes James Logan from Stenton to Thomas Penn, in August, 1743, "are very intent on y^{e} thing and have opened a road to Patapsco. Some trading gentlemen there are

[1] Gibson (Ed.). History of York Co., Pa., p. 514.

desirous of opening a trade to York and y^e Country adjacent. The inhabitants seem willing to close with them; and y^e shortness of y^e cut not being above 45 miles; from Philadelphia, they are about 90 miles, besides y^e Ferriage over y^e Susquehanna."[1]

The efforts of the trading gentlemen apparently met with success, for "as long ago as 1751, in the month of October, no less than sixty wagons loaded with flaxseed, came down to Baltimore from the back country."[2] Five years later, sixty-one overseers were appointed by the Justice, each for one section of the road.[3] The resources of the interior had been discovered, highways to the waterside had been begun, and the development of Baltimore was assured.

Packhorse vs. Wagon.

The beginning of the westward movement was accompanied by a gradual change from packhorse to wagon transportation. This change was accomplished against strenuous opposition on the part of the pack-horse owners; just as a century later the wagoners themselves used in vain every effort to resist the extension of the railroads. A resident of Shearman Valley, Pa., who died in 1830, "aged nearly one hundred years, having lived a long life there among the Indians, . . . remembered seeing the first *wagon* arrive at Carlisle, and the indignation it excited amongst the packers, as likely to ruin their trade!—even the widening of the roads when first ordered, offended them!"[4]

The first wagons, constructed at a period prior to the general development of iron-manufacture, were, it is said, made entirely of wood, the wheels being "sawed from trunks of the gum or buttonwood tree."[5] Improved vehicles came with the larger production of iron, especially after the Assembly of Maryland had extended its aid to the iron-industry.

[1] Gibson (Ed.). History of York Co., Pa., p. 514.

[2] Morse, J. The American Geography, p. 466.

[3] Balto. Co. Court Proceedings, 1756, 508ff.

[4] Watson. Annals of Philadelphia, vol. ii, p. 122. "The pack-horses used to carry bars of iron on their backs, crooked over and around their bodies—barrels were hung on them, one on each side."

[5] Schulz. First Settlement of Germans in Maryland, p. 19.

The French and Indian War.

In the year 1749 Col. Thomas Cresap of Maryland, Lawrence and Augustine Washington and Thomas Lee of Virginia, John Hanbury of London, merchant, and many other gentlemen of the two colonies and mother-country, obtained a charter from the British Government, under the name of The Ohio Company.[1] Into the broader history of this corporation it is here unnecessary to enter; by its scheme, however, of trading with the far west, this company originated an idea which later was realized in the National Road, the Chesapeake and Ohio Canal, and the Baltimore and Ohio Railroad. In all these enterprises the state of Maryland was particularly interested; hence an inquiry is warranted into the relations of the Ohio Company and of the French and Indian War to the development of highways in Maryland.

EXPLORATION OF THE OHIO COUNTRY.

In 1749 Christopher Gist was employed by the new company to explore the Ohio country. Leaving Wills Creek, where the company next year built a stone house, on October 31, Gist followed an old Indian trail, then the only route through the wilderness, and after a wide detour to the west and southwest returned some months later.[2] Two years afterward Thomas Cresap, who had settled at a deserted Indian village known as the Shawanese Old Town, "undertook to lay out the course of a good road from Wills Creek to the mouth of the Monongahela, now Pittsburg. He employed as his assistant a friendly Indian, named Nemacolin."[3]

About this time the French Governor of Canada hastened to take every precaution to keep the English out of the Ohio country and establish the French there.[4] So open and energetic were the movements of the French that the Virginia government decided upon immediate opposition. Accordingly, in 1753, George Washington, then barely twenty-one years of age, was ordered to proceed to the fort

[1] Lowdermilk. History of Cumberland, p. 27.
[2] Lowdermilk, pp. 27-8.
[3] Lowdermilk, p. 29.
[4] Ibid., p. 40.

erected by the French upon the Ohio river, to deliver to its commander a letter from the Governor of Virginia, and incidentally to gather all the information he could concerning the strength of the French and the attitude of the Indian tribes.[1] Upon this, his first public mission, Washington proceeded to Wills Creek, Maryland, over what five years before was, "I believe, y^e worst road that ever was trod by man or beast."[2] He left Wills Creek, in company with Christopher Gist, November 15, 1753, and returned to Williamsburg on January 16, 1754, with a letter from the French Commandant to Governor Dinwiddie. The Governor and Council of Virginia then "unanimously concluded that immediate steps should be taken to repel the invasion of the French by force of arms."[3]

"BRADDOCK'S ROAD."

The expedition now fitted out was put under the leadership of Col. Joshua Fry, with Washington second in command. Since Colonel Fry was killed as the result of a fall from his horse before he arrived at Wills Creek the entire responsibility fell upon Washington, who had gone ahead with the main body of the little army. From Winchester to Wills Creek, Washington was obliged to build the roads as he went and to make them passable for his horses and wagons; and he was bitterly disappointed upon his arrival at Wills Creek to find that no provision had been made for transporting the ammunition and stores across the mountains.[4] As it was impossible to stay where he was he resolved to push forward to the storehouse of the Ohio Company at Redstone Creek and there to erect fortifications and wait for reinforcements. Sixty men were sent ahead to make a road along the route blazed by Nemacolin and Col. Cresap, three years before. This road was afterwards known as Braddock's Road; but it was really constructed by Washington as far as the Great Meadows, and "was the first road built across the mountains."[5]

[1] Lowdermilk, p. 41.
[2] Washington's Journal, 1748.
[3] Lowdermilk, p. 45.
[4] Lowdermilk, pp. 48-9.
[5] Lowdermilk, p. 53. Mr. L. "walked over several miles of this road, starting at Cumberland, in the summer of 1877, and clearly traced it as far as

Braddock's Expedition.

General Braddock arrived in Hampton Roads February 20, 1755.[1] He proceeded to Williamsburg and then to Alexandria, where he held a conference with certain of the Colonial Governors.[2] The year before, Governor Sharpe of Maryland who, before General Braddock's coming, was in charge of the military operations against the French, had ordered the construction of a new road from Rock Creek to Wills Creek.[3] This was probably the road chosen for the regiment under Colonel Dunbar, which was ordered to proceed to Frederick in Maryland by the following route:

	Miles.
To Rock Creek	—
To Owen's Ordinary	15
To Dowdens	15
To Frederick	15
	45[4]

However, it is difficult to see just how Dunbar obeyed the direction, "Within a few miles of the Minocasy across the Minocasy in a Float."

Another regiment, commanded by Sir Peter Halkett, went direct from Alexandria to Winchester, Va., following this course:

the Six Mile House, on the National Road. The route pursued on leaving Wills Creek was along the valley in which Green St. extended now lies, the same being the exact course of the old National Pike. About a hundred yards east of Mr. Steele's house, and just where the Cresaptown Road now leads off southward, the road which Washington followed bore slightly to the North, and ran in almost a perfectly straight line to nearly the top of Wills Mountain, involving a very heavy grade and from there descended to the level of the Old Pike at Sandy Gap. In many respects the road was admirably chosen; it is as plain to-day as it was a hundred years ago notwithstanding trees of more than a foot in diameter are growing thickly in its bed. Having been used for sixty-five years, as the only road to the West, until 1818, when the National Pike was built, it became well worn" (p. 52).

[1] Lowdermilk, p. 104.

[2] Ibid., pp. 104-5.

[3] Maryland Archives. Correspondence of Governor Sharpe, vol. i, pp. 77 and 97.

[4] Braddock's Orderly Book. (Appendix of Lowdermilk, pp. 18-19.)

	Miles.
To ye old Court House	18
To Mr Colemans on Sugar Land Run where there is Indian Corn, &c.	12
To Mr Miners	15
To Mr Thompson ye Quaker wh ye is 3000 wt corn	12
To Mr They's ye Ferry of Shanh	17
From Mr They's to Winchester	23
	97 [1]

April 21 the General arrived in Frederick, Maryland, where he was joined by Washington, whom he had appointed his aide-de-camp. Here Braddock discovered that he needed more wagons, and Franklin undertook to supply them.[2]

"On the 30th of April (1755) Braddock left Fredericktown with his staff and a body-guard of light horse. Before leaving Alexandria he had purchased of Governor Sharpe a chariot, one of the cumbersome carriages of that day, and was making his journey with a great deal of style which would have been better suited to the cultivated districts of England. He quickly discovered that the road was ill-adapted to a conveyance of that character, and did not hesitate to express his opinion by damning it heartily."[3]

The route followed by Col. Dunbar's regiment was

April.		Miles.
29th.	From Fredk on ye road to Conogogee	17
30th.	From that halting place to Conogogee	18
May.		
1st.	From Conogogee to John Evens	16
2nd.	Rest.	
3rd.	To the Widow Baringer	18
4th.	To George Polls	9
5th.	To Henry Enock's	15
6th.	Rest.	
7th.	To Cox's at ye mouth of little Cacaph	12
8th.	To Col. Cresaps	8
9th.	To Wills Creek	16
	Total	129 [4]

[1] Braddock's Orderly Book. (Appendix of Lowdermilk, p. 23.)

[2] Governor Morris had written from Philadelphia to Governor Sharpe, "there is a very good wagon road from this city to Watkins Ferry on Potomack," probably referring to the "Monocasy Road" already spoken of. It was by this route no doubt that Franklin sent to Braddock the needed wagons.

[3] Lowdermilk, p. 114.

[4] Braddock's Orderly Book. (Appendix of Lowdermilk, p. 27.)

From Wills Creek, or Fort Cumberland, the army followed the road made by Washington in the campaign of 1754 and first blazed by Cresap and Nemacolin in 1751; but through the "Narrows" at Cumberland Lieutenant Spendelow opened a new road along the east bank of Wills Creek, crossing the creek just above the mouth of Braddock run and rejoining the old road five miles west of Cumberland. Along this new road part of the army marched.

"The difficulties of the march soon brought the General to appreciate the apprehension of Washington; the steep mountains, rocky roads, and ugly ravines incident to this new country were all beyond his anticipations. It became necessary to double up the teams in order to pull the wagons up the rough grades; in some instances even this was impracticable, the seamen being obliged to draw them up by means of ropes and pulleys. Not more than three or four miles a day could be made and in order to avoid a further delay, where already weeks of precious time had been lost, Braddock eventually yielded to Washington's advice and sent back many of his wagons, taking the animals for packhorses, and transporting his stores in the only practicable manner." [1]

ROAD FROM FORT FREDERICK TO FORT CUMBERLAND.

After the erection of Fort Frederick had begun in 1756, the necessity of a short route from Fort Frederick to Fort Cumberland soon became apparent. Governor Sharpe favored it,[2] and upon the failure of the army to perform the work, he brought the necessity of constructing this work before the Assembly. In December, 1758, after the capture of Fort Du Quesne, a committee was ordered to inquire the cost of connecting Fort Frederick and Fort Cumberland by a wagon-road and their report was as follows:

"Your committee[3] have made an Enquiry into the situation of the present wagonroad from Fort Frederick to Fort Cumberland, and are of the opinion that the distance by that Road from one Fort to the other is at least Eighty miles, and find that the wagons which go from one Fort to the other are obliged to pass the Potowmac River twice, and that for one third of the year they can't pass without boats to set them over the river.

[1] Lowdermilk, pp. 138-9.
[2] Maryland Archives. Correspondence of Governor Sharpe, vol. ii, p. 206.
[3] Assembly Proceedings, Dec. 15, 1758, p. 74.

"Your committee[1] have also made an Enquiry into the condition of the Ground where a road may most conveniently be made to go altogether upon the North Side of the Potowmack, which will not exceed the distance of Sixty-two miles at the expense of 250 lbs. current money as may appear from the following Estimate, viz.:

"An Estimate of the Expense of clearing Road from Fort Frederick to Fort Cumberland, and the Several Different Stages:

For clearing from	£	s.	d.
Fort Frederick to Licking Creek, 3½ miles.........	0	0	0
Licking Creek to Praker's Creek, 8½ miles.........	12	0	0
Praker's to Sideling Hill Creek, 12 miles...........	16	0	0
For a bridge over Sideling Hill Creek..............	60	0	0
Sideling Hill Creek to Fifteen Mile Creek, 4 miles...	22	0	0
Fifteen Mile Creek to Town Creek, 15 miles.........	140	0	0
Town Creek to Col. Cresaps, a good road, 4 miles...	0	0	0
Col. Cresaps to Fort Cumberland, wants clearing, 15 miles	0	0	0
	250	0	0

"Your committee are of the opinion that a road through Maryland will contribute much to lessen the expense of carrying Provisions and warlike stores from Fort Frederick to Fort Cumberland, and will induce many people to travel and carry on a trade in and through the Province, to and from the back country."

Governor Sharpe and the Assembly for some time disagreed concerning this and other appropriations, but the new road was finally authorized. More significant than its timely construction, however, is the fact that the utility, and indeed, the necessity of an easy communication between the Ohio country and the East was popularly understood even at that early date. The cardinal importance of this idea, though forgotten by many, was ever present to Washington, and to him, perhaps more than to any one else, was due the ultimate attainment of a great highway across the Alleghanies.

INTERNAL IMPROVEMENT AND LATER HIGHWAY LEGISLATION.

In Maryland the period intervening between the French and Indian War and the Revolution was a time of intense political excitement. The passage of the Stamp Act called forth many champions

[1] Assembly Proceedings, Dec. 15, 1758, p. 74.

of the colonial rights, among whom was the younger Dulany, whose "Considerations on the Propriety of Taxing America" was often quoted by the elder Pitt in his speeches in defense of the colonies.[1] Hardly had this excitement been allayed by the repeal of the obnoxious legislation when local, but no less bitter, controversies arose to absorb the public interest until differences at home were at last merged in the greater issues of the Revolution.

Under these circumstances it is remarkable that time was found to initiate a policy of internal improvement which was interrupted, indeed, by the Revolution, but which afterwards was steadily pursued until the development of the steam railroad.

Canal Schemes.

The pre-revolutionary period was productive of ideas rather than of accomplishments. The project of extending commercial intercourse by artificial waterways was not a novel one. A canal to cross the Eastern Shore peninsula had been proposed in the days of Augustine Herrman, but after his death the scheme seems to have been abandoned. Canal schemes were revived, however, in the decade preceding the Revolution. In 1768, Sir Henry Moore planned a canal for the Mohawk Valley in New York; the next year Richard Henry Lee laid before the Assembly of Virginia a similar proposition in regard to the Potomac,[2] and a year later investigations were made under the authority of the American Philosophical Society with a view to opening water-communication between the bays of Chesapeake and Delaware.[3]

[1] Tyler. The Literary History of the American Revolution, vol. i, pp. 111ff.

[2] Chevalier. Histoire et Description des Voies de Communication aux États Unis, vol. i, p. 131. Paris, 1840. The idea of improving the navigation of the Potomac had originated with George Washington as a result of the acquaintance with the character and resources of the Ohio country which he had gained during the French and Indian War. After the Revolution the matter was again urged by Washington, and the "Potomac Company" formed—an event of great significance for the future national development. (Acts of Assembly, 1784, chap. xxxii.)

Almost contemporaneous was the incorporation of the Susquehanna Company for the purpose of making that river navigable. (1783, chap. xxix.)

[3] Trans., o. s., vol. i, Philadelphia, 1770.

Highway Legislation.

It was, however, to highway rather than to canal improvement that the Assembly of Maryland directed their attention. Hitherto the legislation regarding highways had been comprehended in two or three fundamental laws variously amended and supplemented, but from 1765 on, one is confronted with a continuous increase in the number of road-laws mainly due to the growth of population; the divergence in the needs of different sections of the state, making uniformity no longer practicable; and the demand for improved and shortened roads. To present in detail all the laws enacted as a result of these influences is neither necessary nor profitable, and surely not interesting. In the complexity of subsequent legislation, however, it is possible to distinguish certain general ideas or principles in accordance with which a classification such as the following may be adopted:

1. Laws regarding single roads.
2. Laws regarding groups of roads.
3. Legislation for separate counties.
4. General legislation for the state.
5. The development of the turnpike system.
6. Legislation for the National Road.

The first four divisions relate especially to legislation near the close of the eighteenth century, while the fifth and sixth are more closely associated with the development at the beginning of the present century. The latter will be discussed at somewhat greater length.

LAWS REGARDING SINGLE ROADS.

The laws concerning single roads began with the passage in 1765 of an act[1] to establish a road from Hunting Creek in Dorchester county to Dover in Talbot county; in 1774 followed an act[2] requiring the justices of Somerset county to appoint persons to lay out a road from the Free School in Somerset county through the forest to Denston's Dams, there to intersect the main road leading from Princess Anne to Snow Hill.

[1] Chap. xv. [2] Chap. xxv.

Unless otherwise indicated references are to Acts of Assembly.

After the Revolution, the number of laws of this sort steadily increased; it is possible, nevertheless, to distinguish some differences in kind which may be best illustrated by a few examples.

The first includes laws for roads which at the present day would be considered private roads. Six acts of the year 1783 exhibit this peculiarity. These provide for a road from the windmill and dwelling of Nathaniel Manning, of Dorchester county;[1] a road from John Goff's Mill in Frederick county;[2] a road from Dr. Ephraim Howard's tilting-forge at Elkridge;[3] the fourth a road from William Matthew's Mill in Baltimore county;[4] in these four cases to the nearest main road; a public road in Baltimore county, to form a cross-connection between two main roads;[5] and another mill-road in Dorchester county."[6] For each of these a separate law was enacted.

Page after page of the statute-books is filled with these laws concerning roads to mills, plantations, churches, iron-works, forges, and many other places of a special or individual character. In cases where the new roads were especially advantageous to individuals those so benefited were usually made responsible for their preservation and repair.

Another class of laws relates to the construction of more important roads. These sometimes connected a town with some previously existing highway. In 1782, for example, the construction of a main road was authorized "from Elizabethtown [Hagerstown], in Washington County, through Charlton's Gap in the South Mountain, on a strait line, till it intersects the road leading from Frederick-town to York-town in Pennsylvania," which "would facilitate the carriage of produce" from the western country to Baltimore, "by which means the subjects of this State would be better enabled to pay their taxes, and would increase the trade of the State in general."[7]

Other roads connected a town with a watercourse. Such a road was the highway from the town of Talbot in Talbot county to Cow Landing, on Third Haven Creek, for which provision was made in 1787.[8]

[1] 1783, chap. v. [2] Chap. vi. [3] Chap. xv. [4] Chap. xi. Nov. Session.
[5] Chap. xii, Nov. Session. [6] Chap. xiv, Nov. Session.
[7] Chap. xli. April Session. [8] Chap. xxiv. December Session.

Still others joined one town with another. In 1796 a committee of gentlemen from Prince George's and Queen Anne's counties and Annapolis was appointed to examine the country between Washington and Annapolis and to ascertain the best route for a road to connect the two cities.[1] The next year, 1797, other commissioners were authorized to lay out the road as reported, at the expense of the two counties.[2]

In a third group may be classed laws establishing or recognizing as public highways roads previously existing. In 1792, the road "from time immemorial" leading from Baltimore to Frederick by Dillon's Fields, Ellicott's Upper Mills, Cumming's new buildings, Fox's the Red Horse Tavern, Cook's Tavern, and Poplar Spring, was definitely established as a public road.[3]

To a fourth class may be assigned a few laws regarding two roads that marked the boundary line between two adjoining counties. In 1792 [2] certain commissioners, three from Dorchester county and two from Caroline county, were appointed to open a main road and change the old road, formerly the divisional line of the two counties, the new road to serve the same end. In 1801 certain [4] similar changes were made in the divisional road between Somerset and Worcester counties.

In a fifth class may be included those laws which refer to roads constructed at a later date to serve as cross-connections between lines of turnpike roads. Such a road was authorized by an act of 1799 [5] to run from Widow Mortar's tavern on Hanover turnpike by George Kerlinger's mill and Hoofman's grist and paper-mill to Benedict Hunt's tavern on the York turnpike.

Laws relating to roads of a chiefly historical interest may form a sixth class. Such was the old Monocacy road, which is the subject of one act of 1789.[6] The same provision was made for the repair of the road from Port Tobacco to Leonardtown, one of the oldest roads in the state.[7]

Finally, in a seventh class, may be mentioned the post-roads, particularly the main road between the North and the South, which required not a little legislation. In 1787 commissioners were ap-

[1] Chap. xci. [2] Chap. xxxv. [3] Chap. xix. [4] Chap. vi. [5] Chap. liv.
[6] Chap. vii. December Session. [7] Chap. xii.

pointed to open and amend the post-road from Havre de Grace to Baltimore-town, and to erect a toll-bridge, for which they might pay by collecting money by private subscriptions, or by a lottery, or by pledging the tolls to be collected.[1] That this legislation was not as successful as might have been hoped will appear hereafter.

Very similar to the legislation for single roads and, therefore, appropriately included under the present heading, is that concerning bridges. These laws, of which it is unnecessary to give specific examples, made provisions for bridges of varying kinds and importance. Some acts order the erection and repair of necessary bridges by the counties in which they are situated; others confer charters for bridges upon private persons or upon corporations.

The constant interference of the General Assembly in these private and often unimportant cases is to be explained by the limited powers of the County Courts. As the counties, one by one, obtained separate laws, the powers of their courts were greatly increased, and the burden of the legislature correspondingly lightened. This subject will be more appropriately treated under a later head.

LEGISLATION FOR GROUPS OF ROADS.

The first movement towards the improvement of the material and bed of the roads in Maryland was expressed by legislative provision for the construction or repair of groups of important market roads.

In 1774, "an improvement of the principal Market Roads in the Counties of Anne Arundel, Baltimore, and Frederick," would, it was thought, "render the Intercourse and Carriage between the Parts of the Province distant from Navigation, and the Places from whence the produce of those parts were and might be most conveniently exported, much easier and cheaper, whereby Trade would be increased and the Settlement, Cultivation and Improvement of Lands would be encouraged and promoted." Part of the bills of credit to be issued in pursuance of a previous act was therefore appropriated for a loan to the inhabitants of Anne Arundel, Baltimore and Frederick coun-

[1] Chap. xxix. Slight changes were made by acts of 1791, chap. xxxi, and 1796, chap. lviii; and the act of 1800, chap. lx, altered the course of the road between Bladensburg and Washington.

ties, in sums not exceeding $2,000, $10,666.66, and $8,000 for these counties, respectively, " towards opening, straightening, widening, repairing and putting in order the following roads, viz.:

" The road leading from the mouth of Conococheague Creek to Frederick Town, crossing the South Mountain at the Gap commonly called Turner's Gap, the road from Hagerstown to intersect the said road at or near the Western Side of the South Mountain.

" The road from Frederick-Town leading by Dowdens to George-Town.

" A road from the mouth of Watts Branch to George-Town aforesaid.

" The road from Frederick-Town leading over Rues Ford on Monocasy and crossing Patuxent River at Green's Bridge to Annapolis.

" The road from Frederick-Town leading over the said Ford over Monocasy, and crossing Patapsco at or near Hoods Mills to Baltimore-Town.

" A road leading from the Catoctin Mountain through the Pipe Creek Settlement by Roysters (Reisters-town) to Baltimore-Town aforesaid.

" The road from Roysters to Hanover as far as the Province Line.

" These roads are divided into eleven districts, for each of which three supervisors are appointed and the maximum amount thereon to be expended definitely fixed. The supervisors are to employ laborers or to contract with others to do the work, and draw their orders on the Commissioners for emitting Bills of Credit, for the money to be expended.

For the repayment of the Bills of Credit, the Sheriffs of the respective Counties are to collect per annum—

In Anne Arundel........................	4 lbs. of tobacco
In Baltimore	12 lbs.
In Frederick	8 lbs.

from each taxable inhabitant, and are to sell the same in August of each year in open court.

The supervisors are to have the roads well cleared, grubbed and *stoned*, 40 feet wide—except the road leading to Annapolis, which is to be 30 feet wide—and cause all necessary bridges and causeways to be made, and trenches and ditches to be cut for draining off the water. The roads when completed are to be public roads."

A peculiar provision is that " in the middle of the Watts Branch—George-Town road, until it intersects the Frederick-George-Town road, large posts shall be well set up in sight of and not exceeding 100 yards distance from each other. When this road is finished, no wagon or carriage of burthen with wheels of a less tread than 5 inches, shall pass upon the part of this road that lies to the *North* of the posts erected, under a penalty of 20s. current money.

The supervisors are empowered to call for a jury of condemnation to assess the value and damages of improved land through which, in their estimation, it is necessary for the road to pass."[1]

A law of 1787[2] provided that several turnpike roads should be laid out in Baltimore county. One of these was to go toward Frederick

[1] 1774, chap. xxi.

[2] Chap. xxiii.

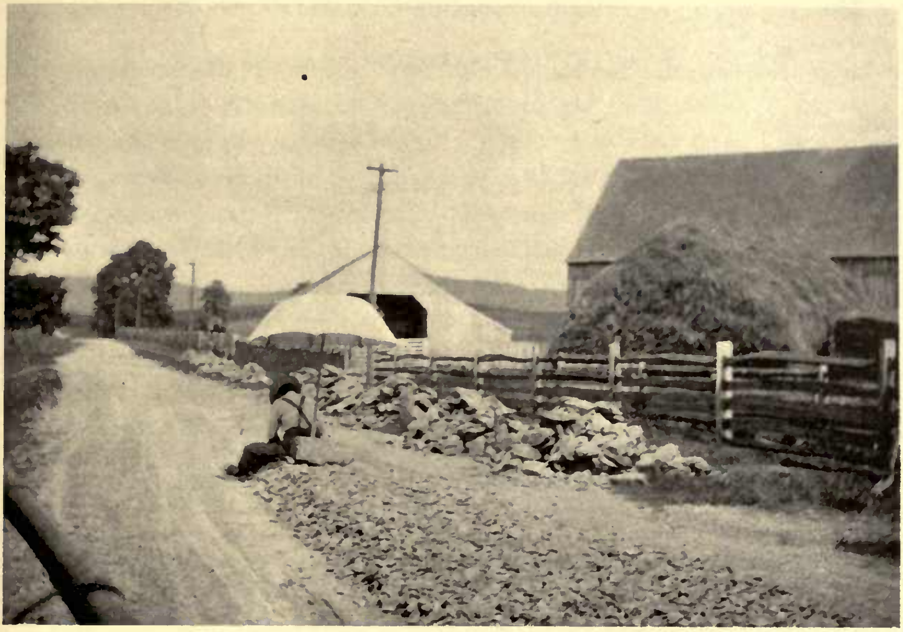


FIG. 1.—BREAKING STONE BY HAND, WASHINGTON COUNTY.

The Friedenwald Co.

FIG. 2.—HAULING WITH TWO-WHEEL OX-CARTS, PORT TOBACCO, CHARLES COUNTY.

SURVIVALS OF EARLY ROAD-METHODS.

Town; one to Reisterstown, branching there in one direction to Winchester Town [Westminster ?], and in another to Hanover, Pennsylvania, and a third road was to go to York. For some time, however, little progress was made on these roads and, as they were really turnpike roads, a detailed treatment of them may be left to a later section.

In 1790 some of the principal market and post-roads in Cecil, Baltimore, Montgomery, Frederick and Washington counties were thought to be "very indirect, much out of repair," and to require considerable improvement. Therefore, an act[1] was passed to improve the following roads:

(1) From Susquehanna Lower Ferry to the Ford at the Furnace, thence to Charlestown, thence to the bridge at the head of North East, and thence through Elk-town towards Christiana to the Delaware line [the Post Road].

(2) From the head of Elk to Rock Creek, to head of Bohemia, to Warwick, to head of Sassafras.

(3) From Baltimore Town, westward of Randallstown through the "barrens" of Baltimore County towards Liberty-Town as far as the Frederick County Line, thence to Frederick, crossing the Monocacy at the Ferry next above the mouth of Israel's Creek.

(4) From the end of Patrick Street, Frederick, crossing the Washington County Line by Peter Bainbridge's, to Elizabeth-Town [Hagerstown].

(5) From Middletown to Williams-port, by way of Turner's Gap.

(6) From Williams-port to Elizabeth-Town.

(7) From Elizabeth-Town through Charlton's Gap in the South Mountain, to Liberty-Town, nearly intersecting the road from Baltimore.

(8) From Elizabeth-Town to Hancock-Town.

(9) From Frederick over Rice's Ford on Monocacy by Hobbs, through Baltimore County to the line of Anne Arundel, to meet the turnpike to Frederick provided for by the law of 1787.[2]

(10) From Frederick to Harper's Ferry.

(11) From Frederick to Georgetown.

(12) From Georgetown to the mouth of Monocacy, thence to the Court House of the said County.

(13) From Elizabeth-town to the Pennsylvania Line, in Nicholson's Gap.

To cover the expense the Justices of Cecil, Frederick, and Washington Counties, were to levy not more than 3s. 9d. on every £100 of assessable property, and the Justices of Montgomery County, not more than 2s.[3]

The next year, 1791, witnessed the enactment of several "group" laws, of which the most important was that "to strengthen and amend

[1] Chap. xxxii. [2] Chap. xxiii.

[3] See laws of 1791, chap. lxxxii; 1793, chap. xl; 1795, chap. xxviii; 1797, chap. xxix; 1798, chaps. xxxii, xlix; 1799, chap. xxxii; 1800, chap. xxii, all of which in some way modify this act.

the public roads in Harford county, and for other purposes." This act provided for the roads specified as follows:

(1) From the Pennsylvania Line at the intersection of the road from Peach Bottom Ferry over the Susquehanna, to Thomas Underhill's mill on Deer Creek.

(2) From Bald Friars Ferry to Belle Air, thence towards Baltimore, to the Baltimore County Line at the Little Falls of Gunpowder.

(3) From Belle Air to Lower X Roads, thence to Smith's Ferry on the Susquehanna.[1]

In 1793 five commissioners were appointed to lay out several roads from Denton, the seat of justice of Caroline county, to different parts of that county,[2] to be added, when completed, to the public roads.

These "group" laws seem to mark a transitional stage in the highway legislation of the state. As they anticipated the turnpike laws in requiring improvement of the road-beds, so they were in some cases closely allied to county laws. The two laws last cited exhibit this characteristic. In these cases the Legislature seems to have wished to give to the county a start by the construction of the more important roads, leaving the future care of them to the county. But with the establishment of complete county road-laws and the development of the turnpikes, the necessity for this class of legislation appears to have passed away, and few examples of "group" laws of any importance are to be found.

LEGISLATION FOR SEPARATE COUNTIES

After the French and Indian War, the rapidity with which the settlements increased in northern Maryland soon made that section one of the most prosperous in the Province. As was indicated in the preceding division, the "principal market roads," for which special provision was first made by a "group" law, lay, to a large extent, in Baltimore county. So, eight years before, the need of an improvement of local transportation in Baltimore county led to the passage of the first county law.

[1] Chap. lxx. Other "group" laws passed in 1791 were, chap. xxx for certain mill roads in Baltimore county; chap. liii for certain roads in Anne Arundel county.

[2] 1793, chap. liv.

In 1766[1] the inadequacy of the laws for the maintenance of highways in Baltimore county was recognized, and the justices were authorized to appoint as many overseers as they thought necessary, and these were empowered to hire a sufficient number of laborers for the repair of the roads. To cover the expense a tax of 10 lbs. of tobacco per poll was laid upon all the taxable inhabitants of the county, besides the sheriff's salary of 6 per cent for collection.

The overseers were to receive 6 lbs. of tobacco per day and render accounts to the justices. Carts or wagons loaded with iron ore should not pass within five miles of the iron-works to which they belonged, except when starting upon or returning from a longer journey, unless the felloes of their wheels were five inches broad at the least. No new gates were to be erected on or over any public road where then there were none.

This act, it will be observed, substitutes in Baltimore county the employment of hired labor paid for by a fixed tax for the compulsory attendance required by the earlier general law. It is notable, also, as the beginning of separate legislation for the different counties; since its enactment a permanent general system has not prevailed.

The counties of Anne Arundel and Frederick were provided with separate laws by one section of the act of 1774[2] mentioned above. The overseers and taxables in these counties were made chargeable to labor upon the highways, generally for not more than six months in each year. It was made permissible, however, for any one personally chargeable, or responsible for others, to employ substitutes, and such substitution was made imperative in the case of "every female negro for whom he [the master] shall be chargeable." It is curious that special provision was made for eight-hour labor.

When, after the Revolution, the state returned with vigor to the development of its natural resources, the necessity for the improvement of local communication became urgent. Consequently the tendency to separate legislation heralded by the acts to which reference has been made becomes more and more apparent. In 1791[3] the Jus-

[1] Chap. xxxii. An Act for Amending and Repairing the Public Roads in Baltimore County.

[2] 1774, chap. xxi.

[3] Chap. lxvi.

tices of Cecil county were empowered to "streighten and amend" the public roads, to appoint commissioners to inspect them, and to levy not more than 2s. 6d. current money for the first year, and not more than 1s. 6d. for succeeding years, on every £100 of assessable property in the county. They were to pay the proceeds thereof to the commissioners, who should, within four months, lay out, etc., the roads for which they were appointed, and return plats of the same, receiving for their service a reasonable compensation.

The Court is to agree for necessary land at a rate not exceeding £3 per acre; if such agreement is impossible, there shall be issued a warrant to the sheriff to summon a jury of condemnation, of 12 freeholders. The Commissioners are given power to appropriate funds, and if expedient, to accept the substitution of labor for the payment of the tax. The Justices are empowered to appoint one or more supervisors to superintend, direct and contract for the making of the roads. Every supervisor has to bond for at least double the amount for which he is responsible, and is to render an account to the Justices yearly, receiving 9s. 6d. per diem of actual employment.

The Commissioners are given power to contract in writing with any person or persons for the necessary bridge or road-building. The provisions of the "group" law of 1790 [1] are repealed so far as they relate to Cecil county.

The complications of this method of highway administration may account for its modification two years later. In 1793[2] the annual tax for Cecil county was raised to 3s. 9d. on every £100, the commissioners were dispensed with, and their powers were transferred to the supervisors appointed by the court. Meanwhile similar laws were enacted for Harford [3] and Queen Anne's counties.

Attempts at Uniformity.

The next year, 1794, witnessed an important attempt to satisfy the various wants of the counties in one law by prescribing uniform methods of administration, with different rates of taxation.[4]

The existing laws regarding road management were characterized as "inadequate, partial and unjust," and the Justices of Peace in the respective counties were authorized to levy on each £100 of property, as follows:

[1] Chap. xxxii.

[2] Chap. lxxiii.

[3] 1791, chap. lxx; 1793, chap. lxv.

[4] 1794, chap. lii.

In Baltimore county,	not more than	1 s.	3 d.	annually.
" Talbot "	"	3 s.	6 d.	"
" Somerset "	"	1 s.	6 d.	"
" Cecil[1] "	"	3 s.		"
" Prince George's county	"	3 s.	9 d.	"
" Queen Anne's "	"	3 s.		"
" Frederick "	"	3 s.	9 d.	"
" Harford "	"	3 s.	9 d.	"
" Caroline "	"	2 s.	6 d.	"
" Montgomery "	"	2 s.	6 d.	"
" Allegany "	"	3 s.	9 d.	"
" Kent "	"	2 s.	6 d.	"

The Justices may permit the substitution of labor at the regular rate for payment of the tax. They shall make out lists of taxables in each hundred of the county, and shall furnish the Collector with copies thereof.

Upon the application of two-thirds of the inhabitants of the hundred through which any road passes, the Justices shall appoint as Commissioners three disinterested persons, to alter or straighten the roads not more than 40 feet wide clear of ditches. In case of disagreement as to the value the Sheriff shall by warrant summon the usual jury of 12 men to assess damages. The Justices shall appoint supervisors who shall give bond for the performance of their duties. The laws of 1704 and 1753 are repealed, as regards these counties. The acts of 1791 for Cecil county and 1793 for Queen Anne's county are repealed; but so much of the acts of 1787 and 1790 as relates to Baltimore county is not repealed.

This act of 1794, though professedly an attempt at uniformity, admitted an exception to the general law by superimposing, in Allegany county, the old plan of compulsory labor upon the new methods of a fixed county tax. Any person summoned might, however, compound at the rate of 3s. 9d. per diem, and complete exemption from labor might be obtained by the annual payment of 15s. current money.

The next year the provisions of this law were extended[2] to Anne Arundel and Washington counties, as they had "proved beneficial" in the others.

The rates to be levied in certain counties were changed as follows:

Baltimore	5s.
Somerset	2s.
Cecil	6s.
Kent	3s. 6d.

[1] Special provision is made that one-third of the money levied on the inhabitants on the east side of Elk Run shall be expended on the same locality.

[2] Chap. xliii.

The Justices of Baltimore, Cecil, Montgomery, Washington, Talbot, Prince George's, Kent, Somerset, Frederick and Anne Arundel were given full power to contract for roads, etc., and to appoint persons to review them when finished.

The provision in the former act as to the distribution of the taxes is repealed as is also the "group" law of 1790 [1] authorizing the Justices of Montgomery county to levy a tax of 2s. on every £100. This power is now transferred to the Levy Court. Since a sufficient number of hands cannot be hired in Queen Anne's and Caroline counties, supervisors in these counties are authorized to require as many male slaves as may be necessary; but not more than one-half of the number of slaves belonging to one person are to be summoned the same day. Other unimportant particulars follow.

Reaction towards Separate Legislation.

By these two acts a degree of generality was given to the law, which now applied to all the then existing counties except St. Mary's, Charles, Calvert, Dorchester and Worcester. The chief characteristic of the law as now in effect was, as has been seen, the substitution of a regular property tax for compulsory labor on the highways. One would naturally expect to find the remaining counties adopting this method, but the exact opposite is the case, for in the following year Somerset county drops out, and, with Worcester, goes back to the law of 1704 with its supplements.[2] The system provided is more detailed but the principles are the same. Apparently the change was not immediately successful, as the law regarding Somerset county was modified four times within the next five years.[3] The same year [4] some alterations were made also in the existing provisions for Cecil, Talbot and Kent counties.

In Cecil additional provisions were made concerning the assessment of damages when new roads were opened. In Kent and Talbot it was found that a sufficient number of hands could not be hired at reasonable wages to repair the public roads, which, therefore, remained in bad condition, while the supervisors were subjected to a fine for neglect. The latter were consequently empowered to require of owners as many able-bodied slaves as might be necessary to work on the roads.[5]

[1] Chap. xxxii.

[2] 1796, chap. lix.

[3] By the acts of 1797, chap. lxxxiv; 1798, chap. xxxviii; 1799, chap. v; 1801, chap. lxxxiii.

[4] 1796, chap. lx.

[5] By the same act the power of contracting granted the courts in these three counties by the supplementary act of 1795 is extended to roads laid out prior to the passage of that act.

A year later the law for Talbot county is again changed,[1] the present modes being "too expensive."

The Justices of the Peace are to meet, and in a well-bound book set down what are the public roads of Talbot county, and nominate overseers, not more than five in each hundred. A fine of $10 is provided for refusal to act as overseer, but no member of the legislature, magistrate, preacher or teacher, nor practicing attorney, nor physician, nor commissioner of the tax, shall be liable to such service, nor shall any one be liable to serve more than once in three years. Fines for non-performance of duty are provided, and after April 1st following, all former acts respecting Talbot county are repealed.

In 1798 Caroline county[2] also returned to the labor system, by which every free male inhabitant over twenty-one years of age was made to serve in road-repairing. So Kent county, which, it has been shown, began in 1794[3] with the property tax system, changed the rate in 1795,[4] and in 1796[5] added compulsory slave labor, now, in 1799,[6] goes over entirely to the labor system.

The overseers appointed yearly by the Justices are authorized to call upon all free male inhabitants between the ages of 20 and 50 and upon all male servants and slaves over 16 to labor upon the highways. The overseers are given power to contract, etc., and the Justices, to turn old roads upon application. Not more than one-half of the males of any family are to be called on at one time, but all persons are to be summoned.

The details of the provisions of this act, the fourth respecting Kent county in half a dozen years, might lead one to suppose that some progress had at last been made towards stability in road legislation; but the exact opposite was the case. The very next year, 1800,[7] the whole system was again modified.

"The present law has been found to bear very unequally on the citizens." An assessment of 40 cents on every £100 of property is to be made, and the supervisors are to require of the owners of slaves as many as they deem necessary. For the payment of the tax, labor may be substituted.

The various county laws have now been carried with some detail from 1766 to the end of the century, and an increasing tendency to diverge from the general law has been shown which is plainly due

[1] 1797, chap. lxiii. [2] Chap. xvi. [3] Chap. lii. [4] Chap. xliii.
[5] Chap. lx. [6] Chap. lxxxi. [7] Chap. lviii.

to the difference in local conditions and needs. Occasional attempts at uniformity are apparent, but the instability of these attempts is equally clear. It is evident, however, that there are two main though conflicting ideas in the legislation of this period: (1) The plan of raising money for road-repair by a general property tax, and the appropriation of such funds to the hire of labor upon highways; (2) compulsory labor, whether of freemen or of slaves.

It would be quite possible to discuss this county legislation to the present time, treating specifically each alteration and amendment of every law for every county. Such a treatment would, however, be extremely unprofitable, as it would deal chiefly with repeals and repetitions of very similar laws.[1] But while the provisions for the care and repair of roads, the appointment of supervisors, the collection of funds, etc., are constantly changing, a certain progress towards generalization is seen in the increased powers given to the various county commissioners in regard to the opening, changing, and closing of roads upon petition. That such powers should be granted was a matter of necessity. The legislation in regard to single, private roads, unimportant from a general standpoint, was extensive at an early period. As population increased the demand for new roads became greater; and the Assembly seemed in danger of being overburdened with the mass of road-legislation required. It was not long, therefore, before the powers of the county courts were enlarged, while efforts were made to check the demands upon the Assembly's time by regulations as to petitions for roads, compelling persons applying for roads of a personal or private nature to give notice thereof in the newspapers, or by advertisement on the Court-house door, for four weeks previous to such application.[2]

The extension of the powers of the county commissioners was at first confined to particular counties. In 1796,[3] for example, the levy courts of Somerset and Worcester counties were authorized to direct the surveyors of their respective counties to lay out new roads upon

[1] With the exception, of course, of compulsory slave labor.

[2] 1813 Resolve, No. 8.

[3] 1796, chap. lix.

the application of all the owners of the land through which the new road must pass.[1]

The discussion of the general extension of the powers of the county commissioners must be deferred to the following chapter on General Legislation. Meanwhile, it should be borne in mind that the lack of uniformity to-day in provisions for the management of county roads is no new thing, but dates back to colonial times, and has resulted from the various causes described in the first part of this chapter.

GENERAL LEGISLATION.

The first road-law under the newly erected state government was passed in 1779,[2] while the Revolution was still in progress. This, an " Act relating to public roads," established new fines: for neglect of duty by overseers, £100; for refusal of laborers to work, £5; or refusal of masters to send servants when summoned, £5. It also repealed the exemptions to iron-workers granted by previous laws.

This act, with the earlier act of 1704,[3] variously modified and extended, remained for some time the general highway law of the state, and included provisions for all counties unprovided for by special enactment. There were also sundry attempts to harmonize the various needs of the counties in one law with special tax-rates; but these attempts, as has been indicated, were fruitless, because it was impossible to get all the counties to accept either the fixed road-tax, or the system of compulsory labor upon the highways.

Extension of the Powers of the County Courts.

Mention has been made of the extension of the powers of county courts relative to the opening and closing of roads, etc. It was along this line that general legislation again became practicable. Accordingly, the attempt to secure complete uniformity was relinquished,

[1] The power of altering old roads, upon petition of two-thirds of the inhabitants of a hundred, was conferred upon many of the county courts by 1794, chap. lii, which see.

[2] Chap. xiv.

[3] The law of 1704, as modified by 1723, 1753, etc. (which see) was frequently continued. See 1785, chap. lxxvii; 1795, chap. xxxvii; 1789, chap. lxv; 1798, chap. lxxi.

and the counties were given as much special legislation for the care and repair of their roads as they desired, while the provisions concerning the powers of the county courts, or commissioners, in regard to opening new roads, etc., were eventually embraced in a general law. In 1818 [1] the county courts, except in Worcester county, were empowered upon petition of any person interested in opening, straightening, or shutting up a public road, to issue a commission to three freeholders to examine whether the public convenience requires it.

After giving notice, these may decide, upon oath, for or against the road. The Court is to pass judgment if no objection is presented, and a trial by jury is authorized in cases where objection is made. The commissioners are to ascertain the damages, subject to the order of the Court, which is to determine whether they shall be paid by the petitioners, or by the county, or in proportion by both. The Levy Court is to levy money for the roads adjudged to be opened, etc., and for the damages, and is to cause the said road to be opened, etc. Such roads are to be thereafter public roads.

In 1853 there was substituted for the law of 1818 a much more detailed act,[2] which, with an act of 1856,[3] formed the basis of the code of 1860,[4] and this, in turn, with the addition of laws of 1874 [5] and 1888,[6] constitutes the present law on this subject as contained in the Public General Laws.[7]

Penal Legislation and the Roads.

There remains a class of legislation for some time closely connected with that concerning highways. A penal statute of 1788 [8] authorized the erection of a new Court of Oyer and Terminer and Gaol Delivery in Baltimore county. This Court was ordered to condemn any person convicted of the crime therein specified, and also any vagrants, to labor upon the roads in Baltimore county. The general court and the various county courts, also, were authorized to sentence persons convicted before them of the same crimes and misdemeanors to the same penalty of labor upon the roads in Baltimore county, the expense of their transportation to Baltimore being borne in the former case

[1] Chap. lxxxix. [2] 1853, chap. ccxx. [3] 1856, chap. cccviii.
[4] Public General Laws (1860) art. 28. [5] 1874, chap. cccxi.
[6] 1888, chap. ccccLxvii. [7] Public General Laws, art. 25. [8] Chap. xi.

by the state, in the latter by the county so passing sentence. In addition the county courts were authorized to sentence criminals to labor upon the roads of their own county, making such provision for their care and expenses as they might see fit.

This act seems to have been put into practice chiefly in Baltimore county, where the convicts were put to work on the main roads of the county. The turnpikes undertaken by Baltimore county were, to a large extent, constructed by their labor, as appears from the accounts published from time to time by the commissioners of the roads. By a resolution adopted at the session of 1807,[1] the Justices of the Levy Court were authorized to apply the whole, or the necessary part, of the dividend received by them from the Baltimore and Frederick, and the Baltimore and Reisterstown roads, to the support of the convicts working upon the roads. Two years later[2] any male convict heretofore condemned to labor on the roads was allowed to pray the court to commute his sentence to confinement in the penitentiary.

When the turnpikes were surrendered by the county to private corporations, the convicts were transferred to the principal county roads. In 1810, for example, they were divided into two lots, one-half to work on the Liberty road, and the other half on the Bel Air and the Philadelphia post-road.[3] Upon the further development of the penitentiary system this method of road-construction was abandoned.

Private Roads.

The laws treated above referred exclusively to public roads, and for a long time private rights-of-way had apparently never been made the subject of legislation. In 1785,[4] however, an act was passed "To declare and ascertain the right of citizens of the State to private roads or ways."

"Whereas," the preamble recites, "the citizens of this State ought to have a road or way from their farms and plantations to places of public worship, mills, market-towns, public ferries and Court-houses. And such benefit ought to be enjoyed and experienced with as little possible dam-

[1] Resolution No. 1.
[2] 1809, chap. xxxviii.
[3] 1810, chap. lxxxviii.
[4] Chap. xlix.

age or injury to the lands through which such private roads or ways shall pass." The county courts on application are authorized to direct the surveyor of their county to lay out such private road, etc., not exceeding 16 feet, clear of ditches, in breadth; upon objection of any person through whose land the road may run the court may order such change as they may think desirable, shall direct the application and return to be recorded, and shall decide on the compensation due to the owners of the land through which the road is to run, which compensation shall be paid by the person or persons applying for the road. Thereupon such road is to be considered a private way, to be kept open and repaired at the expense of such person as shall use the same, and no one shall change or stop up such road [1] under fine of £5, current money.

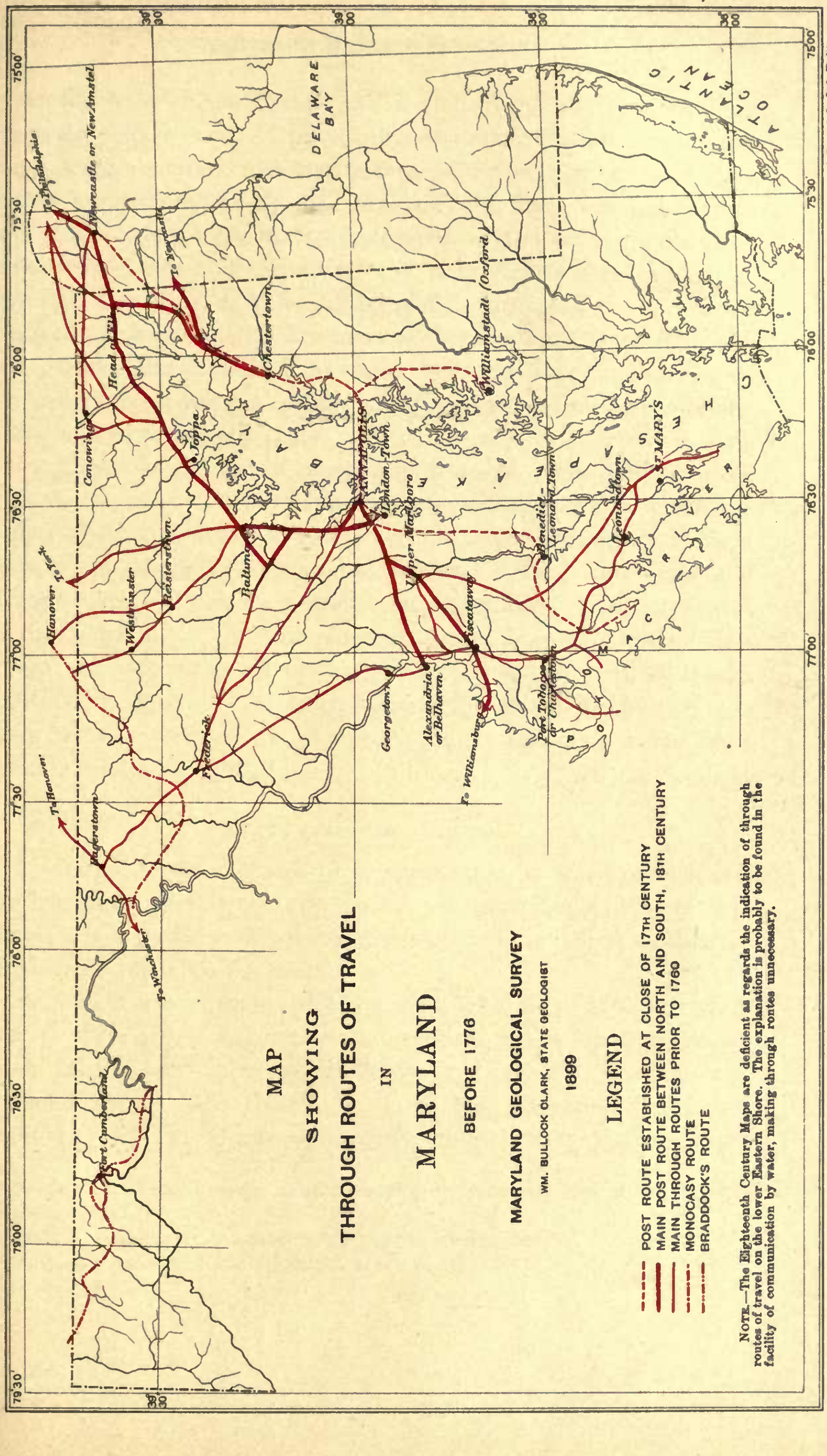
In 1834 [1] was passed a new and more detailed law for private roads. This, together with certain provisions of laws of 1832,[2] 1836,[3] and 1839,[4] was embodied in the Code of 1860,[5] whence it has been re-enacted into that of the present day.

Methods of Travel at the End of the Eighteenth Century.

The extracts and references in this and the preceding divisions are typical of the legislation regarding highways. To learn the results of this legislation, to discover the actual conditions of travel, other sources than the laws themselves must be consulted.

After the Revolution the maps are much more detailed than in earlier years. Griffith's map of Maryland in particular, contains indications of the more important roads, and would admit of interesting comparison with the knowledge derived from the laws, did space permit. The almanacs, which in earlier colonial days gave few facts as to the distances and routes from colony to colony, are later supplemented by detailed and exact road-maps giving every turn and twist in the road. Such a map is that of Christopher Colles, published in 1787, and entitled "A Survey of the Roads of the United States of America." Plates 51 to 62 give the roads from Philadelphia to Annapolis, the route being portrayed upon two or three plates to each page. Similar information is given by the "Traveller's Director or Pocket Companion," published at Philadelphia in 1804,[6] which includes a detailed description of the route.

[1] Chap. ccliii. [2] Chap. ccxcii. [3] Chap. cclv. [4] Chap. xviii.
[5] Public General Laws (1860), art. 28, sec. 29.
[6] In the Map Department of the Congressional Library in Washington.


MAP
SHOWING
THROUGH ROUTES OF TRAVEL
IN
MARYLAND
BEFORE 1776
MARYLAND GEOLOGICAL SURVEY
WM. BULLOCK CLARK, STATE GEOLOGIST
1899
LEGEND
POST ROUTE ESTABLISHED AT CLOSE OF 17TH CENTURY
MAIN POST ROUTE BETWEEN NORTH AND SOUTH, 18TH CENTURY
MAIN THROUGH ROUTES PRIOR TO 1760
MONOCASY ROUTE
BRADDOCK'S ROUTE
NOTE.—The Eighteenth Century Maps are deficient as regards the indication of through routes of travel on the lower Eastern Shore. The explanation is probably to be found in the facility of communication by water, making through rontes unnecessary.
DELAWARE BAY
ATLANTIC OCEAN
To Philadelphia
Newcastle or New Amstel
To Newcastle
Head of Elk
Conowingo
Chestertown
Williamstadt (Oxford)
Joppa
Baltimore
Annapolis
London Town
Upper Marlboro
Piscataway
Alexandria or Belhaven
Georgetown
Port Tobacco or Charleston
To Williamsburg
Benedict
St Leonard Town
Leonardtown
ST. MARY'S
Hanover
To York
Westminster
Reisterstown
Frederick
To Hanover
Hagerstown
To Winchester
Fort Cumberland
POTOMAC RIVER
A. Hoen & Co. Lith. Baltimore.

At the time of the French and Indian War, Governor Sharpe's coach-and-four was out of place upon any other than the main road through the province. In fact, before the Revolution carriages were few in number, and rarely used except in the finest weather. First-rate saddle-horses were much in demand, as the newspapers of the time plainly show. Fox-hunting and horse-racing were among the principal diversions, and the raising and importing of blooded horses received much attention. Members of the Assembly, lawyers, actors, and parsons, and indeed all to whom time was important and speed a necessity, preferred the activity of a thoroughbred to the lumbering "chariot" of these early times.

In Annapolis the use of coaches grew apace. The family coach, with its trappings and outriders, was a matter of pride in which the society of Annapolis turned out to every horse-race, or drove to Marlboro to see the latest company of players. "They have light and elegant carriages which are drawn by fine horses," is the comment of the Abbé Robin[1] on this phase of Annapolitan life, while Eddis writes just before the Revolution: "Our races, just concluded, continued four days, . . . and surprising as it may appear, I assure you there are few meetings in England better attended or where more capital horses are exhibited."[2]

STAGE-LINES AND STAGES.

A glimpse at the methods of transportation in Maryland towards the beginning of this century, before the turnpikes had been completed, might go far to dispel any illusions as to the "good old times," of which so much is often heard.

Stage-lines indeed there were, and had been, since 1765, in which year the first line of stage-vessels and wagons was set up to go once a week from Philadelphia to Baltimore by way of Christiana and French-town on Elk river.[3] In 1785 the Maryland Legislature granted G. P. Van Horne an exclusive right to keep stage-carriages

[1] Robin. Nouveau Voyage dans l'Amerique Septentrionale, p. 104 (Philadelphia, 1782).

[2] Eddis. Letters from America, p. 106 (London, 1792).

[3] Watson's Annals of Philadelphia, vol. i, p. 219.

"on the publick road from the river Susquehannah to the river Patowmack,"[1] and five years later Robert Hodgson and James Thompson[2] were granted the sole and exclusive permission to set up a stage-line from the Delaware boundary, via Chestertown, to Gresham College on the bayside in Kent county by the great public road on the Eastern Shore, and were also given a right, not exclusive, to run stages from North Point to Baltimore Town. This route seems to have been popular, though stress of weather often made delay in crossing the Bay unavoidable. These stages started regularly from Mr. Grant's tavern in Baltimore every Monday, Wednesday, and Friday morning and at six o'clock on the same days from Mr. James Thompson's at the Indian Queen, Fourth Street, Philadelphia.[3]

Another favorite route was by packet up the Chesapeake and Delaware bays, using land transportation only across the peninsula. This was a very old and popular route, perhaps because it took less time. It was not long before rival companies sprang up, one between Frenchtown and Newcastle, and the other from Cecil Court House to Newcastle.[4]

Very many other stage-lines were afterwards opened. In 1790 one was advertised between Baltimore and Annapolis. The trip was made three times a week, the price being 10s. during the summer season including fourteen pounds of baggage.[5] There were also many stage-lines from the western country.

The vehicle in which one ventured upon such a journey has been minutely described. The coach "was a sort of wagon on springs, an open carriage, with a top to it made of boards; and on each side, and at the ends, curtains, to be let down, baize on the inside, and a sort of canvas on the outside, tied with leather ties to the supporters of the top, on the sides and at the bottom, catching on a sort of stud like that of a single-horse chaise apron. The coach has three seats within the carriage and one the coachman sits on before. Thus it carries twelve people, three on each seat, as two passengers ride by the side of the

[1] Chap. xiv. [2] Chap. xxviii.

[3] See the newspapers of the period: *e. g.*, The Maryland Journal and Baltimore Advertiser, July 22, 1791.

[4] Maryland Journal and Baltimore Advertiser, March 22, 1791.

[5] Maryland Journal and Baltimore Advertiser, April, 1790.

coachman; but the mail-coach carries only nine passengers, the mail lying in the inside of the coach."[1]

THE PAINS AND PLEASURES OF TRAVEL.

One advantage certainly was afforded by the vehicles of the last century—time for observation. In such a conveyance as has been described, one might travel at the rate of 4 or 5 miles in fine summer weather, but in winter often not more than one mile an hour could be made. Yet time spent in this manner was certainly not disagreeably employed, for many picturesque scenes would present themselves to the traveler. Seated in such a conveyance, he might be entertained as was one gentleman in his journey through Maryland, on a Sunday morning a century ago, at the sight of girls riding to the parish church nearby, escorted by a negro boy perched behind one of the fair equestriennes, for whom he jumped down every few minutes to open the numerous gates that barred the road, and then nimbly resumed his seat without any detention of the party.[2] On a working day one might meet a long procession of horses, mules, or, more probably, oxen, dragging hogsheads of tobacco by pivots driven into each end and shafts attached.[3]

At another turn in the road one might barely escape collison with a monstrous family coach, escorted by gorgeously-liveried outriders, and proceeding on its journey with more style than comfort to its occupants. Again, there is need to pull up sharply in order to yield the road to the more rapid wagon or "coachee" which has overtaken the coach. Numbers of carts are passing along, and farm-wagons, with high-ribbed bows covered with canvas, to shield the farmer from the sun by day and the dews by night. Nearer Baltimore Town one meets large gangs of "wheelbarrow men," those convicts who, before the institution of the penitentiary system, were condemned to labor upon the highways. Accompanying each group is an overseer, wear-

[1] Parkinson, R. A Tour in America in 1798, 1799 and 1800, vol. i, pp. 252-3. (London, 1805.)

[2] Sutcliff, R. Travels in some parts of North America in the Years 1804, 1805 and 1806, p. 48. (Philadelphia, 1812.)

[3] Sutcliff. Travels, p. 99.

ing side-arms and often carrying a musket. Here and there are cabins in which the convicts at night are lodged or imprisoned.[1]

The driver is a steady man with a wonderful knack of avoiding the many stumps and large trunks of trees that fill the road. He guides his horses, usually named after the prominent politicians of the day, more by the different noises he makes than by the use of the reins. Stopping over night at one of the wayside inns one may get a bed for a quarter of a dollar the night.[2] It will not do to appear too anxious about accommodations, for the host, in an injured tone, informs one gentleman that he need give himself no trouble on that score, because no less than *eleven* beds may be found in one of his rooms.[3] For breakfast or supper one pays half a dollar; for dinner, one dollar. On the bill-of-fare may be found tea, coffee, fish, beef-steak, mutton-chops, sausages, eggs, several kinds of bread and butter, "cakes of buckwheat, &c."[4]

Danger, as well as discomfort, attends the passage of the many ferries which are found on the line of the main road. If the wind is high the trip is perilous as well as uncomfortable. If the water is low we may have to mount upon the backs of sturdy watermen and so be "toted" out, with possibilities of descent into the mud.[5] But even on land the journey may be filled with discomfort. One traveler has left a particularly dolorous account of his misfortunes, experienced, strange to say, upon the main road from Philadelphia via Baltimore to Washington. His own words must recount his adventures: "But the best cultivated parts of the country are not seen from the road, which passes chiefly over barren and hilly tracts, called 'ridges.' The reason for carrying the road over these is, because it is found to be longer than if carried over the flat part of the country, where the soil is deep, a circumstance which the people of Maryland always take into consideration; for after a road is once cut, they never take pains to keep it in good repair. The roads in this state are worse

[1] Tyson, M. E. A Brief Account of the Settlement of Ellicott's Mills, p. 18.

[2] Parkinson's Tour, vol. i, pp. 253-4.

[3] Weld, I., Jr. Travels through the States of North America during the years 1795, 1796 and 1797, p. 16, note.

[4] Parkinson's Tour, vol. i, p. 255.

[5] Sutcliff. Travels, p. 59.

than in any one in the Union; indeed, so very bad are they, that in going from Elkton to the Susquehannah ferry the driver frequently had to call to the passengers in the stage to lean out of the carriage first at one side, then at the other, to prevent it from oversetting in the deep ruts with which the road abounds: 'Now, gentlemen, to the right,' upon which the passengers all stretched their bodies half-way out of the carriage to balance it on that side: 'Now, gentlemen, to the left,' and so on. This was found absolutely necessary at least a dozen times in half the number of miles."

His comments on the road-construction of the times are interesting: "Wherever they attempt to mend these roads, it is always by filling the ruts with saplings or bushes, and covering them over with earth. This, however, is done only when there are fields on each side of the road. If the road runs contiguous to a wood, then, instead of mending it where it is bad, they open a new passage through the trees, which they call making a road. It is very common in Maryland to see six or seven different roads branching out from one, which all lead to the same place. A stranger, before he is acquainted with the circumstance, is frequently puzzled to know which he ought to take. The dexterity with which the drivers of the stages guide their horses along these new roads, which are full of stumps of trees, is astonishing."

Speaking of the travel between Baltimore and Washington, he recites: "The roads passing over these bottoms are worse than any I ever met with elsewhere. In driving over one of them, near the headwaters of a branch of Patuxent river, a few days after a heavy fall of rain, the wheels of a sulky which I was in sank up to the very boxes. For a moment I despaired of being able to get out without assistance, when my horse, which was very powerful, finding himself impeded, threw himself upon his haunches, and disengaging his forefeet, made a vigorous plunge forward, which luckily disengaged both himself and the sulky and freed me from my embarrassment. I was afterwards informed that General Washington, as he was going to meet Congress a short time before, was stopped in the very same place, his carriage sinking so deep in the mud that it was found necessary to send to a neighboring house for ropes and poles to extricate it.

Over some of these bottoms, which were absolutely impassable in their natural state, causeways have been thrown which are made with large trees laid side by side across the road. For a time these causeways afford a commodious passage; but they do not last long, as many of the trees sinking into the soft soil, and others exposed to the continual attrition of the wagon-wheels in a particular part, break asunder. In this state, full of unseen obstacles, it is absolutely a matter of danger for a person unacquainted with the road to attempt to run a carriage along it. The bridges over the creeks, covered with loose boards, are as bad as the causeways and totter as a carriage passes over. That the Legislature of Maryland can be so inactive and not take some steps to repair this, which is one of the principal roads in the state, the great road from north to south and the high road to the city of Washington, is most wonderful!"[1]

The Development of Turnpikes in Maryland.

The development of the turnpike system in Maryland and its influence upon the commercial welfare of the state is a subject to which little attention has been paid, but which would afford material for a separate volume. A complete discussion is forbidden, however, by the extent of the foregoing matter; and while the rise of the turnpikes will be traced with some detail, their history, after the period of their greatest importance, must be discussed only in the most general terms.

A "turnpike" or turnpike road is generally understood to have three characteristics:

1. An improved surface or road-bed.
2. A system of toll-gates placed at certain intervals.
3. An incorporated company with shares of stock, etc., furnishing the capital for the construction of the road.

The first road in the United States fulfilling all three conditions is said to have been that between Philadelphia and Lancaster, constructed by a company incorporated in 1791, for the stock of which frequent advertisements[2] appear in the Philadelphia papers of that and the next year. This turnpike was finished in 1795.

[1] Weld, I., Jr. Travels, etc., pp. 22ff.

[2] Watson. Annals of Philadelphia, vol. iii, p. 152.

BALTIMORE COUNTY TURNPIKES.

Four years later, in 1787,[1] the Legislature of Maryland made provision for the construction of several roads called turnpike roads in Baltimore county. The language used in the preamble of the act then passed shows how strongly the need of improved road-beds was felt:

"The public roads leading from Baltimore town to the western part of the state, by reason of the great number of wagons that use the same, are rendered almost impassable during the winter season, and the ordinary method of repairing the said roads is not only insufficient but exceedingly burthensome; and the establishment of several turnpike roads in the said county would greatly reduce the price of land-carriage of produce and merchandize, and raise the value of the land in the said county and considerably increase the commerce of the state."

Commissioners were appointed "to examine, survey, lay out and mark a public road from Baltimore-town towards Frederick-town in Frederick County to the line of Baltimore County, sixty-six feet wide, and on as streight a line as the nature of the country will permit;" in so doing they should "consider not only the distance but the goodness of the ground on which the said road is to pass." Similarly, other commissioners were to lay out "roads from Baltimore-town to Reisterstown," "from Reisterstown to Winchester-town [Westminster ?];" "from Reisterstown to Hanover-town, to the line of Baltimore County," and a road "from Baltimore-town towards York to the line of Baltimore County."

These highways possessed two of the three usual characteristics of a "turnpike road;" special provision was made for the improvement of the road-beds, and the erection of toll-gates was ordered. The construction and subsequent management of these roads was entrusted, however, not to a private company incorporated for that purpose, but to numerous officials to be appointed by the court of Baltimore county.

The roads were to be cleared sixty-six feet wide, with beds forty feet wide, raised in the middle eighteen inches above the sides. "When necessary," the beds were to be "covered or crowned with small stones or coarse gravel." Milestones and guide-posts were to be set up.

To cover the expenses of construction and management, two means were provided: First, officers known as the Commissioners of Review were to set up toll-gates and collect tolls of specified rates. Secondly, a property

[1] April Session, chap. xxiii.

tax of 3s. 9 d. per £100 for the first year, and of 2s. 6d. for succeeding years, was to be levied in Baltimore county. Besides the "Commissioners of the Roads" and the "Commissioners of Review," there were to be a Surveyor and a Collector. At least twice a year accounts were to be published in the Baltimore papers.

This unique plan of turnpiking under county authority was upon the whole unsuccessful. Within fourteen years the act of 1787 was amended no less than ten times. Many of these changes were unimportant; in 1790, however, the influence of the legislation for counties led to a law[1] empowering the Commissioners of Review to appoint one or more supervisors for the roads in question and permitting the substitution of personal labor for the payment of the tax authorized in 1787. This merely increased the division of authority that already existed; and finally, in 1801,[2] provision was made "for better guarding the executive part of the said law" [of 1787]. It was now decided to dispense with the numerous officials of the earlier law, and the management of the turnpike roads was given to a superintendent who should be appointed by the court of Baltimore county, give bond for $5,000, appoint supervisors, clear the roads, etc. The books and property of the former commissioners and supervisors, and also the convicts at work upon the roads, were to be transferred to the new officials.

That some progress was made in the construction of these roads we may learn from the accounts published from time to time by the Commissioners of Review, two of which it may be worth while to give.

BALTIMORE, MARCH 18, 1791.

BALTIMORE COUNTY, FOR TURNPIKE ROADS, IN ACCOUNT WITH SAMUEL OWINGS, TREASURER.

DR.	£.	s.	d.
To cash paid for Sundries from the 5th of July, 1788, to to the 14th of Feb., 1791, as follows:			
For Centinels and Laborourers, Wagons and Cart hire....	467	8	10½
For Lands taken from the road to Reisters-Town, Surveying and laying out roads, carpenters work, physicians' attendance, medicine and commissioners' attendance....	770	8	8
For clothing and victualling the criminals during that time, and for Carts, Horses, Waggons, and Sundry Tradesmen's Bills	3,332	3	9
	4,570	1	3½
To balance due the Treasurer per Contra.................	102	17	4½

[1] 1790, chap. xxxii.

[2] 1801, chap. lxxvii.

CR.	£.	s.	d.
By Cash received of Philip Graybell, Esq	2,428	6	4
By ditto received of Thomas Rutter, Esq	2,038	17	7¼
By balance due the Treasurer	102	17	4½
	4,570	1	3½

(Errors excepted.)

Baltimore, Feb. 14, 1791.

Samuel Owings, Treasurer.

Baltimore, March 14, 1791.

Compared with the vouchers, and passed.

O. H. Williams,
Daniel Bowley,
Charles Ridgely of Wm.
} Commmissoners of Review.

BALTIMORE COUNTY, FOR TURNPIKE ROADS, IN ACCOUNT WITH THE TREASURER OF SAID ROADS.

DR.	£.	s.	d.
1801.			
To balance, per account filed last year	2,700	4	9¼
Paid overseers, centry, gate-keepers, Medicine and attendance, per vouchers up to October 1st, 1801	812	19	8
Paid for timber, fire-wood, building stone for bridges, masons, lime surveyors, commissioners, provisions and clothing for criminals, iron, steel, blacksmiths' tools, carts and horses, wagon hire, &c., per vouchers to October, 1801	4,341	10	9¾
	7,863	14	6

CR.	£.	s.	d.
By C. H. Gist, Esq., since October, 1800	1,096	14	4
By J. Wilson, Esq., to October, 1801	1,398	17	4
By H. Stevenson	791	5	
By Middle Gate	912	13	1
By York Gate	420	2	5½
By Frederick Gate	278	11	5
By Sundry small credits	43	19	3
Balance due sundry creditors	2,921	11	4½
	7,863	14	6

Samuel Owings, Treasurer.

Baltimore, October, 1801.

Examined, compared with the vouchers, and past.

(Signed) James Ogleby,
J. Nathan Ellicott,
William Owings,
David McMechen,
Charles Ridgely of Hampton.

The latter account shows a marked deficit. The next year, 1801, by an act to which reference was made above,[1] an additional tax of 50 cents per 100 was laid in Baltimore county and new rates of toll were specified. The Levy Court was empowered to borrow $1,600 to finish the roads. This was insufficient, and a further tax of 15 cents per 100 was levied the same year.[2] In 1802, fifteen years after the original act, it was ordered that the Reisterstown turnpike should be recorded as completed.[3]

INCORPORATION OF PRIVATE TURNPIKE COMPANIES.

When the failure of the experiment of turnpiking under county authority became apparent, efforts were made to attract private capital to investment in the construction of turnpike roads. For some time these attempts were equally fruitless. The first turnpike company in Maryland, incorporated in 1796, to build a turnpike road between Baltimore and Washington,[4] apparently accomplished nothing, and those immediately following seem to have been no more fortunate.[5]

THE TURNPIKES OF 1804-5.

It was not until the session of 1804-5 that legislation was enacted which had a permanent result. In that year there were passed two acts, which may be said to have laid the basis of the turnpike system in Maryland. The fifty-first chapter of this year's legislation is entitled "An Act to Incorporate Companies to make Several Turnpike Roads through Baltimore County, and for other purposes." The preamble recites that "it is represented to this General Assembly, that by the several laws heretofore passed on this subject the desirable object

[1] 1801, chap. lxxvii. [2] 1801, chap. lxxxvii. [3] 1802, chap. lxxx.

[4] Chap. lxix. Capital, $160,000.00.

The provisions for tolls include this: For every single horse, *camel*, ass or mule, $0.01.

[5] Other companies apparently unsuccessful were: the Elizabeth Turnpike Company, incorporated 1797 (chap. lxv); the Reisterstown turnpike roads (1797, chap. lxx), intended to connect with the county turnpike of the law of 1787; the Alleghany Turnpike Road (1801, chap. xlv); and the Cumberland and Union Road (1801, chap. lii). These incorporations make evident the desire to improve the conditions of intercourse with the western country.

contemplated by the Legislature has not been obtained and the public expectation almost entirely frustrated." Three companies were accordingly incorporated to make roads as follows:

1. From Baltimore through New Market, Frederick and Middletown to Boonsborough.[1]

2. From Baltimore through Reisterstown towards Hanover and through Westminster to the Pennsylvania line, towards Petersburgh, as shall be agreed upon by a majority of the stockholders.[2]

3. From Baltimore toward York to the Pennsylvania line.[3]

Various extensions of these roads were subsequently authorized (*a*) from Boonsborough to Hagerstown, (*b*) from Boonsborough to Williamsport,[4] (*c*) from Frederick to Harper's Ferry,[5] afterwards, in 1815,[6] put under a separate company, and (*d*) from Boonsborough to the beginning of the Cumberland Turnpike Company's road.[7] By an act of 1805,[8] the second road might be extended from Westminster to Taneytown, Emmitsburg, and thence to Pennsylvania line.

The titles of the three companies were to be respectively—

The President and Managers and Company of the

Baltimore and Frederick Town Turnpike Road,

" " Reisterstown " "

" " York Town " "

and the companies were given full corporate powers.

The text of this act is very lengthy, containing thirty-nine sections. Some of the most important provisions are as follows:

The roads are to be made over, and upon the beds of the present roads, as laid out and confirmed by the Commissioners of Review [of 1787].

Baltimore county having expended considerable sums in turnpiking these roads, is to be reimbursed by the payment to the county of shares of turnpike stock to an amount equal in value to the old roads. This value is to be ascertained by the arbitration of nine commissioners for each road, three of whom are to be chosen by the Levy Court; three by each company, and the remaining three by the former six. The Levy Court, upon receiving the stock awarded by the commission, shall then have all the privilege of

[1] Capital Stock, $220,000.
[2] Capital Stock, $160,000.
[3] Capital Stock, $100,000.
[4] 1804, chap. ci.
[5] November, 1809, chap. cxxiv.
[6] Chap. clxvi, sec. 17.
[7] See 1815, chap. cxxv.
[8] Chap. lxvii.

voting, &c., of an individual holding the same number of shares.[1] Anne Arundel and Frederick counties are also to be reimbursed for their expense in laying out such parts of the roads as lie within their limits.

Twenty feet in breadth, at least, is to be made an artificial road, which shall be bedded with wood, stone or gravel, or any other hard substance well compounded together a sufficient depth to secure a solid foundation; and the road is to be faced with gravel or stone pounded, or some other hard substance, in such manner as to secure a firm and, as near as possible, an even surface. The road is in no place to rise or fall more than will form an angle of 4° with a horizontal line, except over the Catoctin and South Mountains, where an angle of 6° will be tolerated. "The companies shall forever hereafter, during the continuance of said incorporation or incorporations maintain and keep the same in good and perfect order and repair."

Upon finishing the first and every subsequent ten miles of road the companies may notify the Governor of the state, who shall then nominate and appoint three persons to review the same. If they report favorably upon the completed work, the Governor shall, by license, permit the erection of so many gates as will be necessary.[2]

The Treasurer of the Western Shore is constituted a Court of Inspection, to whom the companies shall report annually as to their receipts and expenses. The Stockholders are not to receive more than 10% net profit on their investment. The companies shall keep accounts, an abstract of which is to be laid before the General Assembly by the Court of Inspection every third year until two years after the roads are completed. The Court of Inspection is to employ the surplus above 10% profits to purchasing out the stock of the respective roads. The General Assembly may purchase the road at any time by paying the respective companies the cost of the roads with interest equivalent to 10% on their investment.

If the road is considered to be out of repair, a jury of inquisition is to be summoned. If they find the road imperfect as alleged, the collection of tolls shall cease at the nearest gate on each side of the defective spot. Fines are provided for evading the tolls.

The companies are to erect posts and index hands and mile-stones, and the distance between gates is to be marked on the gates. The destruction or defacing of such posts, etc., is punishable by a fine.

Drivers are to be kept to the right. Persons living on or adjacent to the roads and within three miles of a toll-gate are to pay toll but once in

[1] The Levy Court of Baltimore County shall continue the present turnpike gates on the turnpike, and appoint toll-gatherers to receive the present tolls until the companies have finished their respective roads ten miles from Baltimore City.

[2] Rates of toll are established by section 20 for any person riding, leading or driving horses, cattle, hogs, sheep, sulkey, chair, chaise, phaeton, coach, coachee, cart, wagon, sleigh, sled or other carriage of pleasure or burden. Two oxen are charged the same as one horse. Limits are set to the weight of loads upon wagons of specified tire width. The companies may erect scales and compel the weighing of teams.

twenty-four hours. The tolls may be farmed out. The laws relating to convict labor on the roads are to be in force until the turnpikes are finished. Provision is made as to the time of commencement and completion of the roads; and the construction of the York and Reisterstown roads is suspended until Jan. 1st, 1808. This provision was however modified.[1]

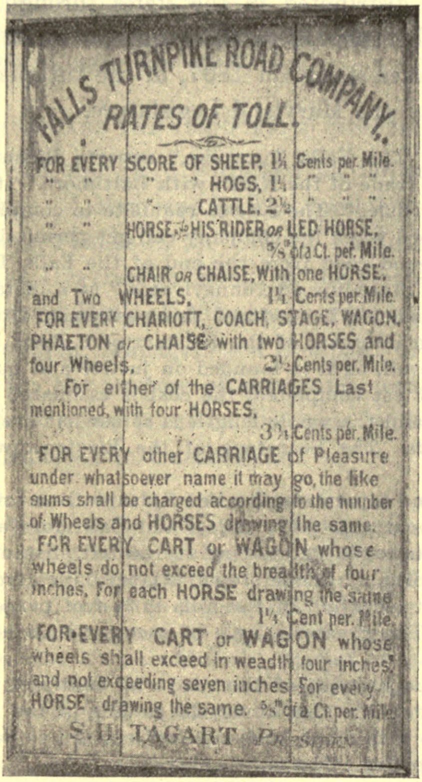


Fig. 4.—Old sign-board giving the rates of toll on animals and vehicles.

The Falls Turnpike Company was incorporated in the same year, 1804.[2] This was to run from the cross-roads near Richard Caton's lime-kiln in Baltimore county, nearly along the line of Jones' Falls to the City of Baltimore. Special provision was made against the York road trade being diminished by the Falls turnpike.

[1] In 1805, the requisite stock having been subscribed, the Reisterstown Company was authorized to proceed at once [chap. xv], and similar permission was granted the York Company in 1807 [chap. cxliv].

[2] Chap. xci.

GALLATIN'S REPORT ON TURNPIKES.

In accordance with a resolution of the Senate adopted March 2, 1807, the Secretary of the Treasury, Albert Gallatin, prepared a list of questions to acquire information concerning turnpikes, and copies of this list were distributed in the states through various Federal officers. From the answers to these queries much may be learned concerning the exact status, in 1807, of the turnpikes authorized by the acts of 1804 of the Maryland Legislature.

Falls Turnpike. "The Falls Turnpike," reports Richard Caton, "is expected to unite the trade of the North with Baltimore. It is in a direct line to Hanover and Carlisle." The $38,000 requisite to complete the road "will be eagerly subscribed when the company can get permission from the Legislature to make a good road from the end of the Falls Turnpike to a road which leads to the State-line of Pennsylvania," at a distance of nine miles. He thinks the Legislature has refused this permission from an over-scrupulous regard for the interests of the Reisterstown Road. "The application must, however, prevail, as it is founded on justice and public utility."

"The road is not yet completed; the cost is estimated at $7,500 per mile, including bridges, and the whole length is somewhat over nine miles."

Reisterstown Roads. The Secretary of the Reisterstown Turnpike Road Companies reports:

(1) Baltimore and a point on the Pennsylvania line towards Hanover are united; distance about thirty-five miles; and Baltimore and a point on the Pennsylvania line towards Petersburg are united; distance about forty-five miles. The road forks at Reisterstown, sixteen miles from Baltimore.

(2) The greatest elevation of the hills is 24 feet perpendicular from the bed of the road. The greatest angle of ascent which has been allowed is 3½°.

(3) Describes the breadth of the road and continues: "The form convex, twenty-four feet in width along the middle of the road, and one foot in depth is bedded with stone broken small enough to pass through a ring of three inches diameter. The rest is clay."

(4) Details of bridges—all of which are of stone.

(5) Cutting through hills and filling up valleys are particular difficulties surmounted and to be encountered.

(6) Expenses for construction, $10,000 per mile.

(7) Capital already expended is about $200,000; that vested is $120,000. Ten miles of road have been completed, and the work is progressing.

(8 and 9) Information as to tolls and charters.

Frederick Road. Jonathan Ellicott of the Baltimore and Fredericktown Turnpike Road reports at greater length:

The distance from Baltimore to Boonsborough is about sixty-two miles. The contract for the first twenty miles of the road was made July 4th, 1805, and the cost was $9,000 a mile on the average. The gates were up and toll being received by April 24, 1807. Seventeen miles farther are contracted for at about $7,000 per mile, and of these, only ten are completed.

"It may be observed," he continues, "that from Boonsborough to Cumberland, a distance of seventy-four and a-half miles, as the road now runs, is as yet without any provision by laws for its improvement, further than as common county roads in other parts of the State. . . . To bring into full operation the benefits contemplated by the general government by the road leading from Fort Cumberland to the Ohio,[1] it becomes necessary that the State of Maryland should either take this matter upon her own account or put it in the power of Congress to promote a design which it is to the interest of the Union to carry into effect.[2]

THE BANKS AND THE TURNPIKE TO CUMBERLAND.

The years of 1812 and 1813 witnessed an important step in the turnpike-construction of Maryland.[3] The president and directors of the several incorporate banks in the City of Baltimore, the president and directors of the Hagerstown Bank, of the Conococheague Bank, and of the Cumberland Bank of Alleghany, were incorporated by the name of "The President, Managers and Company of the Cumberland Turnpike Road," for the purpose of surveying, locating and making a turnpike road from some point on the west bank of Big Conococheague through Hancock to Cumberland.

This company is invested with all the rights of those incorporated in 1804 with the same provisions as to tolls, etc. The charters of the banks included in the statute are extended to January 1, 1835, upon condition of the several banks subscribing in proportion to their respective paid-in capitals for as much stock as will cover the expense of completing the road. In case any one of these banks augments its capital, its President and Directors are required to subscribe for an additional amount of stock in proportion. The President and Directors of each bank subscribing are to choose one manager for every twenty-five thousand dollars of road stock subscribed by them, but every bank is to have the choice of one manager. The managers so chosen shall elect from among themselves a President and Treasurer.

The road is to be made, stoned, etc., in the same manner as the Frederick Turnpike, except in parts where stoning is thought unnecessary.[4]

[1] The National Road.

[2] American State Papers, Miscellaneous, vol. i, pp. 900-909.

[3] 1812, chap. lxxix; 1813, chap. cxxii. The latter act was a substitute for the former.

[4] After Jan. 1st, 1815, all the incorporated banks in the state shall pay annually to the Treasurer of the Western Shore a tax of 20 cents on every $100 of their capital stock, as a further condition of the extension of their charters. The proceeds of this tax are to be invested in stock of the Commercial and Farmers' Bank of Baltimore and the Mechanics' Bank of Bal-

INCREASE OF TURNPIKE COMPANIES.

Meanwhile the incorporation of turnpike companies went on unceasingly. Many schemes that had previously failed were taken up again. For example, the unsuccessful Baltimore and Washington Turnpike Company of 1796 was succeeded in 1812 [1] by a new company formed to make a turnpike road from Baltimore to Norwood's Ferry on the Patapsco, and thence by McCoy's Tavern, Vansville, the White House, Ross's Tavern and Bladensburg to Washington. In 1813 [2] the Newcastle and French-town turnpike, which had not succeeded when first incorporated in 1809,[3] was revived, and the Baltimore and Strasburg,[4] Baltimore and Havre de Grace,[5] and the Westminster, Taneytown and Emmitsburg [6] Turnpike Companies were incorporated. Two years later, in 1815, the Baltimore and Frederick Turnpike Company was authorized to open subscriptions for additional stock to the amount of $160,000, to construct a road from Boonsborough to that point on the west bank of the Conococheague, at which the Cumberland Turnpike road began.[7] At the same time the control of the Harper's Ferry road was taken from them.[8]

GOVERNOR GOLDSBOROUGH'S REPORT.

Three years later is found an interesting executive communication from Governor Charles Goldsborough to the Assembly on the subject of turnpike roads. This was prepared in accordance with a resolution of the House adopted the previous session, calling for information on this point. A list of queries was sent to the various turnpike

timore, to be a fund for the establishment of Free Schools, kept separated from the rest of the funds of the State of Maryland. The Treasurer is to report thereon annually to the General Assembly. The banks may escape the payment of the annual tax by paying to the state before January 1, 1816, the sum of $200,000. If the banks agree to these propositions, the faith of the state is pledged to impose no new tax on them and to incorporate no new banks in Baltimore before January 1, 1835.

Thus by this act two great ends were had in view. The connection of the Cumberland or National Road with Baltimore and the establishment of the public school system of Maryland.

[1] 1812, chap. lxxviii.
[2] 1813, chap. lxxxii. December Session.
[3] 1809, chap. lxiv.
[4] 1813, chap. cxxvi. December Session.
[5] 1813, chap. clxvii. December Session.
[6] 1813, chap. clxxiii. December Session.
[7] Chap. cxxv.
[8] Chap. clxvi.

companies, and a summary of the answers was given in the Governor's report.

The report commences with some general remarks upon the subject. The aggregate capital invested in turnpike roads is valued at $2,100,000, the greater part of which is owned in Baltimore. The stock owned by the state is $10,000 in the Frederick Road and $5,000 in the York Road.[1]

Concerning the difficulties of the turnpike companies in the existing situation, it is reported that each company sustains a great loss from parallel roads, which are neither turnpiked nor shut up, and in fine weather are patronized by all but the heaviest teams in order to avoid paying the tolls. Another mistake was made in fixing the tolls arbitrarily at so much per horse according to the kind of carriage, whereby an empty wagon pays as much as one with the heaviest load if the number of horses is the same.

It is suggested that the tolls be regulated according to the weight, and also according to the season, light in fine weather and heavy in winter. A most pernicious practice is that of locking the wheel of a heavily loaded wagon descending a hill, thereby tearing up the road, when frost and wet weather have made the foundation soft. This is especially true of mountain roads. The substitution of the "shoe" is earnestly recommended, that is, "a piece of iron, or even wood, 18 inches or 2 feet long and 4, 6 or 8 inches broad, fastened to the cross-bar or bolster of the wagon by a chain which is just of such a length that when the shoe is slipped under the hinder wheel, the chain prevents it falling farther back, and the wagon being in motion, the shoe is dragged on bearing the wheel up on it." But the great scourge to a turnpike road is the narrow wheel, which should be made the subject of legislation.

As to the condition of the various roads, the report notes that the Frederick Road "was originally intended to be made eleven miles further to Williamsport on the Potomac, but failed, however, in consequence, it is believed, of the expenditure of the sum of $56,000 upon the bridge over the Monocacy, which the Company was not obliged by law to make, but assumed it voluntarily, in the belief that the Legislature would grant them a special toll to meet the special expense. In consequence, however, of the refusal of the Legislature to do so, their capital was exhausted and themselves discouraged from the prosecution of the road."

The Bank Road to meet the National Road at Cumberland appears to be peculiarily the object of legislative care. The importance of the retention and development of the connection with the Ohio country to the commercial interests of Baltimore is dilated upon at length. The Frederick Road is complete to Boonsborough, sixty miles from Baltimore. The Reisterstown Road is completed to the town of Westminster, whence the road proceeds northerly in the direct route to Chambersburg in Pennsylvania. The under-

[1] A resolution of 1808 extended the financial aid of the state to the turnpike companies by authorizing the Treasurer of the Western Shore to subscribe for 250 shares in the Baltimore and Frederick Turnpike Company's stock and 250 shares in the York Turnpike stock. An additional subscription was authorized the next year.

taking of another company to make a road from the Reisterstown Road near Westminster to Hagerstown through Harman's Gap in the Blue Ridge, is believed to be at a stand for want of funds. A return was made to the executive on Dec. 28th, 1816, that 6½ miles were completed, and license to erect a toll-gate was granted. The distance from Westminster to Hagerstown is estimated at forty miles. From Conococheague Creek to Cumberland, fifty-eight miles, the road undertaken by the banks, will be completed by December, 1820.

It appears, then, that there is a gap in the communication to Cumberland not provided for. This it is proposed to fill up in one of three ways: 1st. By finishing the road from Westminster through Harman's Gap to Hagerstown; 2d, by turnpiking from Boonsborough to Hagerstown; and 3d, by turnpiking from Boonsborough through Williamsport to intersect the Bank Road somewhere at the seventh or eighth mile-stone of that road west of the Conococheague. The executive does not undertake to decide which of these is preferable, but leaves that to the Legislature, whose attention he moreover directs to the Bank Road, recommending its purchase by the state, and the reduction of tolls. The creation of a board of Commissioners of Public Works, to be elected by the Legislature, and to serve without salaries, is recommended. The report is supplemented by statistical information from the various turnpike companies. From these it is plain that the dividends declared by the Reisterstown, Frederick and York turnpikes show upon the whole a steady increase down to 1817, the last year reported.

The immediate outcome of this communication was a resolution authorizing the Governor and Council to ascertain the best terms upon which the possession of the road might be obtained from the state, also upon what terms the banks would consent to release from toll all wagons having tires of certain width.

FURTHER BANK AID.

In 1818 there was published a pamphlet of some thirty pages entitled "Remarks on the Intercourse of Baltimore with the Western Country," with an accompanying map, showing the contemporary status of the turnpike connection. The pamphlet emphasized the necessity of the undertaking to the commercial well-being of Maryland and also its unifying effect politically. This and similar presentations of the case seem to have had due influence upon the Assembly, which, in the session of 1821,[1] extended the charters of the banks ten years longer, to 1845, upon condition of their forming a company to make a turnpike from Boonsborough to Hagerstown.

The new company is invested with all the rights of the previous company and like that is subject to an annual tax of 20 cents on every $100 of their capital stock, the proceeds of the tax to be invested for the benefit of the

[1] Chap. cxxxi.

free schools. Work is to begin within two years, and the road is to be completed within four years thereafter. It is to be constructed like the Frederick Turnpike.

The assistance rendered to turnpike construction by investments compulsory or voluntary on the part of the banks was not limited to the cases mentioned above. The Frederick and Harper's Ferry, Williamsport and Hagerstown, Baltimore and Havre de Grace and other turnpikes received similar pecuniary aid. Dr. Bryan[1] states that the liabilities thus assumed were unprofitable to the banks, and his view is corroborated by the Executive Report of 1817, to which reference has been made above. The directors of the Bank Road, when asked to mention any particular grievances with which they were afflicted, reply: "The Company have but one grievance to complain of, and that is being compelled to make this road. It is a severe and oppressive tax upon the banks, and one which, under present circumstances, their business does not enable them to meet without great embarrassment."

THE TURNPIKES AND BALTIMORE CITY.

With the completion of the connection between Cumberland and the East, by the construction of this road, the importance of the turnpikes reaches its height. The further westward they extended the wider was the territory they "tapped." The National Road, whose historic relation to the State of Maryland will presently be considered more specifically, was now completed from Cumberland to the Ohio river; and from Cumberland to Baltimore was an easy descent.

By these channels a stream of wealth rolled down to Baltimore to be shipped to Europe, South America, or the West Indies. We owe to Jared Sparks, the biographer of Washington, a most pleasing description of Baltimore's prosperity in the third decade of this century. "Within the last thirty years," he says, "the population of Philadelphia has increased to a number three times as great as it was at the beginning of that period; New York to a number four times as great, and Baltimore to a number five times as great. Among all the cities of America, or of the Old World, there is no record of any one

[1] Bryan, A., State Banking in Maryland, pp. 60-61.

which has sprung up so quickly or to so high a degree of importance as Baltimore. At the commencement of the Revolution it was a village of five thousand inhabitants, and at the close of the war it had increased to more than eight thousand. In magnitude it is now the third city in the Union, and has held that rank for nearly twenty years." In ascribing causes for this rapid development he gives first place to its situation, . . . "presenting the nearest market to the western country," adding, as other reasons, the fast-sailing vessels, the almost exclusive intercourse with San Domingo for a long period, the two great staples, flour and tobacco, and lastly, and, it is to be hoped, the most enduring element of all, the energetic spirit of the people. In a more detailed manner he refers to seven turnpikes then entering Baltimore city—the Reisterstown, York, Frederick, Washington, Bel Air and Havre de Grace. "Now," he continues, "the line of communication is complete between Baltimore and Wheeling over one of the best roads in the world, on which it is now in contemplation to set up a line of transport-wagons to run day and night." [1]

From this and other sources it is possible to gather interesting details of the commercial activity of the time. "Large droves of live stock," Sparks tells us, "especially hogs, are now driven every year from the banks of the Ohio, in Kentucky, to Baltimore, in preference to being packed on the spot and sent down the river by a more speedy conveyance to the New Orleans market." [2] "In 1827," another record relates, "a gentleman traveling thirty-five miles on the road between Baltimore and Frederick met or passed 235 wagons in his journey, nearly seven for every mile. These wagons were generally of the largest size and very heavily loaded." [3]

The capacious courtyards of the old inns and hotels in Baltimore city, which have one by one disappeared before the advance of modern civilization, long served to remind one of these old Conestoga wagons that came down to Baltimore drawn by five and six horses—oftentimes with a sturdy bull-dog chained behind. These wagons carried enormous loads. Upon one occasion an ordinary five-horse farmer's wagon brought from Gettysburg, Pennsylvania, to Baltimore, ten barrels of

[1] "Baltimore," in North American Review (1825), vol. xx, pp. 99ff.

[2] Ibid., p. 133.

[3] Niles' Register, 1827, n. s., vol. viii, p. 34.

whiskey and fifteen barrels of flour, besides a few kegs of butter, weighing in all over three tons and a half.[1]

THE RISE OF THE CANAL AND THE RAILROAD.

Hardly had the turnpike system been perfected, however, when its adequacy began to be threatened by another, beyond which the present day has not definitely advanced. The course of events is summarized by Pitkin as follows: "The enterprising citizens of Baltimore in 1826, perceiving that, in consequence of steam navigation on the western waters and the exertions of other states, they were losing the trade of the West, began seriously to consider some mode of recovering it."[2]

The successful application of steam to water transportation preceded by some years its use upon land. As early as 1823 no less than seventy-eight steamboats were plying the waters of the Mississippi and the Ohio.[3] Upon land the use of iron rails had been urged in Maryland in 1816;[4] but it was about ten years later before such a tramway was actually constructed in America, and twelve before Maryland built the first railroad in the United States, expressly intended for the transport of freight and passengers.

Almost contemporaneous with the agitation for railroads was that for canals, and in this also Maryland was not behind, for the Chesapeake and Ohio Canal was incorporated in 1823,[5] three years before the Baltimore and Ohio Railroad, in 1826.[6]

In these two organizations have been reached the latest developments of the idea which began in the century before with the labors of Gist, Nemacolin and Washington. Into the further history of such internal improvement in Maryland, interesting as the subject may be, it will be impossible here to go; but it must be noted that the turnpikes of the early part of this century performed a greater service for subsequent years than the mere transportation of goods; themselves constructed upon earlier lines, they pointed out in almost every instance the general direction for the railroads which succeeded them.

[1] Niles' Register, 1826, n. s., vol. vii, p. 91.
[2] Pitkin, Statistics of the U. S.
[3] Niles' Register, 1823, n. s., vol. i, pp. 94-5.
[4] Niles' Register, vol. ix, sup. p. 151. [5] Chap. cxl. [6] 1826, chap. cxxiii.

SUBSEQUENT TURNPIKE LEGISLATION.

The statement that the completion of the turnpike connection between the East and West marked the zenith of the development of the turnpike system in Maryland, must not be misunderstood as indicating that the era of turnpikes was thereby terminated. On the contrary, very many turnpikes were afterwards constructed. But with the introduction of the railroad system their character was changed, and instead of being leading lines of communication, they became feeders to the railroads, radiating to them from the various towns and thus served to build them up as they had built up Baltimore. In some instances, moreover, on beds of the turnpikes, railroads were later constructed.[1]

All turnpikes were incorporated by special acts of Assembly until the year 1868, when a general incorporation law was provided. This was modified by the act of 1882, chap. cccc, and in this form represents the present law as found in The Public General Laws (art. xxiii, 233). It remains only to note that in the course of time many of the turnpikes have become unprofitable. The companies have allowed them to lapse into the hands of the various counties in which such roads or parts of roads lie. This had commenced as early as 1850, according to a publication entitled "History and Statistics of Maryland," based upon the census of that year. There were then 263 miles of turnpikes in use as such. A map has been prepared indicating which of the turnpikes are now kept up, and which are in the hands of the counties.

Maryland's Relation to the National Road.

To conclude this study of the development of highways in Maryland, perhaps no more fitting theme can be selected than a brief sketch of that highway, which, above all others, historically connects Maryland with the United States, the state with the Nation.

WASHINGTON AND THE OHIO COUNTRY.

The colony of Maryland formed the gateway through which the English settlers of America entered into the Ohio country before

[1] Acts of 1827, chap. ccvii; 1825, chap. cxcviii; 1829, chap. lxiv.

and during the French and Indian War. It was under the leadership of George Washington that the western wilderness was first really pierced and a claim for the English colonies established. It was fitting therefore that the further development of the Ohio country both economically and politically, and especially the idea of connecting it with the seaboard by improved means of transportation, should be thenceforth his constant care.

In the interval between the French and Indian War and the Revolution, Washington in various ways secured possession of large tracts of land in the Ohio country, having regard, however, for "an extensive public benefit, as well as private advantage."[1] He began negotiations for the introduction of German settlers from the Palatinate, of whose thrift and success in the cultivation of new country the German colonizers of western Maryland had doubtless afforded him ample proof. He next turned to the consideration of a plan for opening communication between the western country and the coast. The first means which offered itself was naturally the Potomac river, which, as far back as 1754,[2] had attracted his attention. On July 20, 1770, he writes to Thomas Johnson, afterwards Governor of Maryland, urging that public attention be invited to a scheme for opening up the communication of the Potomac "upon a more enlarged plan, as a means of becoming the channel of conveyance of the extensive and valuable trade of a rising empire."[3]

At the close of the Revolutionary War Washington again turned his attention to this project, and the result was the formation and incorporation of the Potomac Company in 1784. The history of this organization was unfortunate. Washington seems never to have doubted its success; and in his will he made the profits accruing from his share in it the basis of a fund for another of his favorite schemes, a National University.[4] But the company undertook more than its

[1] Sparks. Writings of Washington, ii, pp. 375-7. On the whole subject see Adams, H. B. Maryland's Influence in Founding a National Commonwealth. Maryland Historical Society, Fund Publication No. 11.

[2] Report of Mr. Andrew Stewart. Reports of Committees, 19th Congress, 1st Session. Report No. 228, pp. 1-2.

[3] Stewart's Report, p. 29.

[4] See Washington's will in Sparks' Writings of Washington, vol. i, pp. 569-80.

finances would bear; and it was finally superseded by the Chesapeake and Ohio Canal.

THE NORTHWEST TERRITORY.

But the realization of Washington's idea was not confined to the Potomac Company, for the National Road succeeded where the other had failed. The National Road, like the present magnificent system of public education in the western states, grew out of the public lands of the American Union. Maryland's firm refusal to agree to the Articles of Confederation until the larger states had yielded their claims to the territory west of the Alleghanies won the control over that country for the Congress of the United States, and thereby exerted a powerful influence towards unity, at a time when discord ran high and the prospects of the United States becoming a nation were at the lowest ebb[1].

For the government of the territory thus subjected to National control provision was made by the ordinances of 1784, 1785, and 1787. The second of these provided for the reservation to the United States of certain sections in each township for future sale.[2] The last, the celebrated ordinance of 1787, provided that "the navigable waters leading into the Mississippi and St. Lawrence, *and the carrying-places between the same*, shall be *common highways*, and forever free, as well to the inhabitants of the said territory as to the citizens of the United States and those of any other states that may be admitted into the Confederacy, without any tax, impost or duty therefor."[3] The sections of public land reserved for sale by the former of these ordinances later furnished the pecuniary basis for the National Road, while the phraseology of the latter anticipated the large national character of that highway.

ALEXANDER HAMILTON AND THE NATIONAL IMPROVEMENT OF HIGHWAYS.

Before the beginning of the present century there had been suggested plans for an improvement of the main routes of travel by the

[1] For an elaborate discussion of this see H. B. Adams' work referred to above.

[2] Journals of Congress, 1785, May 20, vol. x, p. 171.

[3] Journals of Congress, 1787, July 13, vol. xii, p. 91.

National Government. Perhaps the most comprehensive of these early schemes was that of the great financier and statesman, Alexander Hamilton, who emphasized the value and necessity of the extension and the "improvement of the great communications, as well internal as coastwise, by turnpike roads," which "would be a measure universally popular. None can be more so. For this purpose," he continued, "a regular plan should be adopted, coextensive with the Union, to be successively executed, and a fund should be appropriated sufficient for the basis of a loan of a million of dollars. The revenue of the post office naturally offers itself. The future revenue from tolls would more than reimburse the expense, and public utility would be promoted in every direction.[1]

ALBERT GALLATIN AND THE INCEPTION OF THE NATIONAL ROAD.

Hamilton's suggestion and others of a like nature prepared the way for the policy later supported by Gallatin, Calhoun, and Clay. To Albert Gallatin, who was Secretary of the Treasury under Jefferson, is due the peculiar character of the "enabling act" for the admission of Ohio into the Union as a state. This act contained a provision that "one-twentieth part of the net proceeds of the lands lying within the said state sold by Congress, from and after the 30th of June next, after deducting all expenses incident to the same, shall be applied to laying out and making public roads leading from navigable waters emptying into the Atlantic to the Ohio, to the state and through the same, such roads to be laid out under the authority of Congress, with the consent of the several states through which the road shall pass."[2] An attempt to devote one-tenth, instead of one-twentieth of the proceeds of land sales to this purpose failed in the Senate.[3]

Gallatin recommended the construction of these roads in the highest terms. They "will be," he said, "as beneficial to the parts of the Atlantic States through which they are to pass, and nearly as much

[1] Hamilton to Dayton (1799) in Lodge, Hamilton's Works, pp. 517-19.

[2] Act of April 30, 1802.

[3] Provisions similar to the above were contained in the acts for the admission of Indiana, Illinois and Missouri.

to a considerable portion of the Union, as to the Northwestern Territory itself." [1]

A year later Congress appropriated three-fifths of the one-twentieth, or five per cent.; *i. e.*, three per cent. of the whole, to "laying out and making roads from the navigable waters emptying into the Atlantic to the river Ohio, to the said State." [2]

In the next Congress an attempt was made to pass a law authorizing the President to provide for the exploration of suitable routes, but this was frustrated by the Senate. In 1805, however, a report was presented by Mr. Tracy of Massachusetts, showing that the net proceeds of the sales of lands in the state of Ohio from July 1, 1802, to September 30, 1805, amounted to $632,604.27, 2 per cent. of which, or $12,652, was then subject to the uses directed by the law of 1802. This report also discussed the best location for the proposed road or roads, treating especially of the relative distances of the cities of the Atlantic coast to the Ohio river. A route was recommended as follows:

"The State of Maryland, with no less spirit and perseverance [than Pennsylvania], are engaged in making roads from Baltimore and from the western boundary of the District of Columbia, through Frederick-town to Williamsport. Were the Government of the United States to direct the expenditure of the fund in contemplation upon either of these routes, for the present, in Pennsylvania or Maryland, it would, probably, so far interfere with the operations of the respective States, as to produce mischief instead of benefit; especially as the sum to be laid out by the United States is too inconsiderable, alone, to effect objects of such magnitude. But as the State of Maryland have no particular interest to extend their road across the mountains (and if they had it would be impossible, because the State does not extend so far), the Committee have thought it expedient to recommend the laying out and making a road from Cumberland, on the northerly bank of the Potomac, and within the State of Maryland, to the river Ohio, at the most convenient place between a point on the easterly bank of said river, opposite to Steubenville, and the mouth of

[1] Letter of Feb. 13, 1802.

[2] Act of March 3, 1803.

Grove Creek, which empties into said river Ohio, a little below Wheeling in Virginia. This route will meet and accommodate the roads leading from Baltimore and the District of Columbia; it will cross the Monongahela river, at or near Brownsville, sometimes called Redstone, where the advantage of boating can be taken; and from the point where it will probably intersect the river Ohio, there are now roads, or they can easily be made over feasible and proper ground, to and through the principal population of the State of Ohio.

" . . . To enlarge upon the highly important consideration of cementing the union of our citizens located on the Western Waters with those of the Atlantic States, would be an indelicacy offered to the understanding of the body to whom this report is addressed, as it might seem to distrust them. But from the interesting nature of the subject the Committee are induced to ask the indulgence of a single observation. Politicians have generally agreed that rivers unite the interests and promote the friendship of those who inhabit their banks, while mountains, on the contrary, tend to the disunion and estrangement of those who are separated by their intervention. In the present case, to make the crooked ways smooth, will, in effect, remove the intervening mountains, and by facilitating the intercourse of the western brethren with those of the Atlantic, substantially unite them in interests, which the Committee believe, is the most effectual cement of union applicable to the human race." [1]

THE MARYLAND ROUTE SELECTED.

In accordance with these recommendations, a law was finally passed by Congress in March, 1806,[2] authorizing the President to appoint " three discreet and disinterested persons to lay out a road from Cumberland or a point on the northern bank of the river Potomac, in the State of Maryland, between Cumberland and the place where the main road leading from Gwynn's to Winchester, in Virginia, crosses the river, to the State of Ohio." They were to examine the route, and make a report to the President. Also, by this act, the first appro-

[1] Senate Reports. 9th Cong., 1st Sess., Rep. No. 195.

[2] An Act to Regulate the Laying out and Making a Road from Cumberland, in the State of Maryland, to the State of Ohio. Approved Mar. 29, 1806.

priation of $30,000 was made to defray the expense of laying out and making the road. The President was authorized, if he accepted the report of the Commissioners, to pursue such measures as he thought proper and to obtain the consent of the necessary states for the construction of the road through their territory.

The Commissioners appointed by President Jefferson—Eli Williams, Thomas Moore, and Joseph Kerr—presented one report December 30, 1806, and a second January 15, 1808. The latter was transmitted to Congress by President Jefferson with his approval on February 19, 1808.[1]

CONSENT OF THE STATES AND FEDERAL APPROPRIATIONS.

In the meanwhile Maryland,[2] Pennsylvania, and Virginia had by statute granted permission to the Federal Government to construct the road through their territory. In 1810 accordingly, there was begun a series of appropriations for the Cumberland Road which finally aggregated about $7,000,000.[3] The contract for the first ten miles was given in 1811 and the road was thrown open to the public in 1818.[4] From that time "until the coming of the railroad west of the Alleghany Mountains, in 1852, the National Road was the one great highway over which passed the bulk of trade and travel and the mails between the East and West."[5]

The details of the construction of the National Road and its very interesting historical associations must be omitted here, with the exception of a brief *résumé* of the important events of its subsequent history.

In 1817, John C. Calhoun introduced into the House of Representatives a bill to set aside for roads and canals the bonds and dividends received by the United States from its newly-chartered National

[1] Exec. Commun., 10th Cong., 1st Sess.

[2] See Message of President Jefferson, Feb. 19th, 1808. Maryland expressed her consent by 1806, chap. lxx, "An Act vesting certain powers in the President of the United States."

[3] The appropriations are to be found in Searight. The Old Pike, pp. 100-6.

[4] Searight. The Old Pike, p. 16. See below.

[5] Searight. The Old Pike, 16. A work containing many interesting descriptions and anecdotes brought together in a colloquial manner.

Bank. Henry Clay supported the bill; but as amended and passed, it was vetoed by President Madison upon the ground that it was beyond the constitutional powers of Congress.[1] Five years later President Monroe vetoed another bill which, besides making a regular appropriation for the preservation and repair of the road, provided for the erection of turnpikes and the collection of tolls and for the protection of the road from malicious injuries.[2]

NATIONAL ROAD UNDER STATE CONTROL.

Regular appropriations, however, were permitted to go on and the road was continued farther west from time to time. The eastern part fell into bad repair; and in 1831 the Legislature of Pennsylvania passed an act, appointing commissioners to build toll-houses and erect gates on so much of the road as lay within the State of Pennsylvania. The act was to be effective only upon the condition that Congress should have the road put in good repair and make an appropriation for the erection of toll-houses by the Pennsylvania Commissioners.[3]

A similar act had been passed by the Legislature of Ohio a short time before. In 1832[4] Maryland proposed her acceptance of the road upon the same terms as Pennsylvania; and Virginia did likewise. Congress assented to this proposition the same year,[5] and commissioners were appointed by the states. The road, as repaired by the Federal Government, was finally accepted by the states at slightly different times. Maryland signified her acceptance in 1834,[6] and the next year made provision for its preservation under state control by the establishment of rates of toll and the appointment of officials.[7] The road then remained the subject of frequent legislation until 1878, when it was put under the control of Allegany and Garrett counties.[8]

Other roads were constructed by the Federal Government at various times and in different parts of the Union; but the road from Cumberland has borne the lasting title of "The National Road." Attempts

[1] Richardson [Ed]. Messages and Papers of the Presidents, vol. i, p. 584. (Mar. 3, 1817.)

[2] Ibid., vol. ii, p. 142. (May 4, 1822.)

[3] Laws of Pennsylvania, 1831, approved April 4.

[4] Chap. lv.

[5] 22nd Cong., Sess. 1, chap. cliii, approved July 3, 1832.

[6] Chap. cciii.

[7] Chap. cccv.

[8] Chap. clviii.

were made to provide for the construction of other national roads passing through the state of Maryland, but they were entirely unsuccessful.[1] The National Road, however, was a success, and for many years was, indeed, the "channel of conveyance of the extensive and valuable trade of a rising empire."

The National Road was described in 1879 as follows:

"It was excellently macadamized; the rivers and creeks were spanned by stone bridges; the distances were indexed by iron mile-posts, and the toll-houses supplied with strong iron gates. Its projector[2] and chief supporter was Henry Clay, whose services in its behalf are commemorated by a monument near Wheeling. There were sometimes twenty gaily-painted four-horse coaches each way daily. The cattle and sheep were never out of sight. The canvas-covered wagons were drawn by six or twelve horses. Within a mile of the road the country was a wilderness, but on the highway the traffic was as dense as in the main street of a large town. Ten miles an hour is said to have been the usual speed for coaches; but between Hagerstown and Frederick they were claimed to have made twenty-six miles in two hours. These coaches finally ceased running in 1853. There were also through freight-wagons from Baltimore to Wheeling, which carried ten tons. They were drawn by twelve horses, and their rear wheels were ten feet high.[3]

Though its glories have long since departed, and coach and wagon no more throng its way, the National Road, rich in its associations of historic interest, still constitutes one of the most enduring monuments of Maryland's past, while the idea to which it owes its existence—the welding of the West and the East in commercial and national unity—has found other and more lasting expression.

[1] *E. g.*, 1. A turnpike road along the Atlantic coast, from Maine to Georgia. 2. A national road from Washington to Buffalo.

[2] An error.

[3] Quoted in an article by Richard Stone, "Historical Sketch of National Road Building," in Journal of the Massachusetts Highway Association, vol. i, No. 3.

PART IV

THE PRESENT CONDITION OF MARYLAND HIGHWAYS

BY

ARTHUR NEWHALL JOHNSON

THE PRESENT CONDITION OF MARYLAND HIGHWAYS.

BY

ARTHUR NEWHALL JOHNSON.

INTRODUCTION.

A knowledge of the present condition of Maryland highways is of value to all who are interested in their improvement, and any satisfactory study of the subject must give information which will lead to the betterment of the roads of the state without any marked increase in the expenditures upon them. The present investigation, which is based upon all of the available official information concerning the highways and upon a personal study of the greater portion of the roads, is intended to give facts regarding their present condition and the methods of road-repair now in vogue.

A complete statement regarding the roads must include an account of the mileage, kinds of roads, and their state of repair. The figures introduced in this report are believed to be as accurate as it is possible to obtain at the present time. They are based upon the figures obtained from the offices of the County Commissioners in the several counties and from nearly nine hundred replies to inquiries sent to farmers in almost every neighborhood in the state. The statements regarding the state of repair, the amount, distance, and cost of hauling are based upon a personal inspection of over 2,500 miles of road representing every county of the state and upon the information furnished by the farmers in answer to the circulars distributed among them. Additional facts concerning the general scope of road-repairs, methods, machinery, and expenditures, were obtained from the offices of the County Commissioners.

The methods of applying the funds appropriated for highway-construction fall into two classes. In the case of bridges, and, manifestly necessary improvements at local points, it has been customary in almost all of the counties to allot relatively large sums for special cases. In the matter of repairing the road-bed it seems to be the custom in nearly every county to so apportion the money that its expenditure will be uniformly distributed over the mileage of the county with little regard to the needs of any particular portion of a given road. In this way it often happens that a sum is assigned to a road to be applied at a uniform rate, mile by mile, instead of locally, in the reduction of a heavy grade or the betterment of the worst portions of the road. The present method leaves very much to be desired, as the thin veneering of improvement upon the roads is soon lost and the roads return to their former condition. With the application of the money for specific improvements the result is far different, since in a few years there is a marked advance in the average condition of the highway. The few cases in which this method has been employed emphasize most strongly the general lack of benefit received from the larger portion of the money spent annually on the roads.

Mileage.

The total mileage of the highways in Maryland, as shown by the records in the County Commissioners' offices and the best maps published, amounts to 14,483 miles exclusive of city streets. This is an average of 1.47 miles per square mile of area. The roads embraced in this estimate may be classified in various ways. According to the nature of the surfacing, they include stone, gravel, shell, and dirt roads, the last including all which have had no surfacing other than that of the earth composing the original road-bed. The grouping of the highways in this manner brings out the fact that there are 890 miles of stone road, including the turnpikes or toll-roads, 225 miles of gravel road, and 250 miles of shell road, leaving 13,118 miles of dirt or unimproved roads.

If another classification is made dividing the highways into main thoroughfares and by-roads there are found to be 2,021 miles of main roads or 14 per cent. of the total mileage. The general location of these roads for the whole state is given in Plate XV, while on the

MAP
SHOWING THE
MAIN HIGHWAYS
OF
MARYLAND
INCLUDING
DELAWARE AND THE DISTRICT OF COLUMBIA

SCALE
1:1,250,000. 20 Miles = 1 Inch

0 5 10 20 40 60

MARYLAND GEOLOGICAL SURVEY

WM. BULLOCK CLARK, STATE GEOLOGIST

1899

LEGEND

MAIN COUNTY ROADS

TOLL ROADS

ABANDONED TOLL ROADS

NOTE.—See individual county maps for the identification of the different roads.

A. Hoen & Co. Lith. Baltimore.

individual county maps, Plates XX to XXVIII, the towns along the routes have been shown so that a more complete conception may be gained of their location. Nearly all the turnpikes are included in this list, as they still constitute some of the principal routes.

Since the building of many of the turnpikes the section of country opened by them has been traversed by railroads. This has reduced to almost zero the hauling over some sections of the turnpikes, so that there is no longer revenue enough derived to maintain the road. When this has happened the particular section of a turnpike has been abandoned and turned over to the care of the counties. These abandoned portions of turnpike, where the old road-bed has been left, are shown on the map by dotted red lines. This leaves at present 497 miles of road on which toll is collected, or about 25 per cent. of the main roads of the state. The following table gives the mileage by counties for each type of road enumerated above:

TABLE SHOWING THE MILEAGE OF MARYLAND ROADS BY COUNTIES AND TYPES.

County.	Total Mileage, including turnpikes.	Miles of road per sq. mile of area.	Dirt roads.	Stone roads.	Gravel roads.	Shell roads.	Miles of Main roads.	Percentage of Main roads.	Toll-roads.
Allegany........	550	1.15	490	60	....	....	107	19	....
Anne Arundel ...	521	1.31	470	1	25	25	96	18	....
Baltimore........	1,060	1.72	640	310	....	110	170	16	154
Calvert..........	265	1.21	265	....	....	....	58	22	....
Caroline.........	547	1.74	537	....	....	10	60	11	....
Carroll..........	800	1.88	758	42	....	....	68	9	30
Cecil............	700	1.87	683	5	10	2	91	13	....
Charles	465	1.00	365	....	100	....	100	22	....
Dorchester......	600	0.99	580	....	....	20	109	18	....
Frederick........	1,280	2.02	1,150	130	....	....	172	13	129
Garrett	650	0.96	628	22	....	....	80	12	....
Harford	800	1.90	680	100	15	5	96	12	8
Howard.........	448	1.79	400	48	....	....	60	13	35
Kent............	435	1.37	430	....	....	5	63	14	....
Montgomery.....	835	1.64	790	45	....	....	120	14	37
Prince George's..	530	1.10	480	....	50	....	73	15	....
Queen Anne's ...	563	1.60	555	....	....	8	70	12	....
St. Mary's.......	535	1.49	505	....	25	5	85	16	....
Somerset........	495	1.36	465	....	....	30	50	10	....
Talbot	400	1.40	380	....	...	20	44	11	....
Washington.....	799	1.84	672	127	....	....	137	17	104
Wicomico.......	605	1.64	595	....	....	10	54	9	....
Worcester.......	600	1.26	600	....	....	....	58	10	....
State.......	14,483	1.47	13,118	890	225	250	2,021	14	497

GENERAL OUTLINE OF HIGHWAY CONDITIONS.

The Surface of the Country Traversed.

The discussion of this subject falls into three major divisions corresponding to the physiographic provinces of the state, in each of which, as earlier described by Professor Clark, characteristic highway conditions prevail. These differences modify the construction of the roads relative to location, grade, and material of the road-bed.

APPALACHIAN REGION.

The steepest, most rugged, and wildest portions of the state are found in the western part of the Appalachian district, where the amount of travel is sometimes so small that the roads are little better than well-cleared wood-roads.

The difficulties have also been so great that little effort has been made to locate and construct the roads to advantage. That the difficulties are surmountable was shown by the construction of the National Road, which begins at Cumberland and traverses the many mountainous ridges in the northwestern portion of the state. In the building of this road the location was so carefully planned that there are no grades over eight per cent. The Williams Road, situated east of Cumberland, also shows the result of considerable skill employed in its location.

A second feature of the roads in this area is their location either in the valleys or on the level tops of the ridges. The former are serviceable for short hauls, as many of the farms are located in the valleys. The main lines of travel, however, include the roads on the top of the ridges, such as the Hoop Pole Ridge Road in Garrett county. These ridges trend across the state in a northeasterly-southwesterly direction. The connection between the valley and ridge portions of the road involves steep grades, which invariably are much higher than is suitable for a good highway. Grades as high as twenty-two per cent. were measured, while those of twelve to fifteen per cent. were of frequent occurrence. Such steepness in the roads, together with the roughness of their surface, precludes economic hauling.

CENTRAL AND SOUTHERN MARYLAND.

In the counties of central and southern Maryland the general level is more uniform, but steep grades are always encountered at the stream-crossings. The length of these grades varies from one-eighth to one-half of a mile, depending upon the depth to which the stream has cut below the general level of the surface. The grades at these points generally average 10 feet in 100 and are seldom less than 8 per cent.

The part of the Coastal Plain on the Western Shore, which includes southern Maryland, presents typical characteristics of topography and soil which give to this section conditions producing especially bad roads. The general level of St. Mary's, Calvert, and portions of Anne Arundel, Prince George's and Charles counties, is about 100 feet, while farther inland, adjacent to the Piedmont Plateau, it increases to more than 200 feet. Since the soil consists mostly of clays, often overlain with sands and gravels with no underlying rocks to withstand the erosive action of the streams, the latter have been cut down to very nearly tide-water level, while their banks have been carved by the rains into deep gullies which extend in every direction. All the streams in reaching tide-water level have cut through the soil from 100 to 180 feet, leaving slopes of this height which it is necessary to descend and ascend in crossing from one side of a stream to the other. In some instances a road crosses the gully diagonally and so avoids excessive grade, but most of the crossings are at right angles with the course of the stream. Owing to the hilly character and the great depth of soil the roadways in this section have suffered much from washouts. Frequently the side ditches are gullied to a depth of five or six feet below the surface of the road, which itself is a number of feet below the general level of the ground. This has caused, in consequence, many narrow and dangerous roads. Sometimes the entire roadway becomes so cut down that its identity is lost and it is impossible for vehicles to pass. Then a new roadway is started.

In the endeavor to save the road stakes are driven along the sides of the ditches nearest the road and brush is interwoven with them. Small trees are also thrown into the ditches to check the force of the water. The roads suffer least when a thick growth of trees and bushes has grown between the roadway and the ditch, for the dense mass of roots holds the bank in place and prevents a further encroachment upon the road itself. But only a few favorably situated roads are thus protected, as the conditions are not such as would warrant any attempt toward starting such a growth.

Wherever the roads are over a hilly or rolling country it may be noticed that there are many sections in which the road-bed is much below the level of the adjacent surface of the land. Moreover, it is evident that a large quantity of earth has been removed which has not been used towards filling the hollows, for embankments are formed on only a few of the roads. When first opened the roads follow the irregularities of the surface, the road-bed being practically at the same elevation. The travel over these roads soon forms ruts and hollows in which the storm-water is collected and carried from the tops of the hills along the roadway to the bottom. Wherever there is clay or loose soil to be easily washed away the ditches are eroded and increased in size with every rain. The water carries the earthy material to the valleys where it is deposited at the sides, to be further removed through some natural drainage channel, scarcely any being deposited in the roadway. On the tops of the knolls the water has very little erosive action, but as the volume and velocity increase in its course down hill, greater energy is developed and a greater quantity of earth is cut away.

This accounts for the fact that the deepest cuts on country roads are so often found part way up the grades, while at the top there has been little cutting, perhaps only a foot or two. Reference to Fig. 5 will perhaps make this point clear and bring out, in addition, an important feature which has not been generally commented upon. This figure shows a longitudinal section or profile of a road on a hill. The light line represents the natural surface of the ground which was originally the road-bed; the heavy line shows the relative elevations of the road-bed at present. As before mentioned, there is very little cutting at the tops of the hills, while the dirt washed from the road does not materially raise the road in the hollows. Though the hill remains about the same in height, the beginning of the ascent is nearer the top, as the sides have been washed away, thus decreasing the distance in which to climb the hill. The grade of road is thus increased. Another point which will be observed on hilly roads which have been gullied out by the storm-water is that the grade is steeper towards the top, which is just the reverse of what it should be. It is better to begin the ascent on a steeper grade and gradually diminish it towards the top, thereby making it easier for the horse as he becomes fatigued.

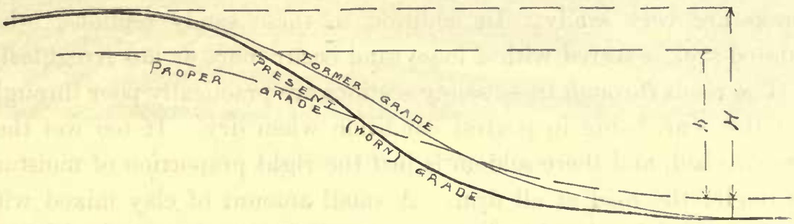


FIG. 5.—Showing effect of storm-water on a steep grade. (Vertical scale exaggerated.)

The broken line in Fig. 5 shows what the grade of the road should be. The deepest cut is made at the top, the earth being removed to the bottom of the hill to make an embankment. The vertical distance to be overcome, instead of being H, is reduced to h, while the grades are less than on any portion of the original road-bed instead of steeper.

THE EASTERN SHORE.

There is a marked contrast in the condition of roads on the western and eastern portions of the Coastal Plain, due to the difference in the topography of these sections. On the Eastern Shore there are no long grades, although at the stream-crossings grades of 6 to 10 per cent. are common, which, however, seldom extend over 100 yards. The present elevation of the bridges at these points is about 30 feet below the level of the surrounding land.

The Eastern Shore presents conditions well suited to excellent dry-weather roads, as the land is nearly level, few areas being over 50 feet above tide-water, and the soil for the most part is composed of a mixture of clay and sand. The proportion of sand and clay varies in different localities, there being extensive stretches of nearly pure sand, which makes some of the poorest roads on the Eastern Shore.

There is a very interesting phenomenon connected with the occurrence of the sandy sections of road, which has probably been noticed by all familiar with them. On the southeastern banks of the rivers there regularly occurs a surface covering of loose sand frequently extending a mile or so back from the river, while on the other bank there is found a clay soil. Thus the roads near the rivers on the westerly banks are over a hard clay soil, while those on the eastern banks are very sandy. In addition to these sandy sections, other limited areas covered with a loose sand occur more or less irregularly.

The roads through these sandy sections are practically poor throughout the year, being in poorest condition when dry. If too wet they are also bad, and there seldom is just the right proportion of moisture to render the road at all firm. A small amount of clay mixed with sand on the other hand makes a very good dry-weather road, although in very wet weather this renders it much worse than a pure sand road.

Instructions to Supervisors.

Most of the counties issue to the Road Supervisors instructions which are more or less detailed in character. Those issued to the Supervisors of Washington county are perhaps the most explicit and are here given in full.

Read Instructions.

INSTRUCTIONS.

It shall be the duty of the Supervisor, as early in the Spring as it is at all practicable, to open drains on the hills of his road and repair the breakers.

All breakers must be made with well broken stone, covered with sufficient dirt to keep them in place, and must be made as near square across the road as possible; also must be well extended so as not to be so abrupt.

All open drains across the road must be not less than six or eight feet wide.

FIG. 1.—DIRT ROAD, HARFORD COUNTY.

The Friedenwald Co.

FIG. 2.—LIMESTONE ROAD, WASHINGTON COUNTY.

TYPES OF ROADS.

In localities where stone can be had without entailing too much expense three-fourths of the appropriation must be expended in macadamizing.

Filling up holes with dirt is especially prohibited.

Where stone cannot be obtained the road should be well graded up in the center and the side drains kept well open.

Ten cents per perch shall be allowed for stone delivered on the road, the furnishing of which must be by and under the supervision of the Supervisor, and must be paid for out of the appropriation made for such road.

In all instances stone must be well broken, not only the top ones but all that are put on the road.

When an appropriation of more than ten dollars is made the Supervisor shall employ three good hands.

At least three-fourths of the appropriation must be worked out before July 1st, and the remainder before November 15th.

If Supervisors expend more than the appropriation without first gaining consent of the Board of Commissioners, the excess will not be paid.

The above instructions must be fully complied with, and upon satisfactory information of their not being, the above commission will be revoked and another person appointed to succeed such Supervisor.

By order,

Dirt Roads.

A considerable variety in the method of treatment of dirt roads is found in different parts of the state, according to their character and location. Thus, the roads in a clay soil are susceptible to different treatment from those of a sandy or stony ground, and roads on the hillsides require different treatment for their preservation from those traversing level country.

The usual method of working a dirt road when composed of soil free from large stones, is to run a plough along either side to form a ditch, and if there is no more money to carry the work through, it ends here, leaving the road with a mound of earth on either side, which prevents the water from leaving the road-bed. There are many roads in various sections left in this manner. Another step toward working the road is to throw the loose material from the ditch into the center. Where the road-machines are used the work of shaping the road is much facilitated and for a time the road presents a much neater appearance. On level tracts, especially where there is a hard, compact soil, a considerable improvement can be made very cheaply with the road-machine, but generally too much is expected of it and its work is not supplemented, as it should be, by proper grading and subsequent rolling of the road-bed. It oftentimes happens that instead of the road being improved, time and money are spent producing results absolutely harmful. In very stony soil road-machines and scrapers cannot be used at all, so that whatever work is done upon such roads must be with pick and shovel. Occasionally projecting outcrops of rock are broken off with hammers.

The steeper portions of the roads have "water-breaks" or "breakers" constructed at intervals more or less frequent according to the amount of money at hand for the purpose. They are made in various ways and often show considerable individuality of treatment. Usually they consist of a mound of earth or broken stone covered with dirt extending square across the road. Plate XXXIII shows a road liberally provided with these breakers. The object is to turn to one side the storm-water, preventing the gullying of the roadway. At the same time they form ugly obstructions to travel and increase the work of a horse hauling over them. They are often 2 feet above the road. An instance was noticed where the supervisor had made a breaker of small logs 4 to 6 inches in diameter, placed across the road and covered with stone and dirt, the whole making a formidable obstruction.

A method frequently seen employed on dirt roads is to plough the entire roadway and then shape with the scraper or some form of road-machine. This leaves a mass of loose dirt in the roadway, in which ruts are soon formed ready to collect the rain-water. This readily finds it way to the subsoil, and so softens it that the wheels cut yet deeper into the soft mud which forms after a protracted period of wet weather. It is a great mistake to loosen the firmly compacted earth road-bed, as bad effects are sure to follow. It is only where the road-bed has become worn very uneven that ploughing should be done. The better way is to build up with new materials from the sides of the road, then shape and roll as firmly as possible. The dirt roads receive far too much scraping and digging. They are shaped up at the expense of material in the roadway and not by the addition of material to it. There is much material washed away by the rains which is not replaced, and the roadway as a result gradually becomes worn more and more below the general level of the surrounding land.

Stone Roads.

The state and character of the stone roads vary according to the authorities that built or at present operate them. Of the 890 miles of this class nearly 500 miles are toll-road, operated and maintained by the different turnpike companies. About 130 miles of former turnpike have been abandoned by the owners, who have left the old road-beds, which are still used. This leaves about 260 miles of stone roads which have been constructed by the counties.

In almost all instances the roads constructed by the companies are better than those built by the counties, although many of the methods employed are the same. The turnpikes have generally been constructed with a heavy foundation course of large stones over which has been spread a course of more finely-broken material.

The method of breaking the stone for the roads has usually been by hand, although crushers have been used in a few instances. It is customary to see the road-maker equipped with a long-handled hammer, breaking, one by one, the large pieces of rock which have been thrown over the road in piles. Each piece of stone is broken and rebroken until the desired size is reached. When thus broken by hand the pieces are invariably too large, many of the loose pieces of rock which are on the surface having faces measuring six or more inches across. When the material is obtained from a crusher it is but little better, as it is usually unscreened so that there is a wide range in the size of the pieces. Such material is almost certain to give unsatisfactory results.

The manner in which the stone is placed upon the surface of the road is equally at fault. It is usually spread upon the surface with little attempt at shaping and almost none at compacting the material. It is usually expected that the stone will be consolidated by the traffic passing over it. In order to gain this result more readily a thin covering of dirt is thrown over the stone which renders the surface somewhat smoother until rains come and soften the dirt between the stones, allowing the wheels to cut into the loose surface.

Without constant attention, ruts are almost sure to be formed on stone roads which are compacted by wagon-wheels. On Plate XVII,

Fig. 2, showing a recently stoned portion of Edmondson avenue in Baltimore near the city limits, it may be noticed that the ruts have already been started. While it costs a comparatively small sum to throw loose stone upon a road, and while by this ill-adapted method good roads can be made in time, if proper care is given, a heavy tax is imposed upon all vehicles until the roadway has become hard and smooth enough for traffic. This tax is far in excess of what it would cost to construct a road by modern methods.

The loose crushed stone, placed commonly upon the highways for the wagons to compact, and the roughness of the surface of these roads due to the working through of the large stones in the well-worn crown of the roadway, lead the teamsters and the drivers of lighter vehicles to seek the more comfortable lines of travel found in the dirt roads along most of the turnpikes. In dry weather these are traveled much more than the stone road, especially if the latter has been recently repaired. The dirt roads wear more readily and are soon at a lower level than the stone road. In fact, these dirt roads are frequently worn so deeply below the grade of the main road as to form a dangerous bank. On the Baltimore and Reisterstown turnpike guard-rails have been erected where there is any danger of vehicles driving over the embankment. This is the only road in the state which is thus protected throughout its entire length. The view of a portion of the old turnpike between Rockville and Washington, as it was previous to the recent improvement, is given in Plate XXXIV, Fig. 2, which shows the depth to which the dirt side-roads are sometimes worn.

The best stone roads which have resulted from this somewhat antiquated method of road-construction are the turnpikes. These vary among themselves according to the character of the stone employed in their construction which is determined in great measure by the country rock over which they pass. The best of these are found in the vicinity of Hagerstown and Frederick where, taken as a whole, the roads are better than in other parts of the state. The turnpikes in these valleys are made of the softer varieties of limestone, which are easily compacted by a moderate amount of traffic. While the soft-

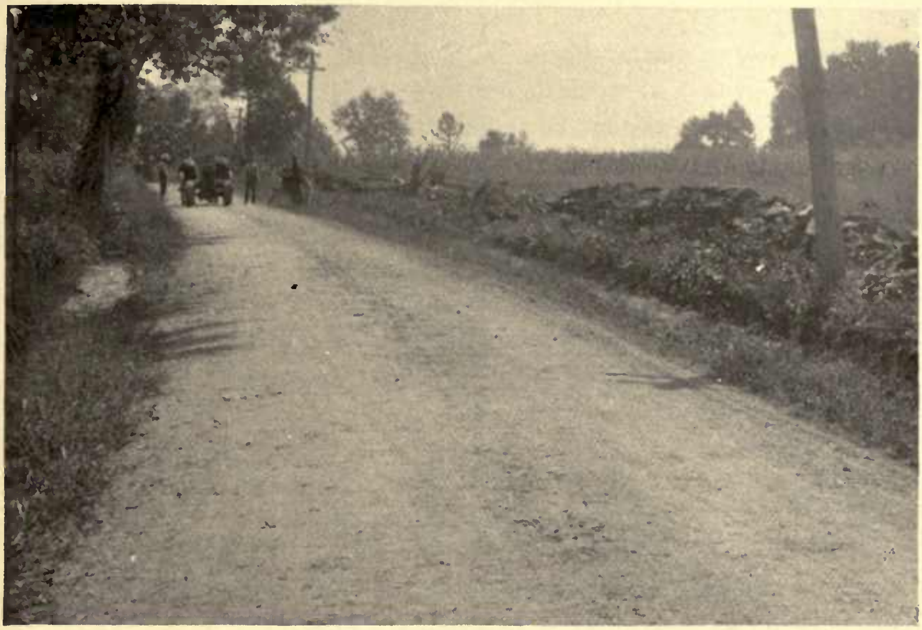


FIG. 1.—TRAP ROAD, BALTIMORE COUNTY. STONE SPREAD IN LAYERS AND ROLLED.

The Friedenwald Co.

FIG. 2.- GNEISS ROAD, BALTIMORE CITY. STONE SPREAD WITHOUT ROLLING.

TYPES OF ROADS.

ness of the limestone is of great advantage in this respect, it is the cause of frequent repair. Yet where there is a good traffic the revenue derived from tolls is found to be sufficient to maintain these roads in good condition and still leave a fair profit for the operators. This is especially the case with the turnpikes mentioned, which are located in broad level valleys with few heavy grades. One of these roads at its best is shown in Plate XVI, Fig. 2.

The sections of the state where there is no limestone are at a greater disadvantage to keep up a smooth roadway. The harder varieties of stone do not form themselves so readily into a compact mass, and it is only where there is a heavy traffic over the road that a smooth surface can be obtained. The turnpikes in the vicinity of Baltimore use several varieties of the harder rocks, usually such as can be found in the immediate vicinity of the road. On the portions of these turnpikes where the repairs are made with fine broken stone the traffic is sufficient to form a hard and comparatively smooth surface.

If, before attempting to construct a stone road its fundamental requirements were observed, better results would be obtained and money saved. The most important of all, and on which too much stress cannot be laid, is that of previously grading the road-bed before surfacing. This has been mentioned elsewhere, but is such an important consideration and a part of road-construction which has been so much neglected that repetition is not amiss. In fact, the surfacing of steep grades is an absolute waste of money and material. After a road has received a layer of stone it is very difficult to have further improvements made, which necessitate the removal of the stone surfacing, as there always exists a prejudice against improving what is already considered an improved road. The surfacing of an ungraded road simply preserves it in a bad condition, making it more expensive to reconstruct it as it should be. No greater improvement of the highways of Maryland can be suggested than a reduction of the excessive grades now found in nearly every county. It is an improvement which does not need to be and cannot be made upon all the roads at once, but it is one toward which much of the money now spent on useless so-called repairs can be applied with real and lasting benefit to the roads.

Gravel Roads.

The beds of gravel employed in road-construction occur in several bands, extending northeast-southwest across the more westerly portions of the Coastal Plain. They usually occur in beds composed of pebbles nearly uniform in size, so that screening is not, as a rule, necessary. With such excellent road-building material at hand in many of the counties of the state, it seems strange that so few miles of road have been improved with this material.

Even where gravel has been applied, owing to its method of application, the roads do not always maintain their form as they should in wet weather. This fault is usually due not to the material employed so much as to an entire lack of proper grading and under-draining. Merely to throw some gravel over a wet or spongy place without raising the level of the road-bed or making any provision for the drawing off of the water can never make a road which will not cut through and become muddy whenever the frost comes out of the ground. The water sinks through the gravel-covering into the clayey foundation and renders the latter yielding to the overlying load which pushes the wheels through the gravel into the clay, or, if the covering is thin, causes the clay to be pushed up between the pebbles.

With proper attention towards grading, under-draining, and the shaping of the road before the gravel is placed upon it, considerable improvement may be made on almost any of the roads where gravel is obtainable, as it makes an even, hard and firm road-bed when supported by proper foundations. An example of the better constructed gravel roads is that extending from Marlboro to Washington, which was built originally as a toll-road. Plate XVIII, Fig. 1.

An economical form of construction is to use the gravel as a support for a macadam surface where the travel over any particular thoroughfare would warrant such an improvement. Many of the roads in Prince George's county, in the neighborhood of Washington, might be treated in this way, as gravel is abundant and the stone for surfacing could be brought by rail at a reasonable cost.

Shell Roads.

The only road-metal of importance in the sandy country along the lower Eastern Shore of the Bay consists of the oyster-shells constantly accumulating at the large oyster-packing establishments near the water-front. The roads surfaced with this material aggregate 250 miles, and are found most fully developed about the head and on the Eastern Shore of the Bay. One of the longest pieces of shell road in the state extends from Princess Anne to Crisfield, which has been shelled nearly its entire length, a distance of about twenty-two miles. This, however, has not been kept in good repair in many sections, so that now the shell covering is almost entirely worn away in spots. The roads at present are shelled for sections two or three miles in length, although now and then a continuous stretch of ten or more miles is encountered. In the main, these shell roads are satisfactory and supply this portion of the state with highways more serviceable than many in those counties which are richer in road-building materials. Plate XVIII, Fig. 2, shows the shell road between Baltimore and Chase's station in Baltimore county.

The manner of applying the shells is to spread them loosely over the surface, where they are left to be compacted by the traffic. Where this is heavy, as in the shell road along Eastern avenue, extending from Baltimore into the lower part of Baltimore county, the shells are thoroughly broken up and compacted by a week's wear. On the Eastern Shore, where the travel is less, it takes a much longer time. The shells are usually either thrown upon the road without first shaping the road-bed in the proper manner, or they are used to fill in muddy places on clay roads. The result is that the shells are easily pushed into the soft bottom, leaving a depression in the surface of the road-bed where water collects. The water tends to dissolve and percolate through the shells, destroying the coherence of the compacted mass, or the mud works up between the shells and forms a mud-hole which must in turn be filled with new material to maintain the surface of the road. Such failures in construction could be avoided by first removing all the loose mud and earth and then refilling with a sandy soil, which should be rolled over or tamped until firm. When shells are spread over such foundations they maintain their surface. A sandy soil is better than one of clay, as it does not work up as readily into the shells.

A still greater difficulty experienced with shell roads is the rapid formation of horse-tracks on those portions of the highway which receive only a small amount of travel. If the hollows in the center of the road are not filled they hold the water which in turn softens the road, causing it to wear through very rapidly. This difficulty is sometimes remedied by spreading loose shells in the ruts and holes as soon as they are formed. The horses, in avoiding the rough coating, bring the wheels over the shells which have been spread in the center of the road, and in this manner, by crushing and compacting, restore the crown of the road. At the same time the traffic is diverted from the center of the road to either side, so that the wear is more evenly distributed over the entire surface. The shells in the center are compacted before a second horse-track has been formed. When the travel is once distributed over the entire width of the road the horses do not again follow a single track so closely.

The use of shells as a pavement in the streets of the larger towns on the Eastern Shore is not wholly satisfactory, since the material, although well adapted to lightly-traveled country roads, is not suitable for the surfacing of much-used thoroughfares. Moreover, owing to their rapid wear, dust is formed in large quantities, to be blown about by every breeze. The color and adhesion of the dust render it a great inconvenience to householders and a positive injury to storekeepers along the roads where shells are used.

The cost of constructing and maintaining a shell road 18 feet wide and 18 inches thick in the center, reducing to 9 inches at the side, may be based upon the following estimates: Such a road requires about 8 bushels of shells per linear foot, or approximately 58,000 bushels of shells per mile, the cost of which is about 2 cents per bushel for the material and 1 cent per bushel for the hauling, making a total of $1,740. For the maintenance of shell roads in the vicinity of Salisbury, from 2,000 to 3,000 bushels per mile are required each year, which, at the rate of 3 cents per bushel, annually cost about $75 a mile.

If, instead of shells for a wearing surface, there should be used material which offers ten to fifteen times as great resistance to wear,

FIG. 1.—GRAVEL ROAD, PRINCE GEORGE'S COUNTY.

The Friedenwald Co.

FIG. 2.—SHELL ROAD, BALTIMORE COUNTY.

TYPES OF ROADS.

repairs would necessarily be much lighter and less frequent. Reference to the tables, pp. 327-9, giving the relative wearing qualities of the different road-materials, shows that the relative value of shells as compared with the average limestone is as 9 to 1; compared to granite as 11 to 1; compared with trap-rock as 16 to 1. Thus, under similar conditions, a stone road would last about 12 times as long as one built of shells.

The cost of shell roads is estimated to be from $1,000 to $2,000 per mile according to the width and thickness of the shell covering. It would then be a saving if a surface could be constructed of material, for example, which had ten times the wearing qualities of shells, and costing, perhaps, five times as much.

There is scarcely an important center on the Eastern Shore not in the immediate neighborhood of a wharf. Thus to all parts of this section of the state there could be sent by water broken stone from some of the numerous points at the head of the Bay, where there is abundant material. The estimated cost of broken stone per cubic yard, delivered at the wharf, in places on the Eastern Shore varies from $1.50 to $2. Shipped by rail, the cost would be about 25 per cent. more.

Bridges.

The total amount spent upon bridges during the past ten years can only be approximated, as the exact figures could not be obtained at the offices of the various boards of County Commissioners. The amount is estimated at $820,000, or about 18 per cent. of the total spent upon roads and bridges. Under the head of bridges is included not only bridges proper, but also culverts and smaller drains.

No detailed examination of the many bridges was attempted, though note was made of their general character and condition. They may be divided into three classes—wooden, iron, and stone.

The majority of the small bridges, with spans up to 30 feet, culverts and drains are of wood. The shortest spans are a simple beam to which is nailed the flooring and rails. For spans from 10 to 30 feet, a simple triangular frame with a central tension rod or post forms the supporting truss. They are in various stages of repair varying from some newly-built to those over which it is unsafe to ride. There are still to be seen across the larger streams a number of the long, old-style, wooden, bow-truss bridges with a heavy curved upper chord built up from planks bolted together. To protect these bridges from the weather a covering of light boarding completely encloses the whole structure.

Iron bridges are, however, fast replacing the longer wooden spans. Plate XIX, Fig. 1, gives a view of the Dover bridge recently erected

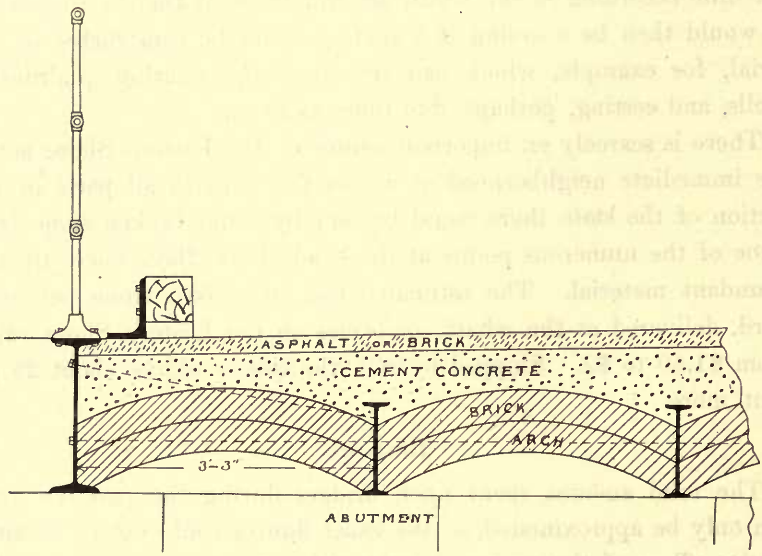


FIG. 6.—Cross-section of I-beam bridge.

across the Choptank river betwen Talbot and Caroline counties. The three new steel spans replace a part of the old wooden bridge. The portion so far erected is on the Caroline county side. There are also many short iron bridges, some of which are of a flimsy construction. There are comparatively few I-beam bridges, one of the cheapest and best forms for spans less than 25 or 30 feet. No method of construction is more durable than the combination of masonry and I-beams, between which are transverse arches of brick, the whole covered with concrete, over which is laid the roadway. Fig. 6 shows a cross-section of such a bridge.

In the early part of the century, when a number of the turnpikes were built, massive stone arches were constructed over all the streams. Substantial as they were, to-day there are plain traces of weakness and disintegration, which have been caused by the weather and in part by willful destruction. Moisture has in some instances gradually penetrated through the joints and crevices, causing, with the frost, a perceptible bulging and cracking of the walls. One instance noted, in particular, is that of the bridge on the Baltimore and Cumberland road, where the Monocacy river is crossed. This bridge consists of four arches, each with a span of 65 feet. The side walls are here bulged to a very noticeable extent. At the easterly end of this bridge is a rather curious monument, on which, among others, may be found the inscription "Built in the years 1808 and 1809. Jona[en] Elliott first produced a bold plan of this bridge." On this same road heavy masonry arches were built across Antietam Creek and the Conococheague river. The bridge over the latter is shown in Plate XIX, Fig. 2.

The longest masonry arch in the world and next to the longest ever constructed is that of the bridge on the Conduit Road, across Cabin John Creek in Montgomery county, a few miles west of the District of Columbia. The length of this arch is 220 feet. The longest one, destroyed in 1427, was built in Trezzo, Italy, and had a span of 251 feet. The Cabin John bridge was built and is maintained by the National Government. Across Castleman's river, in Garrett county, on the National Turnpike is a noted arch, a view of which is shown in Plate I. This is one of the longest highway arches in Maryland. The parapet walls have suffered much from neglect and wanton injury, though the arch is apparently as sound as ever.

One of the items of cost, and often a large one in the construction of any bridge, is that of the abutments upon which the stability of the whole structure depends. It is therefore important that they be properly located. This can only be done after a careful study has been made of the proposed bridge site, and especial care must be exercised that the waterway is not so constricted as to endanger the bridge during high water. The foundation for the abutments should be unyielding. To secure this it is oftentimes necessary to drive piles and rest the masonry work upon them. Iron tubes filled with concrete are employed when there is a deep layer of loose soil overlying the firm substratum. Such a construction was adopted for the piers to the Dover bridge on the Choptank river, to which reference has been made. See Caroline county and Plate XIX, Fig. 1.

Hauling Distances.

The distances which farm products are hauled in different sections of the state have an important bearing on the cost of hauling, the value of the roads, and also in determining what lengths of road are most used.

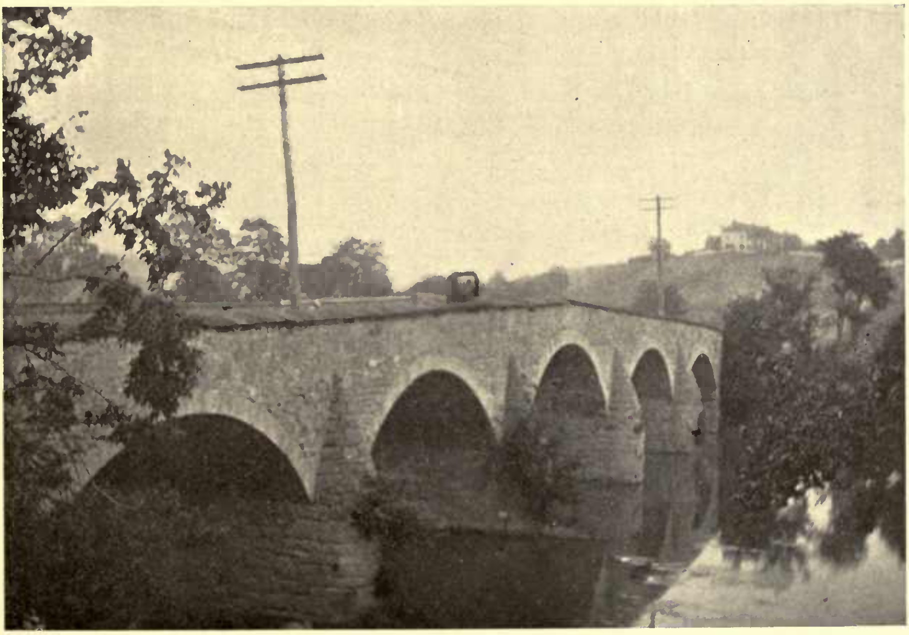
The conditions governing the length of haul in different districts depend upon the proximity of shipping-points or large markets. In the vicinity of large cities, where there is always a demand for garden products, truck-farmers prefer to haul a considerable distance rather than pay the cost of loading and unloading when shipping by rail. Moreover, the perishable nature of such produce requires that it be handled as little as possible. On this account garden truck is hauled considerably longer distances than is usually the case with other kinds of produce. Thus, around large cities, it will usually be found that the limit of the practical hauling distance is considerably greater than in sections remote from urban influences. The following table shows the average hauling distance for each county in Maryland:

AVERAGE HAULING DISTANCE IN THE COUNTIES.

County.	Miles.	County.	Miles.
Allegany	9	Howard	12
Anne Arundel	10	Kent	4
Baltimore	11	Prince George's	13
Calvert	5	Montgomery	13
Caroline	3	Queen Anne's	5
Carroll	5	St. Mary's	5
Cecil	5	Somerset	6
Charles	6	Talbot	4
Dorchester	5	Washington	4
Frederick	5	Wicomico	5
Garrett	8	Worcester	5
Harford	7	Av. for state	6.7

A study of the foregoing table brings out the interesting point that the farmers are accustomed to haul considerably longer distances in

FIG. 1.—IRON BRIDGE OVER CHOPTANK RIVER, CAROLINE COUNTY.



The Friedenwald Co.

FIG. 2.—STONE BRIDGE OVER CONOCOCHEAGUE RIVER, WASHINGTON COUNTY.

TYPES OF BRIDGES.

Anne Arundel, Baltimore, Howard, Prince George's, and Montgomery counties than in any other parts of the state. The average for the first three is about 11 miles, and for the last two, 13 miles; while the average for the whole state is only 6.7 miles. The relative positions of these counties, with reference to Baltimore and Washington, shown by a glance at the map, account for the high average found. Subsequent tables show that the practical limit of the hauling distances is greatest in the neighborhood of the various cities of the state.

It will be further noticed that the hauling distances of the Eastern Shore counties, which are so well provided with shipping facilities by water, are small. In Caroline county, for example, it is seen to be but 3 miles; in Kent and Talbot, 4 miles each. In Somerset county the distance is somewhat greater, being 6 miles. In those counties that are well provided with railroad facilities, such as Washington, Frederick, Carroll and Cecil, none of which are in the neighborhood of large markets, the hauling distance averages about 5 miles. Harford county is exceptional, since the influence of the long hauls to the Baltimore markets raises the average to 7 miles. The comparatively high values found for Allegany and Garrett counties are accounted for by a lack of shipping facilities.

The following table shows the average limit to which it is found practicable to haul in the neighborhood of the larger markets and shipping points of the state:

AVERAGE MAXIMUM HAULING DISTANCE.

		Miles.
To Baltimore from	Anne Arundel county	15
	Howard "	17
	Baltimore "	14
	Harford "	18
" Washington from	Prince George's county	15
	Montgomery "	17
" Cumberland		10
" Cambridge		6
" Centreville		6
" Elkton		5
" Frederick		5
" Hagerstown		5
" Easton		4
" Salisbury		4

These figures do not indicate the average distance over which the produce is carried into these places, but each is an average of the longer hauls and shows the practical limit to which wagon-carriage is usually done. Thus in the instance of Washington and Baltimore many farmers haul a distance of twenty miles, though few exceed this limit. In no other section of the state is it customary to make such long hauls. The effect of Baltimore and Washington upon the average hauling distance in the adjacent counties has already been noticed.

On the Eastern Shore there are occasionally 10 and 12-mile hauls, but they are not frequent enough to affect the general average, as the smaller shipping centers have little or no effect upon the average hauling distance of the county in which they are situated.

Amount Hauled.

In connection with the distance products are hauled, it is of considerable interest and importance to note the loads usually carried. The following table, showing in tons of 2,000 pounds per horse, the loads hauled over the roads in winter, spring, summer and fall, was compiled from a large number of replies obtained in every county from those who go over the roads at all times of the year, and know by experience the difference made in the hauling capacity of their teams by the condition of the roads at different seasons of the year. The figures clearly show that about one-third more can be hauled in summer and fall, when the roads are at their best, than in winter and spring.

There are so many factors which affect the figures in this table that it is difficult to assign in each instance the reason for the particular differences found between the counties:

AMOUNT IN TONS PER HORSE HAULED OVER THE ROADS.

Counties.	Winter.	Spring.	Summer.	Fall.	Average for year.
Allegany	.45	.40	.63	.61	.52
Anne Arundel	.57	.59	.67	.65	.62
Baltimore	.55	.56	.70	.68	.62
Calvert	.35	.38	.51	.50	.44
Caroline	.58	.56	.64	.64	.61
Carroll	.58	.56	.64	.64	.61

Counties.	Winter.	Spring.	Summer.	Fall.	Average for year.
Cecil	.47	.51	.73	.72	.61
Charles	.41	.46	.66	.65	.55
Dorchester	.65	.78	.82	.79	.76
Frederick	.57	.61	.82	.82	.71
Garrett	.41	.36	.56	.51	.46
Harford	.46	.45	.58	.59	.52
Howard	.50	.55	.66	.65	.59
Kent	.44	.52	.65	.67	.57
Montgomery	.48	.59	.68	.68	.61
Prince George's	.55	.56	.72	.74	.64
Queen Anne's	.42	.50	.61	.61	.54
St. Mary's	.27	.35	.50	.50	.41
Somerset	.41	.50	.81	.81	.63
Talbot	.44	.53	.72	.69	.60
Washington	.58	.57	.68	.71	.63
Wicomico	.44	.44	.44	.46	.45
Worcester	.42	.54	.71	.71	.60
Average for state	.48	.52	.66	.65	.58

The average weight hauled per horse for the state per year is .58 of a ton. The difference between this average and the lowest and highest found in a single county is only 350 pounds. If steep grades do not preclude heavy loads, it often happens that the condition of the road will. For example, in certain sections of the Eastern Shore, the deep sands are always a barrier to large loads. On the other hand there is no very large area in which the roads have been improved to such an extent as to make an extraordinary difference in the amount hauled. Of course there are short pieces of road in many localities which are adapted for heavy hauling; but it is too often the case that the roads have been surfaced while the steep grades remain.

For a discussion of the amount hauled in other places, see a succeeding chapter by Professor Reid.

Cost of Hauling.

The average cost of hauling one ton one mile in Maryland is estimated at 26 cents. The average for the United States has been estimated by General Stone to be 25 cents. Further account of the cost of hauling in different countries will be found in a subsequent chapter on road-administration in Europe.

Guide-Boards.

Few features connected with highways and their construction more greatly facilitate the travel of people unfamiliar with a given road than the guide-boards; and few additions of equal expense add more to the pleasure of the traveler. While the laws of nearly all of the counties require the erection and maintenance of guide-posts at all the intersections of the roads, there is little evidence of their enforcement, as guide-posts on the county roads are almost unknown throughout the entire state. One or two neighborhoods, however, in Harford and Baltimore counties have local farmers' clubs or road leagues, which have put up and maintained guide-boards at all the cross roads.

With the turnpikes it is different, as the law requiring them to establish posts every mile has been enforced. Each post shows the distance of its location from either end of the turnpike. Most of them are made of stone in which the lettering has been cut, others are of wood. On the National Road three-sided iron pillars were erected, set with two faces toward the road on which were indicated the distances from Cumberland and Wheeling respectively. These posts were cast hollow, the iron being from one-half to three-quarters of an inch in thickness. At the present time either through wanton injury or accidents, few of them remain intact.

Surveys.

Many of the roads in Maryland have been in use for so long a time that it is impossible to gain any facts regarding the care with which they were constructed, the surveys made, and the grades established, beyond the evidence given by the road itself at the present time. It is probable that they gradually developed from trails and by-paths to well-established thoroughfares. In the case of later roads there is little more to indicate the care with which they were laid out. The usual record consists of a description of the bearings and distances run, which may or may not be accompanied by a sketch. No profiles have been made for establishing grades, and there seldom exist any records by which the locations of a majority of the roads can be identified upon the ground.

Since many deeds introduced the center of a given road as the initial point for bounding adjacent lands, it is of importance that the position of the roads be clearly defined. If no other trace remains to indicate the center of a highway, the middle of the traveled portion of the road must be taken to define the boundary. This, unfortunately, changes, and so may be a number of feet away from the point considered at the time the deed was written. It frequently happens that the encroachments upon the roadway are made by the movement of the fences on either side. This may occur where the land is less favorable for cultivation on one side than on the other, or where there is a personal interest in the gradual shifting of the boundary. After many years it is difficult to locate the original line of the fence. Where the land is cheap this is not of great moment, but with the increase in value of the land as the area becomes more settled, it is of the first importance that the lines of the roads be well defined and fixed by permanent marks upon the ground.

HIGHWAY CONDITIONS IN THE COUNTIES.

In the foregoing discussion the present condition of the roads has been reviewed from the standpoint of the entire state. The following pages present much more detailed information regarding the roads and their problems in the individual counties. In order that these facts may be readily available, a general uniformity of treatment has been adopted. The discussion under each county includes statistical information regarding the total mileage of the highways and its distribution among the different types of road; succeeded by a general description of the topography, or natural surroundings, and the problems in road-construction which these features present. When the conditions warrant, special descriptions are given of the more important roads, their location, construction, and state of improvement. Information is also given concerning the general condition of the turnpikes which form so important a part of the road-system in many of the counties. As the figures for the cost of maintenance of the present road-system would be incomplete without including the amounts paid in tolls an estimate of these has been made for each county. The facts concerning the methods of construction and repair of the roads include data relative to the administration of road-affairs, the number of supervisors and men employed, together with their wages, the machinery utilized in the road-work, and the methods in vogue at the present time. The individual accounts are closed with facts regarding the material available for construction of roads found in the county and the figures showing the expenditures during the last ten years. Many of the facts upon which the succeeding pages are based were obtained from the County Commissioners' offices in the several counties.

ALLEGANY COUNTY.

In Allegany county there are 550 miles of public roads or 1.15 miles of highway to each square mile of area. Of these roads 60 miles are surfaced with stone while the remainder are of dirt. The main thoroughfares amount to 107 miles or 19 per cent of the total mileage of the county. The location of these roads is given on Plate XX. All of them are free as there are no toll-roads in the county.

The surface of the country is so rough and mountainous that it renders the location and maintenance of the roads very difficult. Several of them, however, have been located so successfully that although they traverse some of the roughest portions of the state they do not have excessive grades. The required width between fences on new roads is 33 feet. Most of the culverts and drains are constructed of wood, but a few hundred feet of tile drain have been laid.

The roads in Allegany county include some of the most important constructed within the limits of the state, embracing the National Road, and the old Baltimore and Cumberland turnpike. The National Road, which begins at Cumberland and runs westerly towards the Ohio, was first laid out about two miles to the south of its present location and passed over Wills Mountain which was gained by a long steep grade. The present route, which takes advantage of the gap in Wills Mountain known as The Narrows, practically avoids this grade and affords a good example of the advantage to be gained through reconnaissance surveys before the final location of a route is chosen. The portion of the National Road for two or three miles west of Cumberland has been well maintained as this is the principal driving road out of the city. In addition to the large amount of lighter travel, the road sustains all the heavy traffic from the region to the west and north of Cumberland. At present also, part of the road-bed is occupied by the tracks of an electric car line so that at several points the road-way is too narrow for the large number of vehicles. An especially dangerous point is at The Narrows, where the whole available width for the road, the railroads and the electric line is not over 25 feet.

About one-fourth of a mile of the National Road within the limits of

Frostburg has recently been resurfaced with limestone, over which was spread a large quantity of cinders. The latter proved an utter failure as they form a mass of black mud in wet weather and are a greater nuisance in dry weather owing to the large amount of black dust which is constantly forming.

The old Baltimore and Cumberland turnpike, although having somewhat higher grades than were permitted in the construction of the National Road, is not excessively steep when the nature of the country is taken into consideration, the maximum grade being 8.5 feet in a hundred. This road was formerly a turnpike but at present no toll is collected west of the Conococheague river in Washington county, as this portion of the highway is under the care of Allegany and Washington counties. It is now in very bad shape since almost all of the top stone has been worn and washed away leaving the large foundation stones exposed. Sometimes dirt is thrown upon the road to secure a smoother surface. Broken stone has also been put upon some sections for a width of 8 or 9 feet. The old road-bed is about 20 feet wide, much wider than the traffic now requires, so that no attempt is made to maintain the full width excepting along a portion of the road near Cumberland where fine broken shale has been used for surfacing. This makes a very smooth and comfortable road for travel but it cannot, however, withstand any considerable wear.

Many portions of the Williams road running from Cumberland through Twiggtown to Rush are carefully located and well graded.

In Cumberland a number of streets were macadamized a few years ago in a substantial and thorough manner and they are now among the best macadam roads in Western Maryland.

One hundred and sixty supervisors have charge of the roads, and receive $1.50 per day when superintending five or more laborers, and $1.25 when superintending less. About two hundred and sixty laborers are employed, who receive $1.25 per day. An average of forty days in each year is spent in working on the roads.

The road machinery owned by the county consists of four road-machines which cost $940.00. There is in addition one stone-crusher which has been abandoned. It costs about $40.00 a year to keep this machinery in repair. There are to be found very few wagons with tires as wide as three and a half inches—not over 5 per cent. This applies to old and new wagons alike.

The rocks available for road materials consist, for the most part, of limestones, sandstones and shales. The limestones are the most valuable and occur widely distributed. Many of these limestones having a large percentage of sand and siliceous materials are shown by actual tests to have a wearing power considerably above that of the average limestones. Especially good varieties are found exposed along the railroad near Barrellville. The purer sandstones have very little cementing material and as a consequence do not readily compact but form very dusty roads. The shales have little durability and do not make a satisfactory road-metal. The map on Plate XX shows the general distribution of the different rocks in the county.

The following table shows the expenditure for roads during the last ten years. The figures were obtained from the office of the County Commissioners:

ALLEGANY COUNTY.

Year.	Total amount levied for roads and bridges.	Amount spent for bridges.	Amount spent for new roads.	Amount spent for stone roads.	Amount spent for road repairs.
1889	$13,204.00				$ 5,904.00[1]
1890	24,090.00				16,790.00
1891	20,860.00	About	About	About	13,560.00
1892	28,500.00	$6,000.00	$800.00	$500.00	21,200.00
1893	36,000.00	per year	per year	per year	28,700.00
1894	36,365.00	on the	on the	on the	29,065.00
1895	18,524.00	average.	average.	average.	11,224.00
1896	32,015.00				24,715.00
1897	27,000.00				19,700.00
1898	32,484.00				25,184.00
	$269,042.00	$60,000.00	$8,000.00	$5,000.00	$196,042.00

Cumberland, Frostburg, Lonaconing and Westernport are the only incorporated towns in the county, and they have been paid the sum of $6200.00 for years, divided as follows: Cumberland, $3500.00; Frostburg, $1100.00; Lonaconing, $900.00; Westernport, $700.00.

ANNE ARUNDEL COUNTY.

There are 521 miles of road, or an average of 1.31 miles of highway to each square mile of area in Anne Arundel county. Of these about 50 miles are gravel and shell roads, the remainder being of dirt. There are 96 miles of main traveled roads, or 18 per cent of the total mileage. They are shown on the county map in Plate XX. There are no toll-roads in the county.

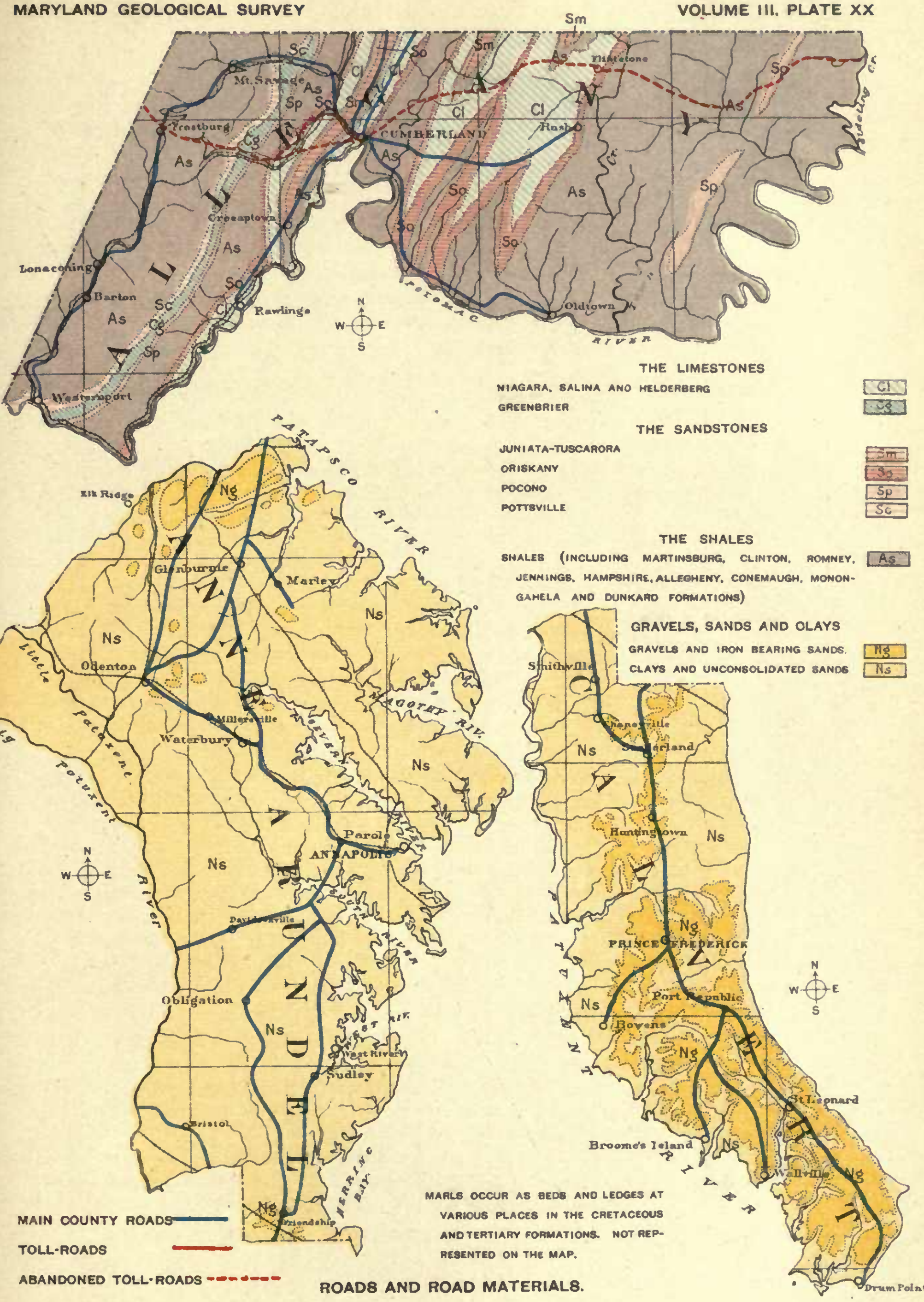
The Road Commissioners have divided the roads into three classes, known as High Roads, First-class, and Second-class Roads; there are 212 miles of the first, 162 miles of the second, and 147 miles of the last.

The surface has been much cut by deep ravines eroded by the action of the streams, and the roads when obliged to cross them invariably have steep grades, frequently reaching 15 to 20 per cent. The more level stretches of road are very sandy, but on the grades the sand has been washed away, leaving a road-bed which is frequently not more than 7 or 8 feet wide, cut a number of feet below the general level of the land, with nearly vertical banks at the sides. On many of the hills there is not room for teams to pass one another. The required width between the fences on the new roads is 30 feet.

Road-machines are used to shape up the road-beds of the dirt roads. Ditches are dug at the sides in some instances, but it is found that these roads are so washed on the hills that it soon becoms necessary to adopt other methods to protect the roadway from destruction. On some of the hills, shells have been placed as a protection to the road-bed, on others corduroy construction has been used for the same purpose but the results obtained have been only partially successful.

A few miles of shell road have been built in the northern portion of the county where it has been found that a road 8 feet wide with shell 6 inches

[1] Approximate.



ROADS AND ROAD MATERIALS.

A. Hoen & Co. Lith. Baltimore.

deep requires from 15,000 to 20,000 bushels of shells per mile. An experiment has been made in the construction of stone roads with limestone brought from Frederick county. About one mile of road was covered with the stone which was left loose and unrolled. This cost, including some repairs to the road, was about $6000.00, but it was not considered a success.

Many of the small wooden drains have been replaced by tile drain pipes or brick culverts. About $1500.00 have been expended on the former and $2500.00 on the latter during the last three years.

Repairs on the roads are generally made under the contract system. In case any portion is not let by contract it is done by day labor, the overseers receiving $1.50 and the laborers $1.00 per day. The road-machinery owned by the county consists of 7 new road-machines which cost $150.00 each.

Wide tires are practically unknown on farm wagons, the usual width being about 2½ inches.

Considerable quantities of furnace slag are found on the sites of the old iron furnaces. Some of the slag is very brittle and glossy in appearance and does not make a good road-metal. Other portions are less brittle and will easily compact to form a smooth road-surface, though one that will not withstand heavy traffic, as was shown by the tests made on slag from the Ellicott Furnace at Elkridge, the wearing quality of which is considerably below the average limestones. This can also be seen by reference to the table on page 330. Roads in the vicinity of Muirkirk have been surfaced with slag from the furnace at that place. Gravel is the principal road-metal, as there are no rocks in the county with the exception of a small area near Elkridge Landing.

The following table shows the total amount levied for roads and bridges during the last ten years. At the office of the County Commissioners there could be obtained only the amounts for the years 1892 to 1898 and it is practically impossible to find the amount for bridges, new roads, etc. The county makes no appropriation for the towns towards the maintenance of their streets, but all towns are exempt from road taxes:

ANNE ARUNDEL COUNTY.

	Total amount levied for roads and bridges.		Total amount levied for roads and bridges.
1889	$28,000.00[1]	1894	$34,006.02
1890	28,000.00[1]	1895	35,636.92
1891	28,000.00[1]	1896	33,395.45
1892	28,837.68	1897	29,770.30
1893	33,790.41	1898	31,684.45
			$311,121.23

BALTIMORE COUNTY.

In Baltimore county there are 1060 miles of road, or 1.72 miles per square mile of area. This total includes 640 miles of dirt road, 310 miles of stone road, and 110 miles of shell road. The main roads which are shown on the county map on Plate XXI measure 170 miles or 16 per cent of the total;

[1] Estimated.

included in the above figures are 154 miles of turnpikes or toll-roads, whose location is also shown upon the map. The following list gives the names and locations of the various turnpikes operated within the county:

Name.	"Piked."	Tolls Collected.
Baltimore and Frederick Turnpike.	Baltimore to Howard county line.	Baltimore to Howard county line.
Franklin and Baltimore Turnpike.	Baltimore to Franklin.	Baltimore to Franklin.
Baltimore and Liberty Turnpike.	Baltimore to Carroll county line.	Baltimore to Carroll county line.
Baltimore and Reisterstown Turnpike.	Baltimore to Reisterstown—two branches to Carroll county line.	Baltimore to Reisterstown—two branches to Carroll county line.
Falls Turnpike.	Baltimore to Brooklandville.	Baltimore to Brooklandville.
Western Run Turnpike.	Marble Hill to Butler P. O.	Marble Hill to Butler P. O.
Baltimore and Yorktown Turnpike.	Baltimore to Pennsylvania line.	Baltimore to Pennsylvania line.
Dulaney's Valley and Towsontown Turnpike.	Towson to Meredith's Ford.	Towson to Meredith's Ford.
Jarrettsville Turnpike.	Meredith's Ford to Taylor P. O.	Meredith's Ford to Taylor P. O.
Dulaney's Valley and Sweet Air Turnpike.	Meredith's Ford to Knoebel.	Meredith's Ford to Knoebel.
Baltimore and Harford Turnpike.	Baltimore to Harford county line.	Baltimore to Harford county line.
Bel Air Turnpike.	Baltimore to Harford county line.	Baltimore to Gunpowder river.
Philadelphia Turnpike.	Baltimore to near Cowanton.	No tolls collected.
Back River Neck Turnpike.	From Middle River, 3 miles toward Baltimore.	From Middle River, 3 miles toward Baltimore.

The wide range of soil and topography gives rise to a variety of conditions from that of the hilly, steep portions in the northern part of the county to the level sections in the southern part. Between these extremes are broad areas of slightly rolling country. With such a wide range in conditions nearly all of the different problems in road-making are encountered. The surface in the upper part of the county is so hilly and broken that steep grades are almost unavoidable except by a heavy amount of cutting and filling. Up to the present little of this has been done to reduce the natural grades. It is not alone on the side-roads that these steep grades are found, for there are many on the turnpikes which, like those in other counties, were built with too little attention towards securing a proper reduction of the grades before surfacing.

While the road-beds of the turnpikes are solid enough their surfaces leave much to be desired. In the vicinity of Baltimore all the roads are well-traveled and the turnpikes, as a consequence, are here in better condition than at a distance where the traffic is lighter. They are repaired in the usual manner by throwing on broken stone which is left to be consolidated by the wagons. This has resulted in an uneven road-surface, making an uncomfortable road on which to travel. In addition to the turnpikes there are many miles of road that have been macadamized by the county, particularly in the southern part. This work has been much facilitated by the use of the steam-rollers owned by the county, and more finished roads have been built than is the case in other counties. One of the best of these roads is that between Fork and Kingsville near the latter place. Here is a stretch of macadam road 12 feet wide and about one-half mile long which is now in excellent condition, having stood about 15 months' use with little sign of wear save that a horse-path is beginning to show in places. This piece of road was built of an excellent quality of trap-rock found in abundance at the roadside. The foundation was first shaped and rolled, then covered with a layer of 2½-inch stone, which in turn was thoroughly rolled. The second layer of stone was then spread and rolled. A thin "binder" course was then added making the total thickness of the macadam about 6 inches. The cost of this piece of road was $2268.00. At the beginning of the work Mr. E. G. Harrison, Road Expert of the National Road Inquiry Office at Washington, had charge and completed a section about 200 yards long showing in detail the exact method to be followed. The remainder of the road was completed by the county supervisors according to the directions given by Mr. Harrison and a thoroughly good road has resulted. A view of this road is shown on Plate XVII, Fig. 1.

Immediately west of this piece of road is a stretch which is covered with broken stone to a depth of 10 or 12 inches. The stone was not well spread but simply dumped in cart-loads upon the road. The roller then went over the stones compacting them into a firm mass but was not able to efface the trace of each pile of stone which at present can be readily noticed by the slight swells on the surface that have become more and more pronounced with subsequent wear.

Many miles of road have also been surfaced with oyster-shells. One of the finest shell roads in the state is that between Baltimore and Chase, a portion of which is shown in Plate XVIII, Fig. 2. An exceptionally large amount of travel of all descriptions goes over this road, a portion of which west of Middle River is a toll-road, so that repairs are constantly needed to preserve the road smooth and even. The worn-out shells form a large amount of dust which greatly detracts in dry weather from what is otherwise a good road-surface.

The general work done upon the county roads consists in opening the side-ditches, shaping up the dirt roads, and filling in the soft places with broken stone. It often happens that much useless and mud-making material finds its way into the middle of the road rendering it rather worse than better. Much of the broken stone used for patching the bad places in a dirt road becomes useless owing to the soft foundation. Before broken stone is put upon such places the roadway should first be drained and raised to insure an even and hard surface. Shells have been used as a "binder" course on some of the macadam roads. This has smoothed the surface temporarily but the shells soon become fine dust which is a great detriment and accomplish no lasting good.

The maintenance of the roads is under the immediate charge of 15 supervisors who are paid an annual salary varying from $250.00 to $1200.00. Additional men are employed by the supervisors, the number varying according to the amount of work on hand. They receive $1.25 per day. No estimate could be obtained of their average number. Supervisors and men average about 200 days per year upon the roads.

The road-machinery owned by the county consists of two 10-ton steam-rollers, three crushers, and five road-machines, the total cost of which was $11,500.00 and it costs about $200.00 annually for repairs. Baltimore is the only county owning steam-rollers. About one-half of the wagons used for heavy hauling have wide tires and nearly all the new ones are equipped with them.

The southern central portion of the county is especially well provided with good road-material. The large area of trap or "nigger head" rock to the north and west of Baltimore has furnished the surfacing for many roads in that vicinity. The gneisses from their wide occurrence form one of the important road-materials. The quality, however, even in the same quarry varies greatly. The marbles do not prove very satisfactory as they are too friable to withstand any considerable traffic. In addition to the rocks there are available within the county quantities of oyster-shells and slag. The slag obtained from the furnaces at Sparrow's Point has exceptional cementing qualities and roads made from this material soon harden and form a surface which is practically a monolith.

The following table shows the amount expended for roads and bridges for the past ten years. These figures were obtained from the office of the County Commissioners:

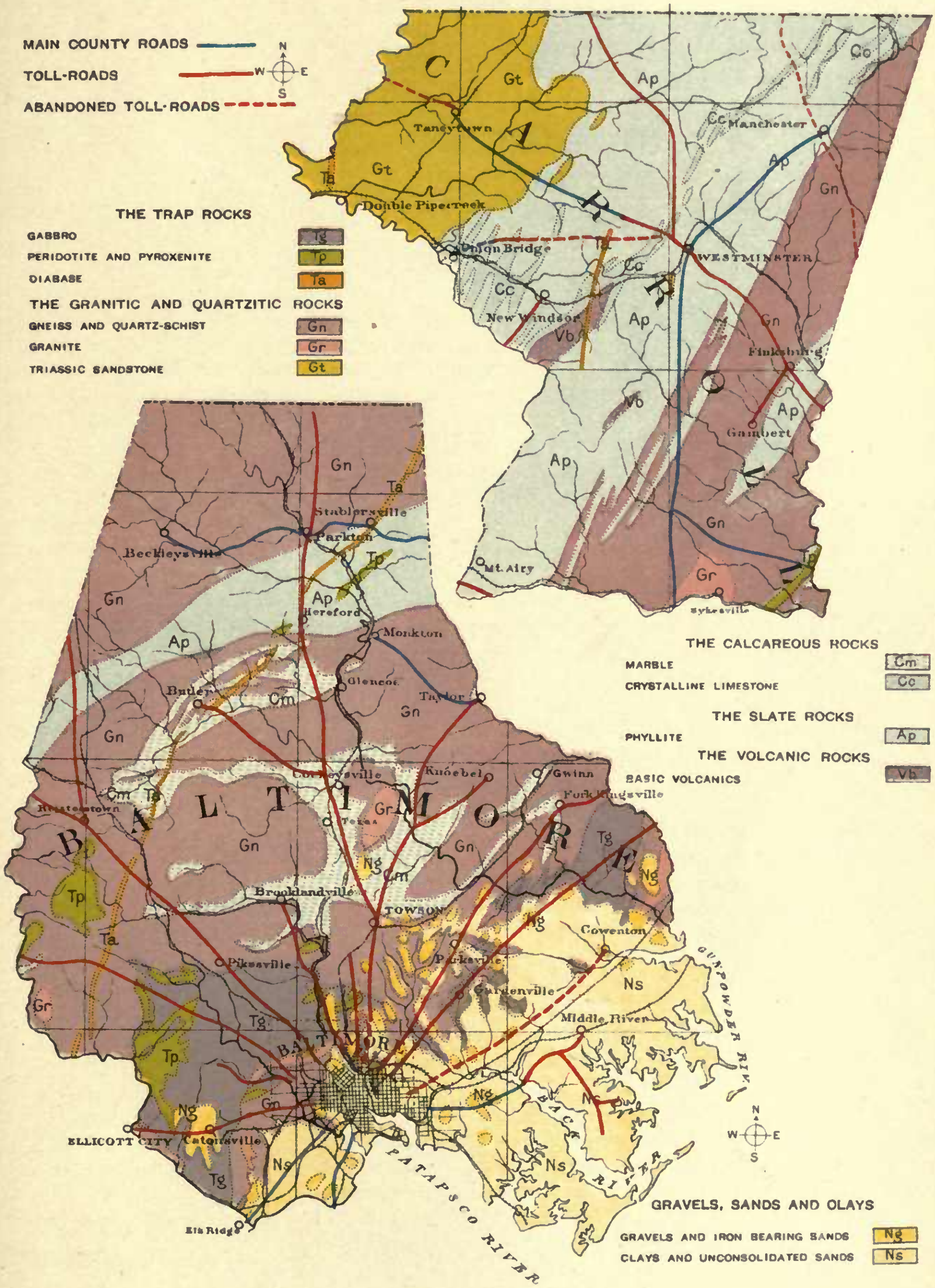
BALTIMORE COUNTY.

Year.	Total amount levied for roads and bridges.	Year.	Total amount levied for roads and bridges.
1889	$ 69,857.00	1894	$146,689.85
1890	75,056.00	1895	161,691.19
1891	51,074.26	1896	143,367.90
1892	134,793.00	1897	143,000.00
1893	143,936.34	1898	157,215.82
			$1,226,681.36

As there are no incorporated towns in the county and all the village streets are maintained out of the general road and bridge fund, the above figures show more than is actually expended upon the county highways proper; but is was impossible to obtain any estimate of the proportion spent in this way so no division of the total amount has been made.

Each year due appropriation is made for roads and bridges and there is no separate account kept of the costs of each material used, but all is charged against the appropriation to the district in which the road or bridge is located, and the whole appropriation is spent.

In addition to the amount shown in the above table it is estimated that $521,000.00 have been paid in tolls during the past ten years, making the total cost to the people of maintenance of the public roads and turnpikes approximately $1,747,700.00, exclusive of private contributions.



ROADS AND ROAD MATERIALS.

A. Hoen & Co. Lith. Baltimore.

CALVERT COUNTY.

The total mileage of roads in Calvert county is 265 miles, or an average of 1.21 miles of road for every square mile of area within the county. There is but little gravel and only occasional patches of shell road near the landings. Aside from these all the roads are of dirt.

The main county routes are shown upon the map on Plate XX. The length of the main roads is about 58 miles which is 22 per cent of the total mileage. There are no toll-roads in the county.

The eastern part of the county drains into the Chesapeake Bay while the streams of the western portion flow into the Patuxent river. On the divide separating these drainage areas extending nearly the entire length of the county is located the main road of the district, which encounters comparatively few steep grades. The soil is mostly clay mixed with a varied proportion of sand. The average width of the traveled portion of the road is about 11 feet, except in the sandy portion, where it is but a single track. The required width between fences on the new roads is 30 feet. There has been very little surfacing of any sort put upon the roads and practically no grading has been undertaken.

The road from Sunderland to Hill's Bridge is the direct route from Prince Fredericktown to Upper Marlboro. It crosses many streams, on the banks of which will invariably be found steep grades. At these points the roads are often worn down 10 to 12 feet.

The repairs to the roads are of the simplest character. Three supervisors, one in each district, have charge of repairs, the salary being $35.00 per month. Five laborers are employed by each supervisor and receive $1.00 per day. Supervisors and men work about 150 days every year upon the roads, the work being done between April 1st and October 15th. With the exception of some smaller tools, ploughs, shovels, etc., there is no road-machinery owned in the county and there are few or no wide-tired vehicles.

Gravel is the only road material at hand. As much of this is overlain by a covering of soil, sand and clay of varying thickness it is available only on the hillsides when the top soil has been worn away. The general distribution is shown on the map on Plate XX.

The following table shows the expenditure for roads for the last ten years. The amount for bridges, new roads, etc., cannot be separated from the total. These figures were obtained from the office of the County Commissioners:

CALVERT COUNTY.

Year	Total amount levied for roads and bridges.	Year	Total amount levied for roads and bridges.
1889	$4,000.00	1894	$4,500.00
1890	4,600.00	1895	4,700.00
1891	4,350.00	1896	5,500.00
1892	4,400.00	1897	4,800.00
1893	4,800.00	1898	4,000.00
			$45,650.00

CAROLINE COUNTY.

There are 547 miles of road in Caroline county, or 1.74 miles of highway per square mile of area. Ten miles have been surfaced with either marl or shells. Of the remaining 537 miles, 413 are on clay soil and 124 miles are on sandy soil. The main roads are shown on the map on Plate XXII. Their length is 60 miles, or 11 per cent of the total mileage. There are no toll-roads in the county.

The surface is exceptionally flat. The grades are less steep than in any other county on the Eastern Shore, but great difficulty has been experienced with sandy roads. Where the depth of sand is not too great, the roadway has been ploughed and this mixes the subsoil with the sand. The road is then reshaped with a road-machine and compacted with a roller. This has been found a great improvement. Where there is a stiff soil the road-machines are used to shape up the road. A number of short sections have been surfaced with shells which the farmers often haul free.

The road leading from Denton to the Choptank river is much traveled and requires re-shelling nearly every year. The road is on a grade of 6 or 8 per cent over a heavy clay soil. With the exception of a few tile drains which have been laid recently, all the subdrains are made of wood.

There are 53 road-districts and 85 supervisors who receive $1.00 per day. They hire on an average 5 men each, who receive 85 cents per day. The county has 5 road-machines and one road-plough, the total cost of which was about $1230.00. There is spent annually on repairs to this machinery between $50.00 and $60.00.

The county has recently rebuilt a portion of the bridge across the Choptank river known as the Dover bridge. The westerly portion of this bridge will be built by Talbot county. As seen from the view on Plate XIX, Fig. 1, the bridge consists of three through trusses. The spans are each 130 feet long and 18 feet wide. The piers are iron cylinders about 5 feet in diameter, filled with concrete. The shore piers are driven 25 feet, the next pair 45 feet, and the two remaining 65 feet. The floor of the bridge is about 3 feet higher than that of the one replaced. The center span will be a draw-span.

ROAD MAPS.

In the office of the County Commissioners there are maps made in 1896 by the late M. L. Saulsbury, C. E. One is drawn on a scale of three inches to the mile, and the other on the scale of two inches to the mile. The larger scale map shows all the roads in the county, indicating whether each is a clay, sand or shell road; it also gives the length and width of all bridges and drains and the distances between intersections of the roads. Such a map is extremely useful, for as changes are made from time to time they can be entered upon the map thus furnishing a record which will show at a glance the general progress and condition of the highways. The smaller scale map shows the roads and other features but is more especially an assessors' map, showing the different property owners.

In addition to the mileage of the roads as given above there are shown on the map 9525 feet of bridges and 323 box drains. Since the time it was made the map has not been posted and brought up to date so that the figures for the roads, bridges, etc., would be somewhat larger at the present time.

Marl and shells are the only materials which have been used upon the roads. Between Denton and Greensboro, marl has been used which was obtained from the dredging of the bed of the Choptank river. The amount thus obtained has been practically exhausted and owing to the depth to which the marl lies there is no other way of procuring it.

The following shows the amounts spent upon the roads for the past ten years. No subdivisions of the cost could be obtained at the office of the County Commissioners:

CAROLINE COUNTY.

Year.	Total amount levied for roads and bridges.	Amount spent for new roads.
1889	$9,000.00	....
1890	7,000.00	$1,000.00
1891	8,000.00	....
1892	8,000.00	....
1893	7,000.00	....
1894	7,000.00	....
1895	5,000.00	....
1896	5,000.00	....
1897	6,000.00	....
1898	6,000.00	....
	$68,000.00	$1,000.00

CARROLL COUNTY.

In Carroll county there are about 800 miles of road or 1.88 miles to the square mile. Of these 42 miles were built by turnpike companies who now collect on only 30 miles, as 12 miles have been abandoned and are now maintained by the county. With the exception of a few short patches of stone road the county roads are of dirt, generally made over a clayey soil.

The main highways of the county are shown on the map, Plate XXI, and are 68 miles in length, or about 9 per cent of the total mileage.

The soil varies from fine-grained compact clay to one with a larger proportion of sand. Occasionally there are found a number of small fragments of quartz intermixed but the proportion of rock fragments is small. The general character of the surface is that of a rolling country, the streams having worn for themselves broad channels which have been cut below the general level to depths varying from 30 to 200 feet. Wherever the roads cross the streams there are steep grades on either bank.

The divides between many of the water courses are comparatively high level tracts on which, so far as possible, the main highways of the county have been located. Such portions of the road have, as a rule, grades rarely exceeding six feet in a hundred. Descending from the higher ground, in order to pass the streams, the grades average 10 per cent with occasional short stretches as steep as 12 per cent. The course of a large number of the county roads is at right angles to the general trend of the divides which they cross one after the other. These roads are in consequence very hilly and the most tedious to travel.

The required width between fences on new roads is 30 feet.

The Hanover turnpike which runs north from Manchester is not at present much traveled and has been abandoned. The full red lines on the map show the portions of turnpikes on which tolls are now collected, the dotted lines showing the portions on which tolls were formerly collected but which are now free roads under the control of the county.

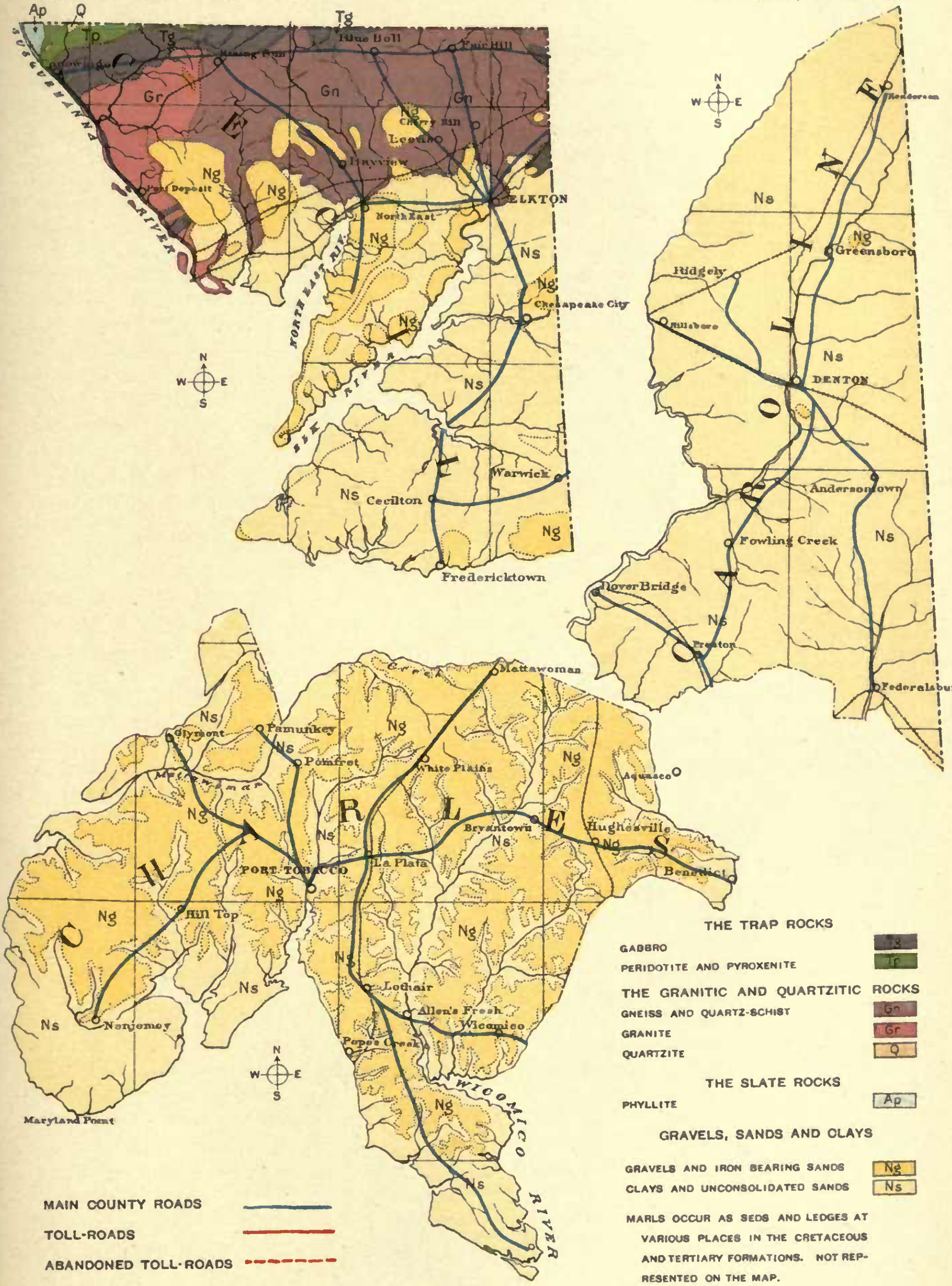
The following list gives the names of the four turnpikes actively operated within the county:

Name.	"Piked."	Tolls collected.
Liberty and New Windsor Turnpike.	New Windsor to one mile north of Unionville.	New Windsor to one mile north of Unionville.
Liberty and Pipe Creek Turnpike.	Liberty to Union Bridge.	Liberty to Union Bridge.
Westminster and Meadow Branch Turnpike.	Westminster to Meadow Branch (2 miles).	Westminster to Meadow Branch (2 miles).
Baltimore and Reisterstown Turnpike.	Uniontown to Westminster.	Uniontown to 2½ miles S. E. of Uniontown.
	Penn. line through Union Mills to Westminster.	Penn. line through Union Mills to Westminster.
	Westminster to Reisterstown.	Westminster to Reisterstown.
(There is also 1 mile of the Baltimore and Fredericktown Turnpike in this County.)	Gambert to Finksburg.	Gambert to Finksburg.
	Penn. line through Manchester to Balto. Co. line.	

The Washington road from Dorsey's Corner to Westminster is probably the most traveled of any in the county, excepting portions of the Baltimore "Pike." Along this road there is very little fencing of any description. The fields have been ploughed on each side leaving 16 to 20 feet for the roadway which has been worn so as to form a broad shallow trench. The width of the traveled portion of the road varies from 15 feet in the vicinity of Westminster to 8 feet on the lesser traveled part. Owing to the lack of grading, pools of water collect after every rain causing deep mud-holes. There are a few 10 per cent grades, the average hill on this road being about 7 per cent.

The Manchester road is another important county road. It is a clay road, hilly and rough, most of the grades being from 8 to 10 per cent. In a few places it has been covered with stone which unfortunately was not broken small enough so that the surface is very rough. On the hills the road has been much washed by the rain. The fences are from 20 to 30 feet apart. The traveled way averages about 10 feet in width being narrower on the steep grades and wider on the more level portions.

There is more traffic over the Baltimore turnpike than over any of the county roads. This is a toll-road and receives much attention. The fences are about 15 feet apart and the traveled portion of the road is 10 to 15 feet wide, and still wider near Reisterstown. In places at the side of the turnpike there is a dirt road which has worn down below the grade of the stone road sometimes from 4 to 5 feet. Whenever this occurs or the road is built on an embankment, guard-rails have been erected to prevent teams from accidentally driving over the edge. This is the only road in the state as well protected in this respect. The grades are not over 6 feet in a hundred. The road-surface is formed principally of quartzitic rocks though



ROADS AND ROAD MATERIALS.

A. Hoen & Co. Lith. Baltimore.

crystalline limestone and hard shale have also been used. The stone for repairs, which are made frequently, is broken to about one inch and a half in size, and this together with the heavy traffic has produced a hard road-surface with few or no rough places.

Perhaps the worst piece of toll-road in the state is that running from Gambert to Finksburg, connecting with the Baltimore turnpike. Its condition is in great contrast to that of the latter. Not graded, covered with loose rock, and with little heavy traffic, there only remains a very rough and uneven surface and the toll-gates.

The work done upon the county roads consists of ploughing and opening ditches at the sides, the loose materials being scraped into the center of the road. On the hills breakers are constructed so that the water flowing down the center of the road will be turned to one side when it meets them. With the exception of some of the turnpikes there has been very little grading done upon any of the roads. Small patches of stone road have been constructed here and there but the stone is seldom broken small enough to insure the formation of a smooth surface. Nearly all the small culverts are made of wood, very little tile drain having been used.

The repairs to the roads are under the charge of 37 commissioners, corresponding to supervisors in other counties, who receive $2.50 per day while employed on the road. In addition there are hired some five hundred laborers receiving $1.25 per day. About twenty days in each year are spent in working on the roads. The road-machinery owned by the county includes 15 road-machines, costing in all $3375.00, and one stone-crusher which cost $400.00. There is also a steam road-roller owned by Westminster. Over 75 per cent of the wagons used for heavy hauling have 3½-inch or wider tires.

The best of the road material, which is the trap-rock, is not widely distributed in the county but is confined to limited areas to the south and west of Westminster. It is, however, of excellent quality. The marbles are not suitable for macadamizing as they form dusty roads and their color is very trying. In the northern portion of the county are found quantities of sandstone. Gneiss is distributed throughout the eastern portion. The map on Plate XXI shows the location of these rocks in the county.

The following table gives the amount spent upon the roads and bridges during the last ten years. These figures were obtained from the office of the County Commissioners:

CARROLL COUNTY.

Year.	Total amount levied for roads and bridges.	Amount spent for large bridges.	Amount spent for road repairs and small bridges.
1889	$14,179.31	$1,476.00	$12,703.31
1890	17,201.94	1,081.00	16,120.94
1891	14,653.22	......	14,653.22
1892	20,542.73	5,718.00	14,824.73
1893	14,547.11	206.00	14,341.11
1894	14,798.88	1,560.00	13,238.88
1895	20,835.00	3,853.00	16,982.00
1896	18,223.85	1,464.00	16,759.85
1897	17,474.20	1,041.00	16,433.20
1898	19,632.25	2,039.00	17,593.25
	$172,088.49	$18,438.00	$153,650.49

Amounts appropriated to the towns for road repairs are: Westminster, $800.00 per annum since 1894; Manchester, $105.00 per annum since 1896; New Windsor, $96.00 per annum since 1896; Taneytown, $123.00 per annum since 1896.

In addition to the amount shown in the above table it is estimated that $75,000.00 have been paid in tolls during the last ten years, making the total cost to the people of the maintenance of both public roads and turnpikes approximately $247,100.00, exclusive of private contributions.

CECIL COUNTY.

In Cecil county there are about 700 miles of road, or 1.87 miles to each square mile of area. There are about 5 miles of stone road, 10 miles of gravel road, 2 miles of shell road, and 683 miles of dirt road. The main county roads are shown on the map on Plate XXII and measure 91 miles, or 13 per cent of the total mileage. There are no toll-roads in the county.

Cecil county presents a greater variety of topography than is usually the case, since the boundary-line separating the Coastal Plain from the Piedmont Plateau passes across the center of the county while its western border is formed by the deep gorge of the Susquehanna. In the Rising Sun and Port Deposit districts the roads for the greater part are rough and hilly, in some places the grades being over 15 feet in the hundred, while grades of 12 feet in the hundred are of frequent occurrence. On the steeper grades the roads have gradually been cut deeper and deeper by the rains until the sides have become steep and the width of the roadway about 8 feet.

On the more level sections of traveled way a width has been maintained varying from 12 to 14 feet, averaging about 12 feet. Many of these level portions present a very neat appearance, being lined with rows of carefully trimmed hedges and closely cut turf-banks at the sides. Clay, gravel, and occasionally sand form the natural road-bed of these districts.

The portion of the county south of Chesapeake City is flat, the roads in consequence having but few heavy grades which are found on approaching streams whose channels are some 10 to 20 feet below the general level of the surrounding land. Sandy roads predominate. Clay forms the material of the lesser portion.

The road from Elkton to Chesapeake City is one of the most traveled routes and is the main road leading into Elkton from the southern portion of the county. The grades for the most part are not excessive, 8 feet in a hundred being the maximum. Where the grades occur the roadway has gradually been worn down by the action of the water and narrowed, but on the average the traveled portion of the road is about 14 feet, varying from 10 to 15 feet. The width between the fences or hedges is from 30 to 35 feet. In some parts the road-scrapers have been used for shaping up the roadway, the turf and dirt at the sides being put upon the middle of the road. The ditches are about 3 feet from the fence line. Clay and sand either separate, or mixed, form the soil of the road-bed. A portion of the road from Chesapeake City has been made into a good shell road.

Perhaps no better example of a clay road can be found than the one from Elkton to Northeast. During the winter months and wet weather this road is practically impassable. Some attempt has been made to raise the roadway by throwing clay from the sides to the center, but the rains soon wash it back into the ditches. To put this piece of road into passable condition would require the construction of deep side-ditches, thorough underdrainage, and a filling in of the roadway with good gravel.

The only long stretch of stone road in the county is between Elkton and Providence. The larger part of the cost of its construction was borne by the late Wm. L. Singerly, the owner of paper mills at Providence and a pulp mill at Elkton, who found it imperative to have a good connecting road. This road was built between 1880 and 1897, during which time the county appropriated from $600.00 to $800.00 annually towards the cost of construction. The total cost of the road is reported to have reached $60,000.00. The bed of this road consists of two layers of stone, the first coarsely and the second finely broken, covered with a rather thick layer of cinders. The cinders aided in smoothing up the road in the beginning, but now have been ground to a fine dust that is very disagreeable in either wet or dry weather.

In the spring and summer the roads are shaped and the ditches opened. When the character of the soil will permit the shaping is usually done with the road-machine. It is not uncommon to see as the result of repairs, mounds of sod along the center of the road.

Broken stone has been used to a very limited extent. It is spread and left loose to be compacted by the traffic. Dirt is oftentimes thrown over the stones to smooth up the surface, but in no instance has a smooth road resulted. The stone is not broken small enough and the traffic is insufficient to compact it.

The repairs are made under the direction of 90 supervisors, 10 being assigned to each district. The pay of the supervisors is $1.25 per day. Each employs from 2 to 10 men according to the circumstances, who receive $1.12 per day.

The road-machinery owned by the county consists of 12 road-machines and a stone-crusher, the total cost of which was $3500.00. About $150.00 is spent annually on repairs to this machinery.

There are very few farm wagons provided with wide tires and it does not seem to be the custom to order them for new wagons.

The northern section of the county is well provided with a variety of good road materials. Between Conowingo and Rising Sun is a large area of gabbro or trap, while south of Port Deposit, near Elkton and at numerous other places there are ledges of trap that rank with the best road-metals in the state. At Port Deposit also, granite is quarried extensively and the smaller pieces are crushed to a size suitable for use on the roads. In the southern portion of the county, gravel and oyster-shells form the local road-metals.

The following table shows the amount that has been expended upon the roads during the last 10 years. No division of the cost has been made, so that only totals for the different years can be given. The figures were obtained from the office of the County Commissioners:

CECIL COUNTY.

Year.	Total amount levied for roads and bridges.	Year.	Total amount levied for roads and bridges.
1889	$15,000.00	1894	$20,000.00
1890	22,000.00	1895	17,777.00
1891	13,212.09	1896	20,000.00
1892	20,000.00	1897	20,000.00
1893	25,000.00	1898	20,000.00
			$192,989.09

The total amount received by Cecilton, Chesapeake City, Elkton, Northeast, Charlestown, Perryville, Port Deposit and Rising Sun for road-repairs in 1898, was $1575.00.

CHARLES COUNTY.

In Charles county there are 465 miles of road, or 1 mile of highway to each square mile of area. 365 miles are of dirt, and about 100 miles are of gravel. The main roads shown on the map on Plate XXII are about 100 miles in length, or 22 per cent of the total mileage. There are no toll-roads in the county.

The general surface features are those of the Coastal Plain west of the Chesapeake. There is, however, a considerably larger proportion of level area than is found in adjacent counties. Wherever the roads cross the streams, they invariably have steep grades, of from 10 to 15 per cent. At these points the roadway has been much worn away by storm-water and is generally too narrow.

The change of the county seat from Port Tobacco to La Plata necessitated opening new roads, making more direct routes to the new county-seat. Among these was the new road between La Plata and Lothair which shortened the distance to La Plata for all travel from the neighborhood of Cox's Station. The route followed runs parallel to and a few hundred yards to the west of the railroad line. By adopting this location it was necessary to cross the headings of a number of small ravines, thus making a hilly road which could have been avoided if the location had been on the easterly side instead of the westerly side of the railroad. The road as opened has not been graded and is merely a surface road. The roadway has been cleared for a width of 30 feet, with a width between ditches of about 25 feet. There are a number of short grades as steep as 15 per cent. It is intended ultimately to gravel the whole of the roadway, and a part of it has already been surfaced, but this road in its present location cannot be made a good one without a very large amount of grading. The length is about 2 miles and the cost $2500.00.

The road from La Plata to Bryantown has been surfaced with gravel and is one of the best in the county.

The repairs of the county roads are in the charge of 9 supervisors who employ 27 laborers. The supervisors are paid $1.50 per day, and the laborers $1.00 per day. The laborers are divided into 9 corps each in charge of a supervisor. They work on the roads about 125 days in each year. At one time the county owned one road-machine, but its use has been discontinued. Aside from this the county owns no road-machinery.

Wide tires on the farm wagons are the exception, and it is not generally the practice to have them on new wagons.

The required width between the fences on new roads is 40 feet. It has been found that roads surfaced with gravel to a width of 9 feet and about 5 inches thick using 750 cubic yards of gravel have cost approximately $225.00 per mile. This merely covers the cost of throwing the gravel upon the road, the grading and draining being additional. Only wooden drains have been used for draining as no tile drains have been laid for this purpose. Those portions of roads which have been repeatedly graveled and are now well-seasoned and compacted, remain firm and hard in all kinds of weather.

As is seen by a glance at the map, Plate XXII, the gravel beds are well distributed over all portions of the county. The character of the gravel varies, one section containing different proportions of clay and sand from that of another. The gravel used upon the roads in most instances was that which was closest at hand and showed considerable variability. On some roads the gravel has compacted, making a firm and solid road-bed, while on others, owing to the sandy nature of the gravel it has not compacted as well. To obtain the best results it would be necessary to make a careful selection of the material used.

The following table shows the amounts expended for roads and bridges during the last ten years as obtained from the office of the County Commissioners:

CHARLES COUNTY.

Year.	Total amount levied for roads and bridges.	Amount spent for bridges.	Amount spent for new roads.
1889	$8,000.00	....	....
1890	8,000.00	....	....
1891	8,000.00	....	....
1892	8,000.00	....	....
1893	7,000.00	....	....
1894	7,000.00	....	....
1895	7,000.00	....	....
1896	7,000.00	$750.00	....
1897	7,000.00	900.00	....
1898	9,500.00	....	$2,500.00
	$76,500.00		

The amounts levied for road and bridge purposes in years indicated have generally been spent without separating—most of the bridge repairs and work having been done under the direction of the supervisors and the regular road force.

The two amounts in column for bridge expenses were for two iron bridges built under contract, and represent the only iron bridges in the county.

DORCHESTER COUNTY.

In Dorchester county there are 600 miles of road or 0.99 miles per square mile. There are about 20 miles of shell road, the remainder being of dirt. The main county roads shown upon the map are 109 miles in length, or 18 per cent of the total mileage. There are no toll-roads.

About the flattest portion of the Eastern Shore is found in Dorchester county, the southern part of which is but a few feet above tide-water. The road-beds are practically without grade and in many portions it is very difficult to obtain sufficient slope for the side-drains to carry off surface-water. Where the areas are marshy the roads have frequently been corduroyed and covered with earth while the sandy roads have become deeply rutted by the teams following each other in the same tracks.

From Cambridge to Church Creek, which is one of the principal lines of travel of the county, a shell road has been constructed. In the vicinity of Cambridge the shelled portion is from 15 to 20 feet wide, narrowing down to 10 feet farther away. From Cambridge to East Newmarket the road has been shelled an average width of 12 feet for three or four miles out of Cambridge. There is also a shell road fully 15 feet wide from East Newmarket to Secretary over which there is a considerable amount of hauling. Most of the other roads in the immediate vicinity of Cambridge have likewise been shelled.

A mile of road covered 10 feet wide and 8 inches thick requires about 40,000 bushels of shell, which cost ¾ of a cent a bushel. The average cost for hauling and spreading is about 1½ cents to 3 cents per bushel, making a total cost of shells placed upon a road about 3 cents per bushel. A man can spread in the neighborhood of 2000 bushels per day. The required width between fences on new roads is 30 feet.

Repairs on the roads are in charge of 53 supervisors who receive, when engaged upon general work, $1.25 per day, which work is usually done before July 1st; during the remainder of the year, for such work as may be necessary, they are paid $1.00 per day. On general work the supervisors employ from 4 to 8 laborers, and on other work, 1 to 8, according to the necessity. Laborers are paid 75 cents per day. On an average there is annually paid to the supervisors, $1500.00 and the yearly amount paid for other labor during the last three years has been $5000.00. The attempt has been made to let out the work by contract, but there were no bidders within reasonable limits and this system was abandoned. There was formerly one road-machine. The county at present has no machinery, the results not being satisfactory. Wide tires are used but little, the majority being 2 to 2½ inches in width.

There is neither stone nor gravel in the county, the only road material at hand being oyster-shells.

The following table shows the amount expended for roads and bridges during the last ten years. These figures were obtained from the office of the County Commissioners.

DORCHESTER COUNTY.

Year.	Total amount levied for roads and bridges.	Amount spent for bridges.	Amount spent for new roads.	Amount spent for shell roads.	Amount spent for road-repairs.
1889	$10,723.00	....	....	....	....
1890	10,717.00	....	....	....	....
1891	12,709.00	....	....	....	....
1892	11,125.00	....	....	....	....
1893	9,782.00	....	....	....	....
1894	8,979.00	....	....	....	....
1895	8,810.00	....	....	....	....
1896	11,387.00	$2,000.00	$297.00	$1,200.00	$7,890.00
1897	12,902.00	2,000.00	61.00	1,900.00	8,941.00
1898	10,000.00	2,000.00	348.00	3,500.00	4,152.00
Total	$107,134.00				

The amounts in bridge expense column are average amounts for the last three years.

Amounts for shell roads are given in round numbers, being within a few dollars of amounts found by actual search of the records.

Cambridge received $700.00 per annum previous to 1898 and for that year, $1200.00; East Newmarket, $20.00 per annum.

FREDERICK COUNTY.

The total mileage of roads in Frederick county is 1280 miles, or 2.02 miles to the square mile. This is the largest mileage of any county in the state. There are 1150 miles of dirt road and about 130 miles of stone road. Toll is collected over 129 miles of stone roads, leaving only short patches built and maintained by the county. The main roads, including the turnpikes, are shown on the map, Plate XXIII. Their mileage is 172 miles or 13 per cent of the total mileage. It is a noticeable feature that nearly all of the main thoroughfares in the county are turnpikes. This is especially true about Frederick from which radiate nine turnpikes that are very well traveled within three to five miles of the city. The portion of the Frederick and Woodsboro turnpike from Frederick to Ceresville bridge is more traveled than any of the others.

The amount of travel on the majority of the county roads is secondary in consideration to that which follows the turnpikes, as they are usually feeders to the latter. The most traveled county roads are those from Knoxville to Brunswick, and from Woodsboro to Libertytown. Much of the heavy hauling that now goes over the Liberty and Woodsboro road formerly went over the turnpike through Johnsville and Uniontown, and thence to Baltimore, or else by the way of the old Liberty road to Baltimore. Much of the produce of the lower portions of Middletown valley is now hauled over the Knoxville and Brunswick road.

Nearly all of the turnpikes in the vicinity of Frederick cross the gently rolling country forming the Frederick valley which is shut off from the Middletown valley and the western portion of the county by the Catoctin mountain. The northern portion of the county is more broken and the roads as a consequence rougher.

The "pike" west of Frederick where the grades are light crosses the Catoctin mountain to Middletown with nearly an 8 per cent grade. Across the Middletown valley the "pike" follows the undulations of the country resulting in many short grades of 8 to 9 per cent. Part of the road in the Frederick valley is surfaced with limestone for the first two miles from Frederick and is worn down comparatively smooth. The width of the traveled way on this section is about 15 feet. On the portion over the Catoctin mountain and across the Middletown valley the surface is for the most part of "flint" or quartzitic sandstone, and paralleled in many places by a dirt roadway. As the sections having the "flint" rock are rough, dirt and soft shale have been thrown over the stone to render the surface smoother. The surfaced portion of the roadway through Middletown valley does not average over 9 feet in width, although the road-bed is about 30 feet wide. The fences along this road are from 50 to 55 feet apart.

The turnpike leading to Yellow Springs, except for the first mile or so from Frederick, is generally rough, with many loose stones on the surface. There is not enough hauling over it to compact the quartz rock with which the greater portion of the road is surfaced. On the part near Frederick limestone has been used and this has compacted better. The width of the traveled portions of the road is about 11 feet; fences are from 35 to 40 feet apart.

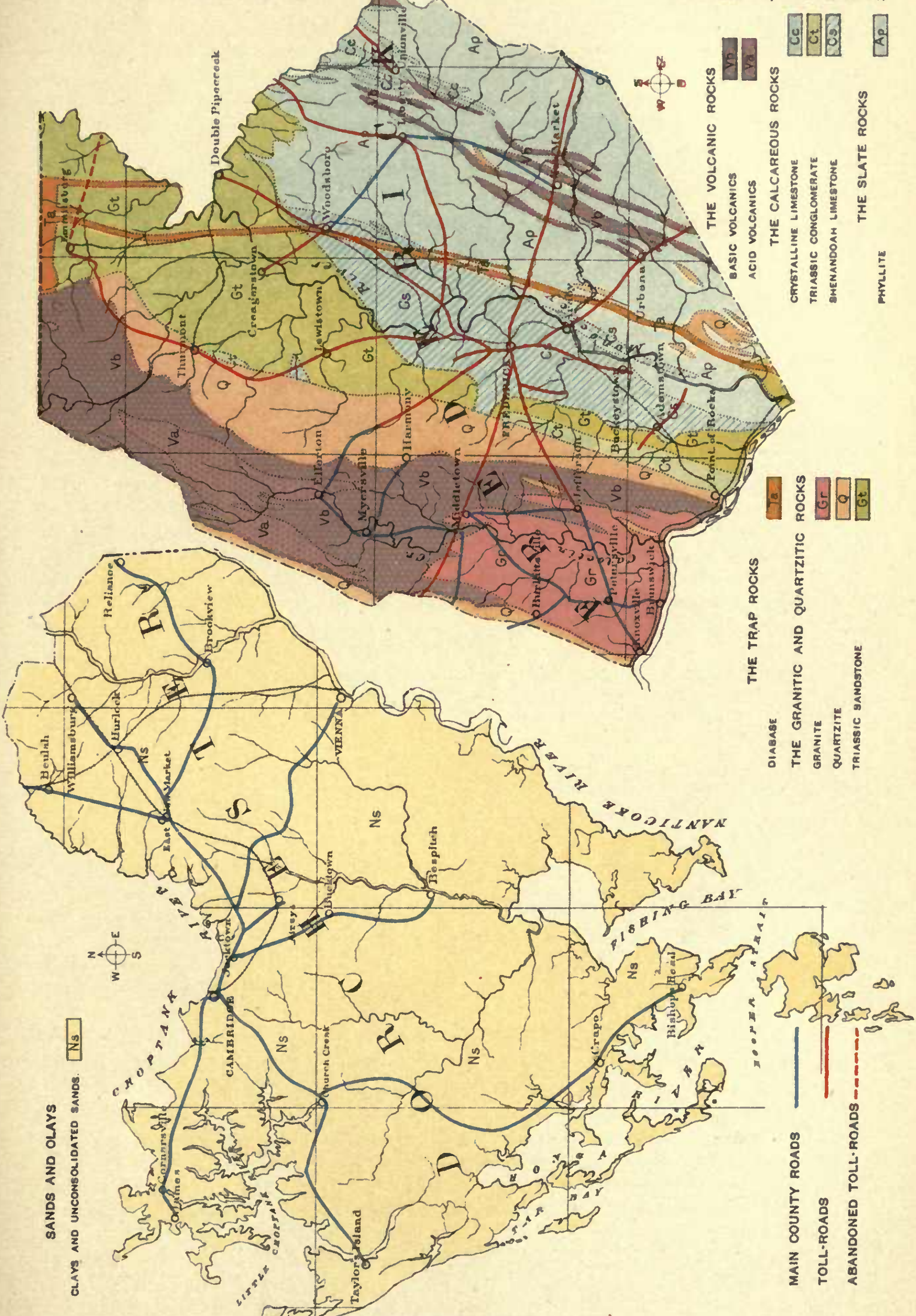
The Woodsboro turnpike from Frederick to the Monocacy river, is the best piece of road in the county and one of the best in the state.

The following turnpikes are operated in Frederick county:

Name.	"Piked."	Tolls Collected.
Adamstown Turnpike.	Adamstown to Doubs, and to intersection of Noland's Ferry Road.	Adamstown to Doubs, &c.
Buckeystown Turnpike.	Frederick to one mile beyond Buckeystown.	Frederick to one mile beyond Buckeystown.
Frederick and Ballinger Creek Turnpike.	Jefferson Turnpike to Ballinger Creek.	Jefferson Turnpike to Ballinger Creek.
Frederick and Emmitsburg.	Worman's Mill to Emmitsburg.	Worman's Mill to Emmitsburg.
Frederick and Jefferson.	Frederick to Jefferson.	Frederick to Jefferson.
Frederick and Monocacy.	Frederick to Monocacy river.	Frederick to Monocacy river.
Liberty and New Windsor.	New Windsor to one mile north of Unionville.	New Windsor to one mile north of Unionville.
Liberty and Pipe Creek.	Liberty to Union B'dge.	Liberty to Union B'dge.
Frederick and Woodsboro.	Frederick to Monocacy river.	Frederick to Monocacy river.
Liberty and Frederick.	Monocacy river to Liberty.	Monocacy river to Liberty.
Monocacy and Urbana.	Araby to three miles beyond Urbana.	Araby to three miles beyond Urbana.
Woodsboro and Creagerstown.	Woodsboro to Creagerstown.	Woodsboro to Creagerstown.
Woodsboro and Frederick.	Liberty "Pike" to Woodsboro.	Liberty "Pike" to Woodsboro.
Woodsboro and Double Pipe Creek.	Woodsboro to Double Pipe Creek.	Woodsboro to Double Pipe Creek.
Baltimore and Fredericktown.	Blue Ridge to Ridgeville.	Blue Ridge to Ridgeville.
Frederick and Catoctin Mountain.	Frederick to Catoctin mountain.	Frederick to Catoctin mountain.
Frederick and Opossum.	Frederick to Forks of County Rd. (3 miles.)	Frederick to Forks of County Rd. (3 miles.)
Frederick and Washington (or Georgetown).	Frederick to Araby.	Frederick to Araby.

The cost of putting stone on the roads for a width of 14 feet and a depth of 9 inches was given as from $1750.00 to $2000.00 per mile, 3500 perches of broken stone being used. In the last three years there have been laid from 1000 to 2000 feet of tile drains for draining the roads.

There are 346 road supervisors in Frederick county who receive $1.25 per day, or when superintending six or more laborers $1.50 per day. In addition to these supervisors there are employed for a short time about 1000



ROADS AND ROAD MATERIALS.

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laborers, who are paid $1.25 per day. The supervisors and men average from six to ten days' work per year.

The road-machinery owned by the county includes four rock-crushers, 15 road-machines or scrapers, a few hand scoops and picks, hammers, sledges and shovels. The rock-crushers cost about $700.00 each, and the road-machines about $200.00 each. There are $300.00 worth of small tools, making in all about $6100.00 worth of road-machinery. From $300.00 to $400.00 are spent annually for repairs.

Over three-fourths of the wagons used for heavy hauling have tires 3½ or more inches in width. Nearly all of the new wagons are provided with wide tires.

The required width between fences on new roads is 30 feet.

The road-materials consist of trap-rock, limestone, quartzite and sandstone. The best of these is the trap-rock which is popularly known as "nigger-head" rock. This occurs in massive bands or dikes extending southward from Emmitsburg to the Potomac. About Emmitsburg this rock has a coarse granular structure and is known commercially as Gettysburg granite. This coarse-grained variety is not of so great value for a road-metal as the compact fine-grained rock found elsewhere in this dike. This stone can be conveniently shipped by rail. The limestone is confined to a limited area about Frederick and is generally rather soft. The harder varieties are found to have a considerable percentage of silicious material and made a better road-metal than those with less silica. The western portion of the county is furnished with sandstone and quartzitic rocks which present a very great variability of structure. The shales in the eastern portion are not of especial value as a road-metal. The map on Plate XXIII shows the location of the different rocks in the county.

The following table shows the amount expended for roads and bridges during the past ten years. These figures were obtained from the office of the County Commissioners:

FREDERICK COUNTY.

Year.	Total amount levied for roads and bridges.	Amount spent for bridges.	Amount spent for new roads.	Amount spent for stone roads.	Amount spent for road-repairs.
1889	$47,964.64	$25,065.58	$1,515.91	....	$21,383.15
1890	21,227.80	2,500.00[1]	190.98	....	18,536.82
1891	21,543.65	2,500.00[1]	374.50	....	18,669.15
1892	26,031.77	2,500.00[1]	1,184.11	....	22,347.66
1893	27,649.07	2,500.00[1]	1,439.07	....	23,710.00
1894	31,624.50	5,000.00[1]	424.50	....	26,200.00
1895	37,309.71[2]	2,500.00[1]	2,069.01	....	32,740.70
1896	29,106.46	3,758.54	504.87	$500.00[1]	24,343.05
1897	39,545.05	13,495.81	3,919.24	2,000.00[1]	20,130.00
1898	26,814.75	3,000.00[1]	1,814.75	500.00[1]	21,500.00
	$308,817.40	$62,819.93	$13,436.94	$3,000.00	$229,560.53

[1] Estimated. Previous to 1896 there was little or nothing spent for stone roads as far as the books show, and since then only a rough estimate can be made.

[2] Includes $9000 for snow drifts.

Walkersville and Unionville receive $25.00 each; and all the roads (except turnpikes of incorporated companies), in towns, except in Frederick City, Thurmont and Emmitsburg, are allowed the regular appropriation of $12.00 per mile.

In addition to the amount shown in the above table it is estimated that $395,000.00 have been paid in tolls during the past ten years, making the total cost to the people of the maintenance of the public roads and turnpikes approximately $603,800.00, exclusive of private contributions.

GARRETT COUNTY.

The total mileage of roads in Garrett county is 650 miles, or 0.96 miles per square mile of area. In the disputed strip of land along the western boundary of the county there are about 50 miles of road, but as these have never been under the care of Garrett county, they are not included in these statistics. No stone roads have been constructed by the county. The 22 miles of the National Road within the county is the only stretch of stone road. The main roads are shown on the map on Plate XXIV, and have a mileage of 80 miles, or 12 per cent of the total mileage. There are at present no toll-roads in the county as toll has not been collected on the National Road since 1878.

The roughest and wildest country to be found in the state is in Garrett county. The mountainous character of the whole area imposes some of the hardest conditions upon road-construction. Many of the roads on a side-hill location are oftentimes so narrow in places that teams cannot pass. Some of the roads when first opened were simply lumber roads, and were scarcely more than clearings. As the timber from a particular area was exhausted, a large number of these roads became disused. Some of them, however, have been kept open and they are the roughest in the state.

A good example of a narrow side-hill road is to be found near Friendsville on the road to Accident where the entire roadway is not over 12 feet wide and extends for about three-fourths of a mile on a 10 per cent grade. The mountain slope is very steep, and no form of guard-rail is provided to prevent a frightened animal dashing down the mountain side.

In the location of the Hoop Pole Ridge Road advantage was taken of the narrow level strip found on the top of the Hoop Pole Ridge, which portion of the road has comparatively easy grades. This thoroughfare continues on through McHenry and Hoye's to Friendsville, on the westerly slope of the divide between the area draining into the Potomac river and the area draining into the Youghiogheny river. On this slope are very steep grades. On a hill near Hoye's they are as high as 20 per cent.

The road running south from Oakland to Gormania has many steep grades. One in particular near Gormania measured twenty-two per cent. In the summer of 1898 the County Commissioners had surveys made for a relocation of a portion of the road so as to avoid this excessive grade.

Around Oakland and Deer Park, where the road-beds are comparatively free from rock, road-machines have been used to shape the roadway. As most of the soil is clay with some sand, very good dry-weather roads can be made, but with much travel they become deep with dust in dry weather or with mud in wet weather.

The portion of the National Road within Garrett county is in bad condition. In many places it has been worn down to the large foundation stones, while on the hills it is gullied into a very rough and uneven roadway. Sections have been covered with broken stone, which was put on in such large pieces that travel invariably turned to one side. The width of the old roadbed is about 20 feet, which is far wider than the present small amount of travel requires. An appropriation of $600.00 per year is made by the county for this road.

On the hilly portions of the roads breakers are constructed to turn aside the rain-water, and some of them, judging from their size, have received too much attention. Broken stone has only been used to fill up mud holes, a method of repair which has oftentimes resulted in forming two new depressions on either side of the first, for the dirt soon wears away from the stone, making new places for the water to collect. It is the common custom to throw everything from the ditches into the middle of the road. The steep grades on most of the county roads which resulted from inattention to their proper location when the roads were first laid out can only be remedied by relocations.

The required width between fences is 30 feet. The width of the traveled way varies from 15 feet on level stretches to 7 or 8 feet on the hilly portions. Lumber is used for constructing the drains.

Repairs to the roads are under the immediate control of 167 supervisors, who are paid $1.50 per day. The supervisors have under them five men each, who receive $1.25 per day. Supervisors and men average one week per year on the road. The county owns five road-machines which cost about $800.00 in all. $50.00 a year is spent in repairs to this machinery. Wide tires are seldom found on the farm wagons.

The rocks available for road purposes shown by the map on Plate XXIV are widely distributed and consist of successive bands of sandstones, limestones, and shales. While these rocks do not make the best road-metals, yet it is possible to obtain very satisfactory results from many of the harder sandstones and limestones. The shales compact easily but are not durable and roads made of them become very dusty in dry weather and muddy in wet.

Good exposures of limestone occur at Sang Run, on the road between Accident and Friendsville, and at many other points, especially along the Baltimore and Ohio Railroad. Sandstone has been used in and about Oakland, but not always of the hardest and most durable varieties.

The following table shows in detail the expenditure for the last ten years on different portions of the road-work. These figures were obtained from the office of the County Commissioners:

GARRETT COUNTY.

Year.	Total amount levied for roads and	Amount spent for bridges.	Amount spent for new roads.	Amount spent for road-repairs.
1889	$8,999.46	$1,804.96	$131.50	$7,063.00
1890	9,112.98	554.02	63.75	8,495.21
1891	8,649.14	1,318.12	160.92	7,170.10
1892	9,677.27	1,289.46	194.50	8,193.31
1893	9,703.38	1,004.53	288.00	8,410.85
1894	13,990.82	1,805.53	2,020.32	10,164.97
1895	12,153.86	1,575.04	185.50	10,393.32
1896	15,772.43	1,797.97	3,400.00	10,574.46
1897	11,707.11	1,616.59	......	10,090.52
1898	13,647.60	3,393.10	64.50	10,190.00
	$113,414.05	$16,199.32	$6,508.99	$90,745.74

Year.	Amounts levied for towns.	Year.	Amounts levied for towns.
1890	$430.00	1895	$630.00
1891	430.00	1896	630.00
1892	430.00	1897	630.00
1893	580.00	1898	630.00
1894	580.00		

HARFORD COUNTY.

There are 800 miles of road in Harford county, or 1.90 miles per square mile. 680 miles are dirt road, 100 miles stone road, 15 miles gravel road, and 5 miles shell road. The main roads are shown on the map, Plate XXIV. They have a mileage of 96 miles, which is 12 per cent of the total mileage. Included in the mileage of stone roads are 8 miles over which toll is collected.

The location of Harford county gives a great variety of roads, due to the varying surface conditions. In the northern portion, the land is much broken and there is an abundance of rock. This rough and hilly area merges by degrees into the low and level section on Gunpowder Neck.

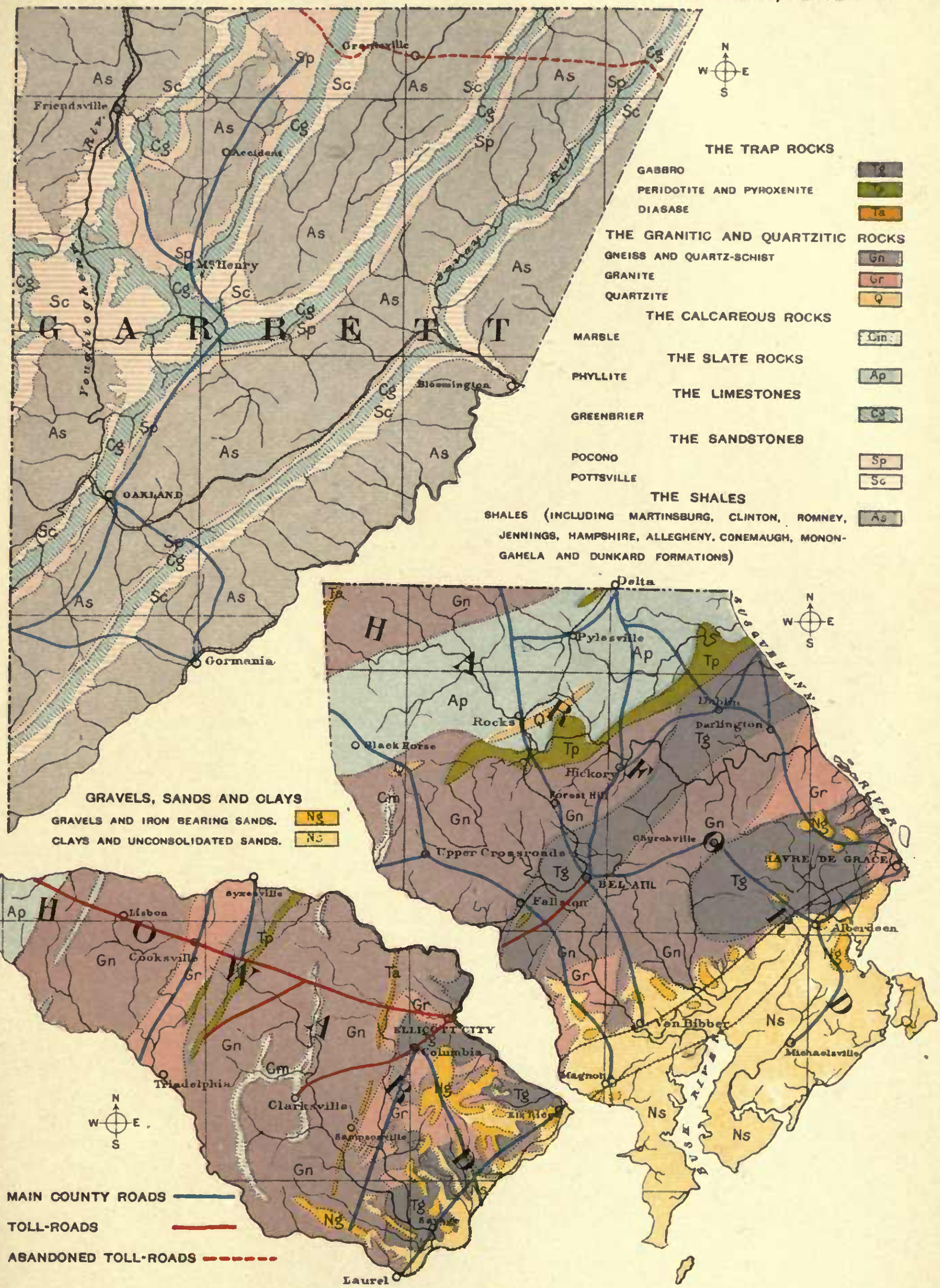
Although considerable attention has been given to the building of stone roads, many being built of trap-rock, the stone has generally not been broken small enough to be compacted readily by the traffic. Consequently the surface of these roads is invariably rough, although a firm road-bed has been obtained which is far better in winter and spring than the former dirt roads.

The road from Bel Air to Hickory has been surfaced with trap-rock but ruts have formed over nearly the whole distance. In many places there are two or three sets of such ruts, the second set being formed in avoiding the first set, and so on. The width of the stone covering varies from 15 feet in some places to not over 7 feet in others. Where the macadam is narrow there is generally a dirt road at the side. Such a road as this could be made hard and smooth by surfacing it with a two-inch layer of broken stone well rolled down.

Near Dublin there has recently been constructed a few hundred yards of stone road furnishing an excellent example of how not to construct a road. A layer of boulders ranging in size from one to two feet was laid on an ungraded road-bed to a depth varying from 10 to 24 inches. These large stones or boulders were placed in a loose and unskillful fashion leaving large spaces between them. Over this layer of large rocks was spread a layer of stone from 3 inches to 6 inches in size. The road when seen had been left in this condition for over six months. Wherever possible the travel has turned into the neighboring fields to avoid going over this mass of loose stones. Such a piece of work is a waste of both time and material.

On the roads in the hilly portions of the county the roadway is generally narrow and the repairs consist in making water-breakers. The dirt roads on less rocky soil are rounded up with road-machines.

The roads in the southern section on the Gunpowder Neck have no heavy grades. The soil is a clay mixed with more or less sand which forms a



ROADS AND ROAD MATERIALS.

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hard road in summer, but one which becomes very dusty with any considerable travel.

Near Churchville there is a piece of road that was improved under the direction of Mr. Harrison, Highway Expert of the Office of Road Inquiry, U. S. Department of Agriculture. A small amount was macadamized, but for the larger portion of the distance the money was sufficient to provide only a system of underdrainage. About 175 yards of road 12 feet wide was surfaced and the underdrainage was extended 400 yards further. The whole work cost $608.39.

The following turnpikes are operated in Harford county:

Name.	"Piked."	Tolls Collected.
Harford Turnpike.	From Baltimore County line to within 2½ miles of Bel Air.	From Baltimore County line to within 2½ miles of Bel Air.
Bel Air Turnpike.	From end of Harford Turnpike to Bel Air.	From end of Harford Turnpike to Bel Air.

There are 10 general supervisors, who appoint sub-supervisors; the former receive $2.00 per day, the latter $1.25 per day. The repairs in the neighborhood of Darlington, Churchville and Bel Air, have been under the supervision of local Road Leagues. The first of these Road Leagues, and the first of its kind in the United States, was the one formed at Darlington in 1887 by residents in the vicinity of that place. The League has now in charge the maintenance of about 15 miles of road. The work is in the hands of an overseer, the same one being employed from year to year. He, in turn, hires what men are necessary. Formerly the League raised a portion of the funds by subscription, the county also making an appropriation. At present, however, the only money spent by the League is the amount granted by the County Commissioners, which is from $400.00 to $500.00 per year. The machinery owned by the League consists of a road-machine, a stone-crusher, and an equipment of smaller tools. The Bel Air and Churchville Leagues are modeled after the one at Darlington. It has been found that while the enthusiasm is great in the beginning it soon abates and leaves the carrying on of the work to a very few. The Bel Air and Churchville Leagues were both organized in the fall of 1894.

The road-machinery owned by the county includes 11 road-machines, 1 stone crusher, and 1 horse-roller, which cost in all about $3000.00. The repairs to this machinery cost $200.00 a year.

It is estimated that only 1 per cent of the farm wagons have tires 3½ inches or more in width, and it is not the general custom to have new wagons provided with wide tires.

Good road material is found more widely distributed in Harford county than in any other. Broad areas of trap-rock extend in a northeasterly direction across the entire county and, save in the extreme northern and southern portions, there is no section which cannot be readily supplied with this rock. Near the mouth of the Susquehanna the trap-rock is most favorably situated for shipment by water to any point to which it may be desired to send it, especially to the southern and eastern parts of the state which are entirely devoid of good road-material. In addition to the trap-rock there are found quantities of gneiss and quartzitic rocks which lend themselves fairly well for road-purposes. The map on Plate XXIV shows the general distribution of the various rocks throughout the county.

The following table shows the amount expended upon the roads and bridges for the past ten years. These figures were obtained from the office of the County Commissioners:

HARFORD COUNTY.

Year.	Total amount levied for roads and bridges.	Amount spent for bridges.	Amount spent for road-repairs.
1889	$19,000.00	....	$19,000.00
1890	40,000.00	$1,000.00	39,000.00
1891	37,496.00	1,000.00	36,496.00
1892	57,554.00	1,000.00	56,554.00
1893	29,000.00	800.00	28,200.00
1894	37,000.00	900.00	36,100.00
1895	25,000.00	700.00	24,300.00
1896	23,000.00	600.00	22,400.00
1897	20,000.00	500.00	19,500.00
1898	21,000.00	700.00	20,300.00
	$309,050.00	$7,200.00	$301,850.00

In addition to the amount shown in the above table it is estimated that $20,000.00 have been paid in tolls during the last ten years, making the total cost to the people of the maintenance of the public roads and turnpikes approximately $329,050.00, exclusive of private contributions.

HOWARD COUNTY.

In Howard county there are 448 miles of road, or 1.79 miles per square mile. There are 400 miles of dirt road and 48 miles of stone road, which includes 35 miles of toll-road. There are 13 miles of stone road built and maintained by the county. The main county roads shown on the map on Plate XXIV, aggregate 60 miles, or 13 per cent of the total mileage.

Howard county occupies a portion of the Piedmont Plateau and has a general level rising from 500 feet on the east to 750 feet on the west. The main topographical feature is the continuous stretch of comparatively level land which forms the divide between the Patapsco and Patuxent drainage basins, and which extends easterly and westerly the entire length of the county. The Old Frederick Road follows this divide very closely, but the location of the more direct New Frederick Road takes it near the southern edge, necessitating somewhat heavier grading than on the earlier location. The streams have cut deeply into the surface making many rough and steep hillsides. The soil is for the most part a mixture of clay and sand, some places being a very heavy stiff clay.

There is much hauling over the roads which lead to the different stations on the Baltimore and Ohio railroad, so that the portion of the Baltimore and Frederick turnpike between Lisbon and St. Charles College has little through teaming. A particularly good example is here afforded of the effect upon the direction of travel produced by the building of a railroad. Formerly all the heavy hauling was along the turnpike, whereas now the turnpike is followed only to the nearest cross-road which leads to a railroad station. For 6 or 8 miles west of Ellicott City there is more travel of all descriptions over the Baltimore and Frederick turnpike than over any other piece of road in the county.

This turnpike is the principal road of the county which it traverses from east to west. Repairs are made frequently, and it is, as a whole, in good condition. It was noticed that the better traveled portions were smoother than the lesser traveled ones. Considerable trap or "nigger-head" rock, taken from the diabase dike near Pine Orchard, has been used for surfacing. This rock is broken by hand and left in piles at the side of the road to be used as occasion requires.

Many of the county roads have been improved by widening and in some instances by stoning them. The method of placing the stone on the road does not produce a smooth surface, as it is spread upon it in coarsely-broken pieces forming a layer 6 to 15 inches deep and 10 to 15 feet in width. The cost of such a road with a covering of stone 12 feet wide and 6 inches deep is given as $1000.00 per mile, 1056 perches of stone being used.

The turnpikes operated in Howard county are:

Name.	"Piked."	Tolls Collected.
Baltimore and Frederick Turnpike.	Ellicott City to Ridgeville.	Ellicott City to Ridgeville.
Ellicott City and Clarksville Turnpike.	Ellicott City to Clarksville.	Ellicott City to Clarksville.
Triadelphia Turnpike.	Glenelg to Balto.-Fredk. Turnpike.	Glenelg to Balto.-Fredk. Turnpike.

The roads are under the immediate charge of 13 supervisors who employ in addition 118 men. The pay per day of the men is $1.00. The total amount paid to the supervisors is $360.00 per year.

There are 13 road-machines and one stone-crusher, with a capacity of about 40 perches per day, owned by the county. The road-machines cost $200.00 each, and the stone-crusher $740.00, making a total of $3340.00. It costs about $100.00 per year for repairs to the crusher and about $15.00 each for repairs on the road-machines. It is safe to say that one-half of the farm wagons have tires 3½ inches wide and wider. In those localities near the turnpikes it is the general practice to have wide tires put on new wagons. In sections more remote this practice is not so general. The required width between fences for new roads is 30 feet.

The road-materials include some excellent rock. That found in the trap or diabase dike crossing the county in a northerly and southerly direction is the best road-metal in the county. Near Pine Orchard this rock has been used upon the turnpike. In the eastern portion is another area of trap-rock. There are also granites and gneisses widely distributed but these are inferior to the trap-rock. The map on Plate XXIV outlines the general location of the different rocks in the county.

The following table shows the amount that has been spent on roads and bridges during the last ten years. These figures were obtained from the office of the County Commissioners:

HOWARD COUNTY.

Year.	Total amount levied for roads and bridges.	Amount spent for bridges.	Amount spent for new roads.	Amount spent for road-repairs.
1889	$14,000.00[1]	....	....	....
1890	16,403.00	$10,803.00	....	$5,600.00
1891	11,704.00	6,198.00	$506.00	5,000.00
1892	12,281.00	4,248.00	1,233.00	6,800.00
1893	15,196.00	8,000.00	396.00	6,800.00
1894	16,750.00	9,233.00	717.00	6,800.00
1895	9,925.00	3,000.00	125.00	6,800.00
1896	10,978.00	3,260.00	918.00	6,800.00
1897	11,667.00	2,888.00	2,067.00	6,712.00
1898	15,997.00	4,890.00	1,657.00	9,450.00
	$134,901.00	$52,520.00	$7,619.00	$55,762.00

In addition to the amount shown in the above table it is estimated that $100,000.00 have been paid in tolls during the last ten years, making the total cost to the people of the maintenance of the public roads and turnpikes approximately $234,900.00, exclusive of private contributions.

KENT COUNTY.

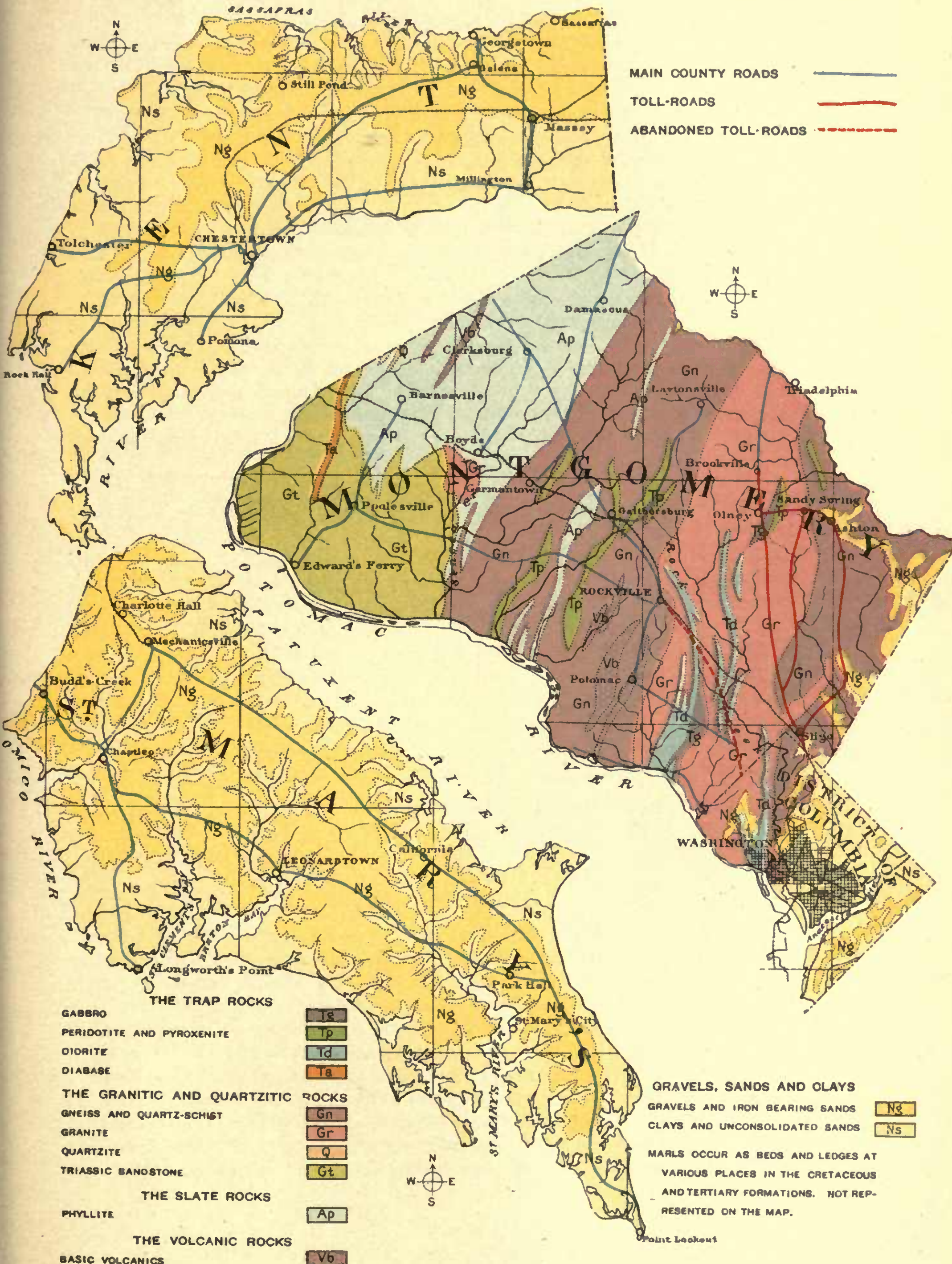
There are 435 miles of road in Kent county, or an average of 1.37 miles of road for each square mile of area. There are 5 miles of shell road; the remainder are of dirt. The main roads are shown upon the map on Plate XXV and have a mileage of 63 miles, or 14 per cent of the total mileage. All of the roads are free.

The soil, which is generally hard clay with some sand, is about the best that can be obtained for dirt roads and this, together with the flat character of the country, makes it possible to have fairly good roads for a considerable portion of the year with comparatively little work. During wet weather, especially in the hollows, the clay soil becomes soft and sticky, rendering a passage through it very difficult.

Many of the roads in Kent county are considerably wider than the average county road. For example, on the roads leading into Chestertown the fences and hedges are from 50 to 60 feet apart. On the road near Tolchester the fences are 60 feet apart. The traveled portion of these roads is correspondingly wide, and is oftentimes 25 to 30 feet broad. Much attention has also been paid to building substantial culverts in all parts of the county. They are made of tile drains with ends well protected by neat brick walls generally carried two or three feet above the level of the roadway. The amount of tile drains laid cannot be ascertained, but there is probably more in proportion to the number of miles of road than in any other county of the state.

A great improvement has also been made on some roads by grading. Near Galena, on the road towards Still Pond, a section has recently been relocated and graded by filling to a depth of 10 feet in places. The width of the top of the embankment is about 25 feet. This is one of the few in-

[1] Estimated.



ROADS AND ROAD MATERIALS.

A. Hoen & Co. Lith. Baltimore.

stances where a county road has been well graded. The road near Betterton has also been much improved by grading, as have many of the roads in the vicinity of Chestertown.

There are 110 supervisors in the county who have charge of the road-work. They receive $1.00 per day and when superintending other laborers, $1.25. Laborers receive $1.00 per day. The average number of men employed by each supervisor is 4. The work upon the roads is done between April 1st and July 1st.

The road-machinery consists of 10 road-machines which cost about $1500.00, and about $50.00 a year is spent for repairs. Wide tires are practically unknown in the county.

No stone is found in Kent county. There are, however, large scattered areas of gravel, but not in sufficient quantities or of a character to be considered available for general use as a road-material. In the vicinity of Chestertown oyster-shells have been used which cost hauled upon the road, about 3 cents per bushel.

The following table shows the total amount spent for the last ten years on roads and bridges; also the amount spent for bridges and new roads:

KENT COUNTY.

Year.	Total amount levied for roads and bridges.	Amount spent for bridges.	Amount spent for new roads.	Amount spent for road-repairs.
1889	$11,853.99	$100.00	$770.00	$10,983.99
1890	13,687.99	1,194.26	828.49	11,665.24
1891	15,475.81	....	909.61	14,566.20
1892	27,823.34	5,650.00	674.52	21,498.82
1893	23,640.56	1,000.00	404.02	22,236.54
1894	22,960.15	1,200.00	2,060.09	19,700.06
1895	20,638.17	3,238.21	1,224.74	16,175.22
1896	22,354.10	....	2,096.34	20,257.76
1897	16,525.12	....	188.76	16,336.36
1898	23,246.37	692.72	3,710.71	18,842.94
	$198,205.60	$13,075.19	$12,867.28	$172,263.13

Chestertown under act of 1888 has received $22,079.57—prior to said act and under act of 1882, from $300.00 to $625.00 annually—and prior to the last named act $300.00 annually under act of 1876.

MONTGOMERY COUNTY.

There are 835 miles of road in Montgomery county, or an average of 1.64 miles to each square mile of area. 790 miles are dirt road and 45 miles are stone road. The latter estimate includes 37 miles of toll-road but does not include short patches scattered over the county. The main roads of the county are shown on the map on Plate XXV. They aggregate 120 miles or 14 per cent of the total mileage.

Montgomery county is on the border between the hilly country of the Piedmont Plateau and the flatter sections of the Coastal Plain. The surface is characterized by broad, level terraces offering locations for the roads free from excessive grades. On the main thoroughfares the grades are generally low except at the stream crossings. On the road east of Dawsonville crossing Seneca creek the grades are 12 to 15 per cent. Smaller streams have not eroded as deeply as the larger ones and the grades are consequently shorter and not as steep. If the grades of all the roads were raised at the stream crossings one of the most needful improvements would be accomplished.

The most extensive piece of road-construction undertaken in this state for a number of years is the rebuilding of the old turnpike between Rockville and Georgetown. No road in the county was more in need of improvement both on account of its condition and of its importance as the direct route from Rockville to Washington. It has long been known as one of the worst pieces of main highway in the state. The old foundation stones, many two or three feet in size, formed the surface of the roadway proper which was but little used. At the sides a rough single-track dirt road had been worn sometimes five to ten feet below the level of the old road-bed, as is shown on Plate XXXIV, Fig. 2. As a result where there should have been a well-travelled road and much improved suburban property there was but little travel and land values below those of other neighborhoods no farther removed from Washington.

To meet the cost of improving this road bonds were issued by the county to the amount of $25,000 as authorized by an act of the General Assembly in 1898. The law further provided that the county should build the entire length of the road from Rockville to the District of Columbia, a distance of 7¼ miles; grade it to a width of 40 feet; and surface it 20 feet wide and 12 inches thick with macadam thoroughly rolled with a steam-roller. As soon as construction was begun it was evident that these specifications could not be fulfilled with the amount of money at hand. The road as constructed has 16 feet of macadam flanked on either side by a 12-foot dirt road. Broken stone is put on to a depth of 12 inches for a short distance from Rockville but elsewhere it is 9 inches.

To prepare the roadway for the macadam it is first necessary to remove the foundation stones of the old turnpike which are taken out and thrown to one side and afterwards crushed to form the material for the new road. Considerable grading is done on account of the depth to which the sides have been worn and also to reduce the grades to 6 per cent, as required by the law authorizing the improvement.

The crushed stone is put on in two courses. The lower one consists of the "tailings" from the crusher which range in size from 2 to 6 inches. The top course is a mixture of what are commonly known as No. 1 and No. 2 stone, which vary from ¾ of an inch to 2½ inches in diameter. Over this screenings are spread for 1 to 2 inches in depth. Where there are not enough screenings clay is substituted. The rolling is done by a four-ton horse-roller, but very inefficiently, as the stones are by no means compacted; the wagon wheels on the finished portion forming ruts, especially where clay has been used.

At the present writing, October, 1899, about 3 miles have been completed. It was at first thought that there was sufficient stone in the old road-bed for the new one, but it is found that much additional stone will be needed.

The work was let by contract at the following prices: Grading per cu. yd., 12½ cents; macadam, per sq. yd., 12 cents; removing old stone from road-bed, per sq. yd., 9 cents; rubble masonry per cu. yd., $4.50; brick masonry, per cu. yd., \$6.00; concrete, per cu. yd., \$3.00; timber, per 1000 ft., \$24.00; laying 12-inch pipe, per linear ft., 10 cents; 18-inch pipe, 16 cents; 24-inch pipe, 20 cents; cobble-paving, per sq. yd., 16 cents.

The other stone roads as built by the county are made by spreading the broken stone of various sizes, large and small being mixed together, over the road where it is compacted by the traffic, so that no good roads have resulted from this treatment. In every instance possible the dirt road is preferred to the stone road except during wet weather. The county uses one-half its appropriation each year in macadamizing, which costs from \$1000.00 to \$1500.00 per mile according to the price paid for the stone. Quartzitic rocks are principally used and these are very difficult to compact so as to form a smooth surface under even the most favorable circumstances. There has been very little grading done.

The width between fences on different roads and different parts of the same road varies from 25 to 30 feet. The required width for new roads is 30 feet. On the turnpikes the width is 30 to 50 feet.

The turnpikes operated in Montgomery county are:

Name.	"Piked."	Tolls Collected.
Union Turnpike.	District of Columbia to Brookville.	District of Columbia to Brookville.
	Olney to Ashton, and from Sandy Springs to Glenmont P. O.	Olney to Ashton, and from Sandy Springs to Glenmont P. O.
Washington, Colesville and Ashton Turnpike.	Sligo to Ashton.	Sligo to Ashton.
Georgetown and Rockville Turnpike.	Rockville to District of Columbia.	No tolls.

There are 290 road supervisors in the county whose pay ranges from \$1.10 to \$2.00 according to the number of laborers they superintend, the average pay being \$1.50. The number of men generally employed by a supervisor is 5, each of these receiving \$1.10 per day for from 5 to 7 days each year.

The road-machinery owned by the county consists of 15 road-scapers of various makes, 1 stone-crusher and a 3½-ton horse-roller. The road-machines cost \$200.00 each, the crusher \$700.00, and the roller \$300.00; making a total cost of \$4000.00. The cost for repairs is about \$100.00 a year.

Over three-fourths of the wagons are provided with tires over 3½ inches in width.

Trap-rocks, granites, gneisses, and sandstones comprise the road-materials of the county and are especially well distributed throughout the eastern and central portions. In the extreme western part there is a narrow band of trap-rock in a wide area of sandstones and sandy shales. Especially good material is found in the region about Hunting Hill. The map on Plate XXV shows the general distribution of the rocks throughout the county.

The following table gives the amount spent upon roads since 1892. No figures for years earlier than this date can be obtained from the office of the County Commissioners:

MONTGOMERY COUNTY.

Year.	Total amount levied for roads and bridges.	Amount spent for bridges.	Amount spent for new roads.	Amount spent for stone roads.	Amount spent for road-repairs.
1892	$23,044.57	$2,667.88	$3,881.94	$1,786.25	$14,708.50
1893	28,798.30	2,793.34	6,097.28	3,128.62	16,779.06
1894	22,051.23	2,633.88	1,264.77	4,388.37	13,764.21
1895	22,590.00	3,258.44	899.25	4,368.61	14,063.70
1896	21,363.38	4,076.35	438.38	5,016.85	11,832.80
1897	23,196.76	3,478.37	529.84	6,090.39	13,098.16
1898	22,873.54	4,264.13	1,253.54	7,167.69	10,188.18
	$232,917.78[1]				

In addition to the amount shown in the above table it is estimated that $96,000.00 have been paid in tolls during the last ten years, making the total cost to the people of the maintenance of the public roads and turnpikes approximately $328,900.00, exclusive of private contributions.

PRINCE GEORGE'S COUNTY.

There are 530 miles of road in Prince George's county, or 1.10 miles per square mile. There are about 50 miles of gravel road and in addition there are numerous pieces of corduroy road and short sections built of slag. The main roads are shown on the map on Plate XXVI and have a mileage of 73 miles, or 15 per cent of the total. There are no toll-roads.

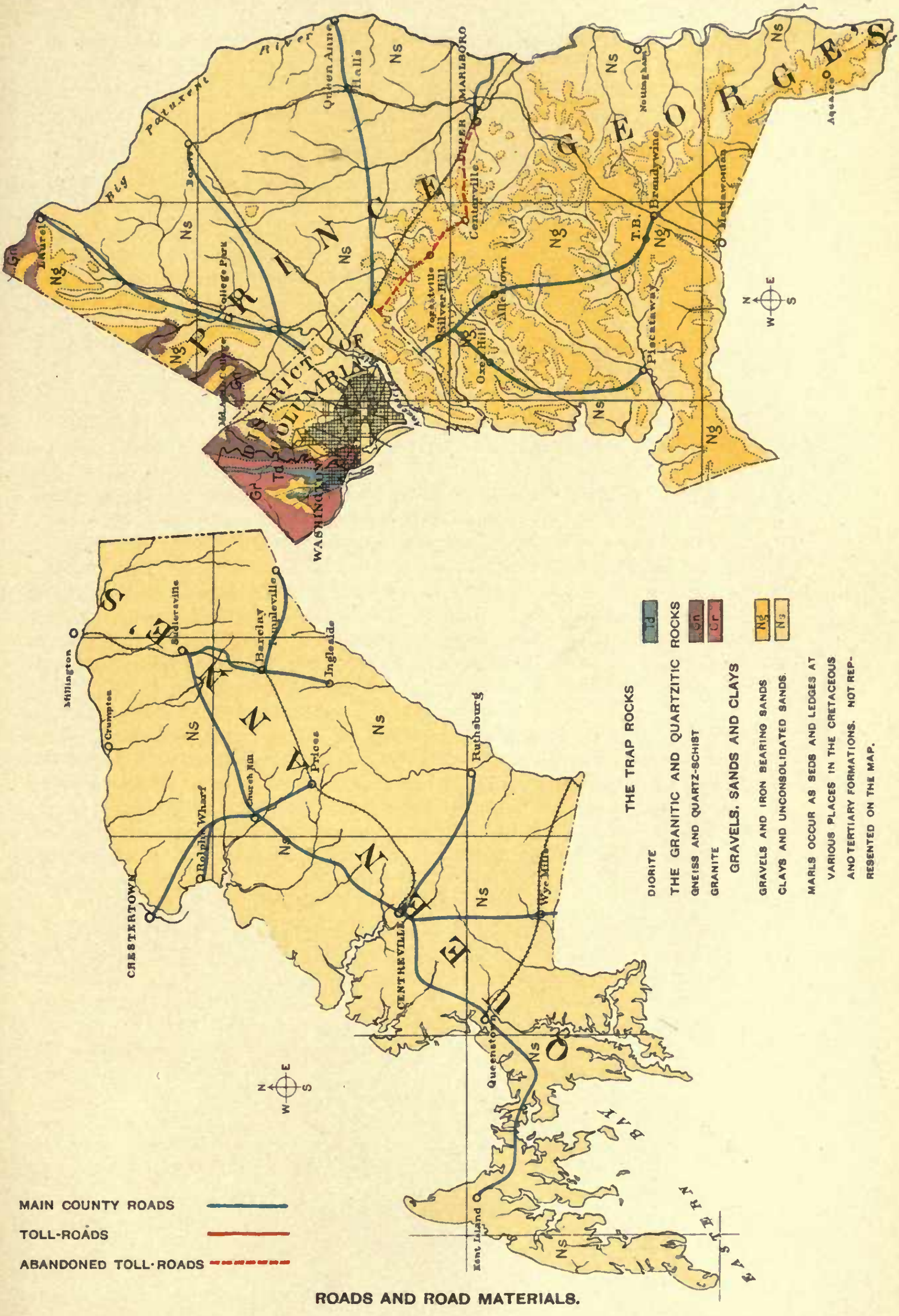
The surface is much gullied and worn by the action of the storm-water and the opening of small ravines which are constantly forming compels the farmer to apply various devices to preserve his roads and fields from destruction.

The roads have generally been located so as to avoid stream-crossings and where these are not encountered few or no excessive grades exist. At the stream-crossings steep grades averaging 10 per cent are always found. On the road from Silver Hill to Allentown there are two stream-crossings where the grades on the banks measure from 9 to 10 per cent.

The road from Marlboro to Washington was formerly a toll-road. It was graded to some extent and then surfaced with gravel which has now become compacted into a firm, hard roadway. This road is 12 miles long and is the longest piece of gravel road in the state. The roads about Suitland have been gravelled and are among the best gravel roads in the state. On the Washington and Baltimore road between Beltsville and College there are about 2 miles of corduroy road constructed at a cost of $750.00, $500.00 of which were appropriated by the county, the remainder being subscribed by people in the vicinity of the road.

One of the best improvements made by the county was the extension of Central Avenue, necessitating the building of 2 miles of new road, thereby forming a direct route from Hall's Station to Washington. This is also the direct road between Annapolis and Washington. A dirt road has been made in which a special feature is the extensive amount of grading on the westerly portion where embankments 10 to 12 feet high have been built.

[1] Estimated total for past ten years.



ROADS AND ROAD MATERIALS.

A. Hoen & Co. Lith. Baltimore.

The larger portion of the road, however, still requires much grading to put it in good shape. The heavy grading necessary on the western portion took most of the funds, leaving only enough to clear and shape the easterly portion. This piece of work cost in the neighborhood of $5000.00, about one-half of which was paid for land damages.

But very little tile drain has been laid, $300.00 covering the cost of all such work which has been done so far. Where drains have been put in they are usually made of planks. The required width between the fences on new roads is 30 feet.

Repairs to the roads are in charge of 35 supervisors who are appointed in the different districts some having but 1 while others have 3. The supervisors generally work 5 men, in which case they receive $1.50; otherwise $1.00 per day. The laborers receive $1.00 per day. About 50 days each year are spent by the supervisors upon the road, or as much time as may be necessary to work out their appropriation.

The county owns 3 road-machines which cost about $550.00.

Wide tires are not in general use though a number of farmers have ordered them on their new wagons, while others have replaced their old tires with wider ones.

The principal road material in the county is gravel, a good quality of which is found widely distributed. Care should be taken not to use that which is mixed with a very large proportion of either sand or clay.

There is no rock in the county which is available and suitable for a road-metal. At Muirkirk, however, there is a large quantity of slag which has been used to a limited extent on the roads in that vicinity. Much of this slag makes a fairly good road-metal, though some of it is too brittle to form a good road-surface. It would answer well as a foundation course with either gravel or a crushed stone surfacing. Gravel is well distributed over nearly all of the county.

The following table shows the amount expended upon the roads since 1890; no records can be obtained from the County Commissioner's office for years previous to this date. Assuming that the same average amount was spent from 1888 to 1891, the total amount spent for roads and bridges in the past ten years is $190,000.00, $20,000.00 of which was spent for bridges. Repairs to the roads proper have cost, therefore, $170,000.00.

PRINCE GEORGE'S COUNTY.

Year.	Total amount levied for roads and bridges.	Amount spent for bridges.	Amount spent for road-repairs.
1891	$19,000.00	$2,000.00	$17,000.00
1892	19,000.00	2,000.00	17,000.00
1893	19,000.00	2,000.00	17,000.00
1894	19,000.00	2,000.00	17,000.00
1895	19,000.00	2,000.00	17,000.00
1896	19,000.00	2,000.00	17,000.00
1897	19,000.00	2,000.00	17,000.00
1898	19,000.00	2,000.00	17,000.00
	$190,000.00[1]		

[1] Estimated total for ten years.

Upper Marlboro receives for road repairs $300.00; Laurel 10 per cent of the tax paid by the corporation; Hyattsville, Takoma Park and Bladensburg, $86.00 yearly.

QUEEN ANNE'S COUNTY.

The total mileage of roads in Queen Anne's county is 563 miles, or 1.60 miles per square mile of area. There are 555 miles of dirt road and 8 miles of shell road. On the map on Plate XXVI are shown the main thoroughfares of the county which measure about 70 miles or 12 per cent of the total mileage. The road from Chestertown to Stevensville has the largest amount of travel. There are no toll-roads.

The eastern part of Queen Anne's county around Church Hill, Centreville, and Wye Mills is more hilly than other sections of the county and the greater part of the Eastern Shore. On the south bank of the Chester river is a level stretch of very sandy country extending one or two miles from the river bank. There are also other small areas of very sandy soil but the larger portion is a mixture of sand and clay.

On the road traversing the section between Church Hill and Wye Mills are a number of 8 or 9 per cent grades from 100 to 200 feet long where the ditches have been considerably eroded by storm-water. Oyster-shells have been spread on the roadway to prevent further washing away.

Level sandy roads receive few or no repairs, but roads through the stiffer clay soil are shaped with a road-machine. The distance between fences varies from 20 to 40 feet, being generally about 30 feet. The required width between fences on new roads is 33 feet, or is 3 feet more than is provided by the laws of the other counties. The width of the traveled way ranges from a single-track sandy road 6 or 8 feet wide to one 15 or 20 feet in width on the level sections over a firmer soil, the wider sections being near the towns.

A considerable amount of tile drain has been laid, the total cost of which for the last three years is $3700.00. The repairs are done both by day labor and contract. Where a section of road was to be scraped good results were obtained by the contract system. Where the repairs were of such a nature as to require but small amounts of work here and there the day labor was better.

The repairs are made under the supervision of 32 supervisors who are paid at the rate of $1.00 per day. Laborers are hired by them at the same rate. All the regular work upon the roads is done between April 1st and October 1st. There are 10 road-machines owned by the county which cost from $150.00 to $235.00 a piece, the total cost being $2005.00. It costs about $120.00 a year to keep this machinery in repair.

There are very few wide tires on the farm wagons, the majority being 2 to 2½ inches wide.

The only road-metal immediately available is oyster-shells.

The following table shows the amounts spent upon the roads for the last 10 years according to figures obtained from the office of the County Commissioners:

QUEEN ANNE'S COUNTY.

Year.	Total amount levied for roads and bridges.	Amount spent for bridges.	Amount spent for new roads.	Amount spent for shell roads.	Amount spent for road-repairs.
1889	$16,000.00	$5,550.00	$ 609.00	$1,000.00	$8,841.00
1890	15,000.00	4,127.00	1,278.00	950.00	8,645.00
1891	13,000.00	2,886.00	2,020.00	1,068.00	7,026.00
1892	15,000.00	4,175.00	624.00	854.00	9,347.00
1893	15,000.00	4,300.00	400.00	....	10,300.00
1894	14,000.00	4,138.00	200.00	1,600.00	8,062.00
1895	13,300.00	7,191.00	592.00	2,429.17	3,087.83
1896	16,100.00	5,386.00	28.00	945.00	9,741.00
1897	15,000.00	5,071.03	360.00	5,094.21	4,474.76
1898	21,100.00	4,000.00	....	5,000.00	12,100.00
	$153,500.00	$46,824.03	$6,111.00	$18,940.38	$81,624.59

ST. MARY'S COUNTY.

In St. Mary's county there are 535 miles of roads, or 1.49 miles of road per square mile of area. 505 miles are dirt road, 25 miles gravel road, and 5 miles shell road. The main roads of the county shown upon the map on Plate XXV are 85 miles in length or 16 per cent of the total mileage. The most important of these is the Three Notch Road which extends from Mechanicstown to Point Lookout. There are no toll-roads in the county.

The general level of the surface, which is about 140 feet above tide-water, is interrupted in all directions by the deep gullies that have been worn by the numerous streams. Near their mouths these valleys are about 100 feet deep and from 1½ to 2 miles broad according to the volume of the stream which formed them. Two miles back from tide-water, erosion has taken place to a depth of 60 feet leaving level tongues of land between the valleys extending parallel to the streams. The main road is on the watershed between the Patuxent and the Potomac rivers extending the entire length of the county. From this stem-road numerous others branch off along the watersheds between the streams flowing into the Patuxent or Potomac as the case may be. The effect of this topography upon the roads is marked. The Three Notch Road which keeps up on the main divide has no heavy grades and there are very many stretches that are nearly level, a very favorable condition for maintaining a good road. Branching from this main stem are roads leading to numerous points upon the shore. These follow for the first few miles one of the divides separating the small streams but they extend only a short distance before they are obliged to leave the higher level and cross one or more streams. It is here that one finds steep grades on which the roads are invariably cut far below the general level. In some instances the roadway is so washed by the storm-waters that it can no longer be used and the travel has been obliged to turn to one side and seek a new way for itself. As nearly all traffic begins or ends at some wharf or landing, except in the immediate vicinity of Mechanicstown where connection is made with the railroad, it is necessary to pull over sections of road which are bad at all times. In the spring when softened by thawing they are deep with sticky clay and practically impassable. There are very few sandy sections; the soil being generally clay or clay mixed with sand.

The repairs to the roads consist of ploughing ditches at the side, throwing the material to the center of the road and shaping with scoops and shovels. Gravel is spread on some sections of the road, and in the vicinity of the landings there are short strips of road surfaced with shell. On the hills a constant effort is required to prevent the total destruction of the roadway by the encroachment of the ditches which become deeper and wider with every storm. Stakes are driven into the banks of the ditches, bushes and small trees are interwoven to uphold the bank, and sometimes small trees are thrown into the ditch itself. The latter is of doubtful advantage, for as soon as there is a small space between the bottom of the ditch and the branches of the tree the effect will be to produce more intense scouring owing to the increased velocity of the water. Tile drain is used to some extent, $600.00 having been spent on this work in the last three years.

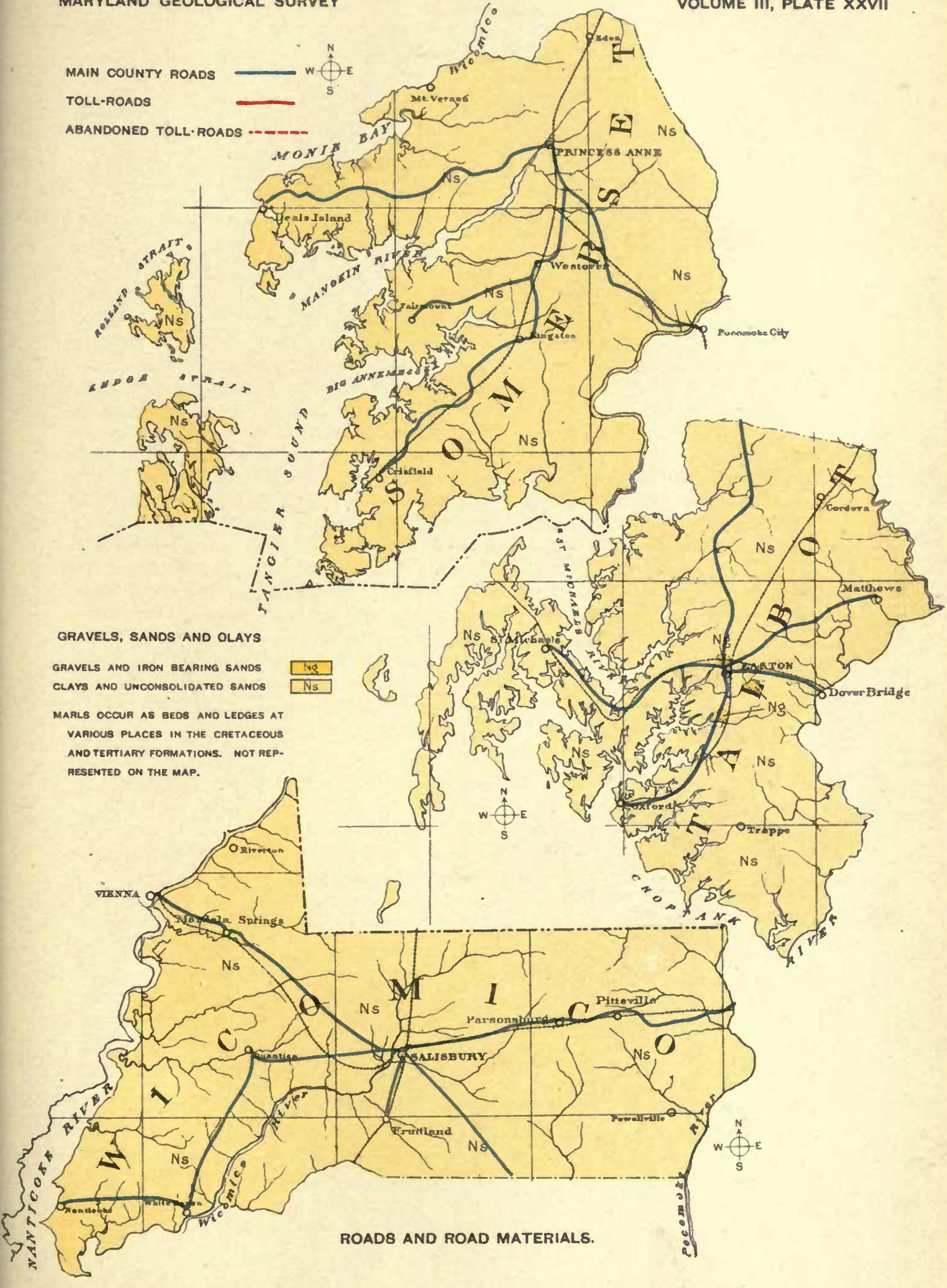
The repairs to the roads are under the immediate direction of 17 supervisors who are paid $1.12 per day while employed upon road-work. Under them are two to four laborers who receive 90 cents per day. About 70 days each year are spent upon the road. The county owns scoops, ploughs, and smaller tools which cost in all $250.00. About $25.00 a year are spent in repairs. There are wide tires on few or no farm wagons.

The road-material in the county consists of gravel. There is no stone of any kind. The gravel is well distributed, as seen upon the map, but this is generally overlain by a layer of clay soil to a depth averaging about 10 feet. Thus the points at which these gravels become practically available are on the hillsides where the top layer of clay has been washed away. Good exposures of gravel are seen on the road just east of Leonardtown where the overlying earth is about 15 feet thick. Gravel has been used from this point upon the roads and has formed a hard, smooth surface. Upon many of the other roads similarly situated may be found exposures of gravel which is available for the roads in the immediate vicinity. With a road-bed previously well shaped, 6 to 8 inches of these gravels thoroughly rolled will form roads well adapted to a moderate amount of traffic.

During the past 10 years there has been levied $5000.00 a year for roads and bridges; and in addition to this there has been appropriated annually $250.00 to cover additional expenses, making a total for the 10 years of $52,500.00. No figures can be obtained at the office of the County Commissioners showing what portion of this amount has been spent on bridges, new roads, etc.

ST. MARY'S COUNTY.

Year.	Total amount levied for roads and bridges.	Year.	Total amount levied for roads and bridges.
1889	$5,250.00	1894	$5,250.00
1890	5,250.00	1895	5,250.00
1891	5,250.00	1896	5,250.00
1892	5,250.00	1897	5,250.00
1893	5,250.00	1898	5,250.00
			$52,500.00



ROADS AND ROAD MATERIALS.

A. Hoen & Co. Lith. Baltimore.

SOMERSET COUNTY.

There are 495 miles of roads in Somerset county, or an average of 1.36 miles of highway for each square mile of area. Of these roads 465 miles are of dirt and 30 miles are of shell. The main thoroughfares are shown upon the map on Plate XXVII and have a mileage of 50 miles or 10 per cent of the total. All of these highways are free as there are no toll-roads in the county.

The surface of the country is generally flat and the soil over which the roads run is a mixture of sand and clay which in places becomes exceedingly sandy. Up to the present about 5000 feet of tile drain have been laid replacing some of the wooden drains and culverts. The application of shells to the surface of the roads is the best method of improvement so far utilized although it is found that the shell roads require constant attention and that where the travel is heavy they cut through within two years so that they must then be reshelled. On account of the location of the roads near shell-piles or navigable water, the cost of shelling is not excessive, averaging about $350.00 per mile where the shells are spread over a surface 12 to 14 feet in width at the rate of 35,000 bushels to the mile.

The repairs of the roads as above described are made under the charge of 33 supervisors who receive $2.00 per day. In addition to the supervisors there are usually employed about 150 laborers who are paid $1.00 a day. The supervisors and laborers work on an average about 50 days each year. The county owns 1 road-machine that cost $235.00, and is kept in repair at the annual expense of $20.00. Not over 1 per cent of the wagons have tires over 3½ inches wide and it is very exceptional to find them on new wagons.

With the exception of oyster-shells there is no local material available for the improvement of the roads.

The following table shows the amounts spent on the roads during the past 10 years, according to figures obtained from the office of the County Commissioners:

SOMERSET COUNTY.

Year.	Total amount levied for roads and bridges.	Amount spent for bridges.	Amount spent for new roads.	Amount spent for shell roads.	Amount spent for road-repairs.
1889	$6,900.00[1]	$1,850.00[1]	$500.00[1]	$600.00[1]	$3,950.00[1]
1890	7,100.00[1]	1,700.00[1]	350.00[1]	975.00[1]	4,075.00[1]
1891	6,900.00[1]	1,800.00[1]	400.00[1]	1,100.00[1]	3,600.00[1]
1892	7,000.00[1]	1,500.00[1]	400.00[1]	1,000.00[1]	4,100.00[1]
1893	8,700.00[1]	1,800.00[1]	200.00[1]	1,300.00[1]	5,400.00[1]
1894	9,000.00[1]	2,000.00[1]	300.00[1]	1,100.00[1]	5,600.00[1]
1895	10,150.00	3,100.00	150.00	1,500.00	5,400.00
1896	12,101.00	3,000.00	75.00	2,975.00	6,051.00
1897	8,299.00	1,500.00	100.00	2,500.00	4,199.00
1898	13,586.00	1,200.00	300.00	7,312.00	4,774.00
	$89,736.00	$19,450.00	$2,775.00	$20,362.00	$47,149.00

[1] These amounts are not actual but are estimated by averaging, as no data in the county offices give the exact cost.

TALBOT COUNTY.

There are 400 miles of roads in Talbot county, or an average of 1.40 miles per square mile of area. There are 380 miles of dirt road and 20 miles of shell road. The main roads, among which the most traveled is the one from Easton toward St. Michaels, are shown upon the map on Plate XXVII and measure about 44 miles or 11 per cent of the total mileage. There are no toll-roads.

Talbot county is better provided with facilities for transportation by water than any other county in the state as no farm is over 5 miles from a landing.

The topography of the county is generally flat with the features characteristic of the Eastern Shore, excepting that as in Queen Anne's county, there are, perhaps, more pronounced undulations of the surface than in the other counties of the Eastern Shore. These give rise to considerably longer, though not steeper, grades on many of the roads.

The road from Easton toward St. Michaels is through a very level section and over a stiff light-colored clay soil. Nearly the whole distance has been shelled and is now in excellent condition. Near Easton the shells have been put on 20 feet wide; but on the other portions of the road they are only from 10 to 12 feet wide. From Easton to Skipton there is a sand and clay road on which are encountered a number of 8 to 10 per cent grades where the streams are crossed. Most of the other roads out from Easton have been shelled for a few miles and make smooth, comfortable highways. The majority of the dirt roads have been shaped with a road-machine for a width of 12 to 15 feet.

Tile drains with the ends protected by brick masonry, similar to the construction adopted in Kent county, are replacing the wooden drains. There have been spent on this class of work in the last three years, $1650.00.

Repairs to the roads are in charge of 5 district superintendents and 64 supervisors. The 5 superintendents together receive $900.00, each one being paid according to the mileage under his care. The supervisors receive $1.00 per day. In addition some 40 laborers are hired who are paid $1.00 per day. The county owns 6 road-machines, 2 wheel-scoops, and 6 drag-scoops, the total cost of which was $1300.00. It costs about $35.00 a year to keep this machinery in repair. Very few farmers of the county have adopted wide tires for their wagons, the usual width being 2 to 2½ inches.

The only gravel on the lower Eastern Shore whose occurrence is such as to warrant its use as a road-material is in Talbot county. The gravel-bed which occurs along Washington street, on the northerly side of Easton, as a layer about 2 feet thick, would serve well for a road-material, especially for a sandy road. This bed of gravel is overlain by 2 or 3 feet of sand with more or less gravel mixed through it which would have first to be removed before reaching the good gravel. Heretofore it has not been used upon the roads on account of its limited occurrence. Oyster-shells and marl have been used for surfacing.

Part of the road between Easton and Trappe has been covered with marl which apparently affords nearly as good a surface as is obtained with oyster-shells. While there is evidence that the marl beds are of considerable extent the points at which the marl is available are few.

The following table gives the amount expended upon the roads and bridges for the past 10 years. These figures were obtained from the office of the County Commissioners:

TALBOT COUNTY.

Year.	Total amount levied for roads and bridges.	Amount spent for bridges.	Amount spent for new roads.	Amount spent for shell roads.	Amount spent for road-repairs.
1889......	$11,200.00	$1,834.10	$1,965.34	....	$7,400.56
1890......	14,687.50	2,460.35	4,400.00	$1,036.00	6,791.15
1891......	13,137.50	2,437.00	2,150.00	1,124.56	7,425.94
1892......	14,762.50	3,337.00	1,968.00	1,336.42	8,121.08
1893......	16,262.50	4,287.00	1,440.00	1,460.38	9,075.12
1894......	16,320.00	4,800.00	1,506.00	1,635.60	8,378.40
1895......	16,270.00	2,870.00	505.00	1,724.40	11,170.60
1896......	14,270.00	3,282.53	....	1,890.30	9,097.17
1897	14,050.00	3,963.42	....	2,150.00	7,936.58
1898......	15,810.00	4,667.68	52.00	1,654.30	9,436.02
	$146,770.00	$33,939.08	$13,986.34	$14,011.96	$84,832.62

WASHINGTON COUNTY.

There are 799 miles of road in Washington county, or 1.84 miles of highway on an average to each square mile of area. There are 672 miles of dirt road and 127 miles of stone road. There are 104 miles of toll-road.

Name.	"Piked."	Tolls Collected.
Baltimore and Fredericktown Turnpike.	Frederick Co. line to Boonsboro.	Frederick Co. line to Boonsboro.
Boonsboro and Sharpsburg Turnpike.	Boonsboro to Sharpsburg.	Boonsboro to Sharpsburg.
Downsville and Hagerstown Turnpike.	Downsville to Sharpsburg Turnpike.	Downsville to Sharpsburg Turnpike.
Gapland Turnpike.	Gapland to top of mountain.	Gapland to top of mountain.
Hagerstown and Sharpsburg Turnpike.	Hagerstown to Sharpsburg.	Hagerstown to Sharpsburg.
Hagerstown and Waynesboro Turnpike.	Hagerstown to the state line.	Hagerstown to the state line.
Hagerstown and Conococheague Turnpike.	Hagerstown to Allegany.	Hagerstown to Conococheague river.
Hagerstown and Middleburg Turnpike.	Hagerstown to Middleburg.	Hagerstown to Middleburg.
Hagerstown and Smithsburg Turnpike.	Hagerstown to Smithsburg.	Hagerstown to Smithsburg.
Hagerstown and Cross Roads Turnpike.	Hagerstown to Cearfoss.	Hagerstown to Cearfoss.
Marsh Run Turnpike.	Waynesboro Turnpike to the state line.	Waynesboro Turnpike to the state line.
Williamsport and Greencastle Turnpike.	Williamsport to the state line.	Williamsport to the state line.
Beaver Creek Turnpike.	Funkstown to Smoketown.	Funkstown to Smoketown.
National Turnpike.	Hagerstown to Boonsboro.	Hagerstown to Boonsboro.

With the exception of one or two towns in the southern part of the county there is no town or village which is not connected with Hagerstown by turnpikes. These taken together form the most complete system of stone roads to be found in any county in the state.

The main roads of the county are shown on the map on Plate XXVIII and have a mileage of 137 miles, or 17 per cent of the total.

Washington county, extending as it does across the trend of the ridges of the state for over 40 miles, possesses widely differing surface conditions for the construction of roads. On the western and extreme eastern sides of the county the surface is rugged and hilly, requiring considerable care in location to avoid steep grades. In the center is the Hagerstown valley, a continuation of the Shenandoah valley of Virginia, with a rolling surface that offers no especial obstacles to the construction of highways. The most important highways through the county are or have been the turnpikes, nearly all of which have been constructed with some sort of a telford foundation. The road-beds are usually 14 feet wide and consist of a lower course of 8-inch stone over which is spread a layer of 1½-inch stone to a depth of 6 inches in the center, falling away to 3 inches on the side. Over the broken stone is spread a thin layer of stone dust. Roads constructed in this manner according to figures obtained from the County Commissioner's office, cost $1,500 a mile to place upon the road. The cost of grading is not included in this estimate.

Many of the turnpikes of the county have been built with little regard to the grading. For example, the turnpike between Sharpsburg and Boonsboro has many grades as high as 10 per cent. The Baltimore-Cumberland road is better in this respect and serves as the main thoroughfare for the county. From the Frederick county line to the Conococheague river this is a toll-road but west of the latter point no toll is collected as the road is maintained by the county. Since there is comparatively little travel along the western part of this road it is not kept in very good repair and large foundation stones show in many places through the surface formed by throwing on dirt and shale. The old road-bed is about 30 feet wide which is wider than the present traffic requires.

Although the turnpikes of Washington county are better than the average for the state they are still far short of what they might be if proper care was exercised in the selection, preparation, and application of the limestone used on the roads. It seems to be the custom to use the more weathered fragments of limestone found in the fields in preference to the harder stone from the quarries, because it is easier to break; one man being able to break into 2-inch pieces about three perch of this softer rock a day. While this weathered grade is cheaper in its initial application it does not last as long and renders the roads more dusty in dry weather.

Nearly all of the material used on the road is broken by hand. The view reproduced in Plate XIII, Figure 2, which was taken on the Sharpsburg-Boonsboro turnpike, shows a man at work breaking the stone which is piled at one side ready to be measured. The hammer used in this work has a circular head, fitted at the center with a handle 12 inches in length, and weighs about 2 pounds.

The method of repair is also open to improvement. At present it is customary to wait until the top layer of stone is nearly worn away when a new surfacing about 3 inches in thickness is given of broken stone varying in size from $1\frac{1}{2}$ to 4 inches according to the care which has been taken in breaking it. A covering of loose stone placed in this manner upon the road is very objectionable to drivers of light vehicles and is avoided as far as possible by the teamsters who use the dirt road at the side during dry weather. The loose stones gradually become compacted, beginning on the side nearest the dirt road, with the result that a cross-section of a road when it is entirely hardened is not uniform, the highest part being at one side. It oftentimes happens, also, that the dirt road is first on one side and then on the other so that in crossing from one to the other the vehicles compact the stone in a direction diagonal to the trend of the road producing a warped appearance of the road-surface. Finally when the travel has spread evenly over the road the wear compacts the mass of limestone and binds the loosened stones together into a smooth surface. The rate at which this is done depends upon the amount of traffic and the hardness of the stone used.

The width of the traveled portion of the road varies with the amount of traffic. In the vicinity of Hagerstown where the travel is greatest the average width of the traveled way is about 17 feet. The distance between the fences varies from 30 to 40 feet. Along the Williamsport turnpike on which there are electric-car tracks the width between the fences is 60 feet while the traveled way averages about 18 feet. The traveled way of the Baltimore-Cumberland road is about 20 feet.

A considerable number of pieces of stone road have been built by the co-operation of the county and the farmers living in the vicinity of the road. The farmers haul the stone from their land free of charge. The county breaks the stone and places it upon the road. The cost for broken stone, broken by hand, is 28 cents per cubic yard.

Repairs to the county roads, in addition to putting on broken stone, consist in opening drains at the sides, filling up mud holes, and making breakers. In this work the road-machine is used but very little. Some of the small wooden bridges have been replaced by steel beam-bridges with wooden flooring.

Instructions issued to the supervisors require that work shall be done as early in the spring as practicable, and that at least three-fourths of the appropriation must be spent before July 1st, the remainder before November 15th.

There are 273 road supervisors in the county, who employ as assistants from 1 to 3 men each, according to the amount of the appropriation allowed them. If the appropriation exceeds $10.00 they must employ not less than 3 men. The pay of the supervisors is $1.25 per day when employed upon the roads, that of the other men is $1.00 per day. An average of $20.00 per mile is allowed for repairs.

The road-machinery owned by the county consists of 1 rock-crusher, 1 road-machine, and 1 scoop-scraper, the total cost of which was about $750.00. It is estimated that about one-half of the wagons have wide tires, those having narrow tires are the older.

The great mass of the road-material is limestone which occurs in great variety and covers over two-thirds of the county. The best of this stone makes an admirable road-surfacing, one or two varieties having a durability equal to many of the trap-rocks and also possessing the advantage of compacting readily. The limestones showing these high wearing qualities have the drawback of being light-colored. The softer limestones which compact readily are not very well adapted to heavy traveled roads. The map on Plate XXVIII shows the general location of the different rocks in the county.

The following table shows the expenditures for roads and bridges for the last ten years. The figures were obtained from the office of the County Commissioners:

WASHINGTON COUNTY.

Year.	Total amount levied for roads and bridges.	Amount spen for bridges	Amount spent for new roads.	Amount spent for road-repairs.
1889	$35,541.56	$19,829.95	$1,742.86	$13,968.75
1890	21,604.43	8,077.10	210.80	18,316.53
1891	15,298.97	2,869.44	......	12,429.53
1892	11,544.52	537.97	530.65	10,475.90
1893	17,701.17	3,641.60	750.00	13,309.57
1894	18,696.18	2,331.07	595.00	15,770.11
1895	16,654.72	3,524.38	75.00	13,055.34
1896	16,904.92	3,640.69	......	13,264.23
1897	17,299.11	4,807.08	......	12,492.03
1898	18,182.92	4,150.60	......	14,032.32
	$189,428.50	$53,409.88	$3,904.31	$132,114.31

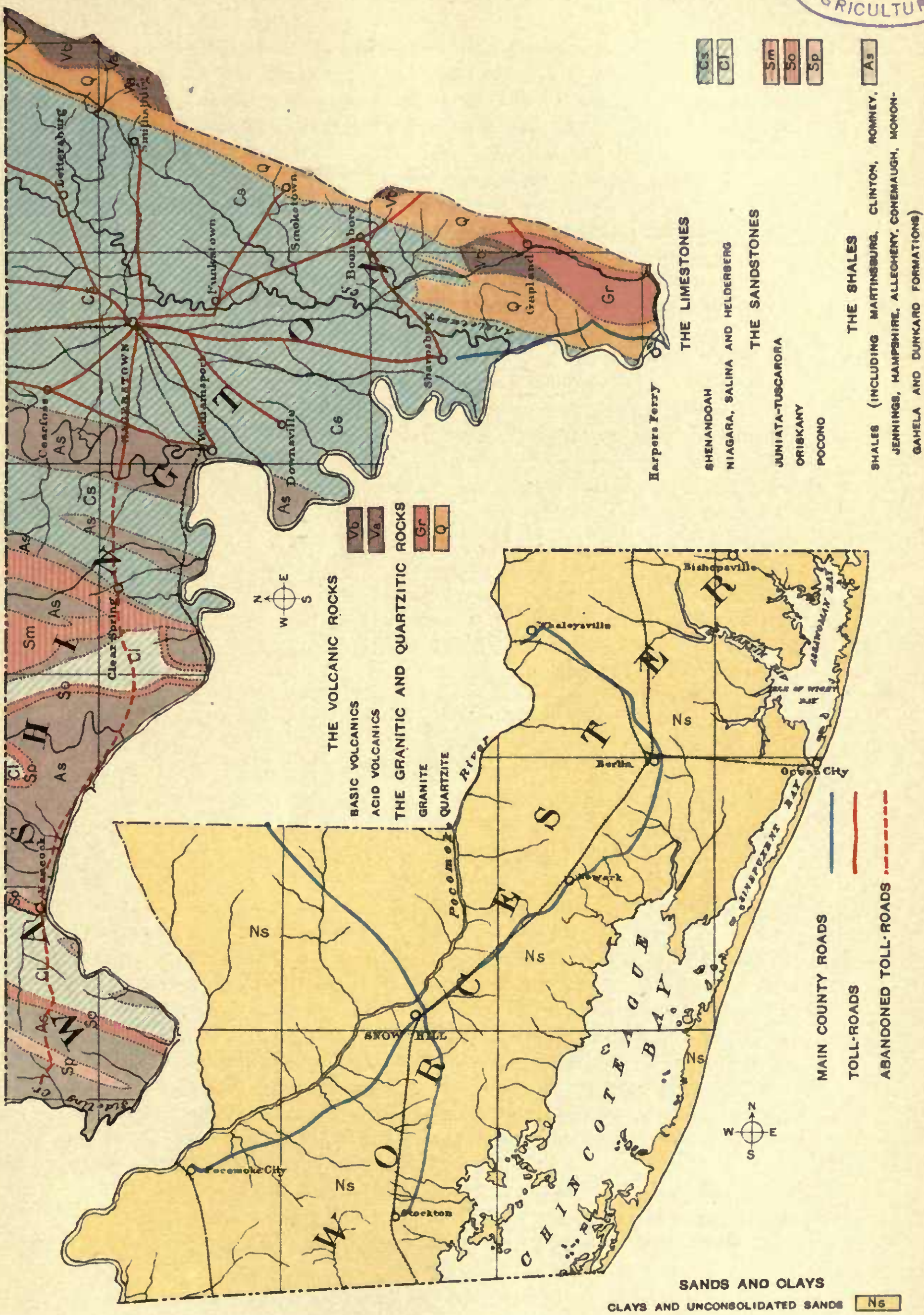
In addition to the amount shown in the above table it is estimated that $193,000.00 have been paid in tolls during the last ten years, making the total cost to the people of the maintenance of the public roads and turnpikes approximately $382,400.00, exclusive of private contributions.

WICOMICO COUNTY.

In Wicomico county there are 605 miles of road, or 1.64 miles of highway for each square mile of territory. With the exception of 10 miles of shell road about Salisbury, all of the roads of the county are of dirt built over a sandy or sandy clay soil. The main thoroughfares of the county are shown on the map on Plate XXVII and aggregate a mileage of 54 miles or 9 per cent of the total for the county. No toll-roads have ever been constructed.

The general surface of the area is flat and offers no obstructions to road location except those due to the swampy areas.

The best roads in the county are situated in the vicinity of Salisbury where ten miles of excellent shell road have been constructed by the combined action of the county authorities and the people adjacent to the road. In some instances the farmers have hauled the shells from the wharf free of charge while in others they have raised by subscription a portion of the expense, the county appropriating the rest. In the construction of these roads much has been due to the interest of a few men who have devoted their time without salary to their supervision. An unusual feature in this work was the care applied to straightening and grading the location of the



ROADS AND ROAD MATERIALS.

A. Hoen & Co. Lith. Baltimore.

road before surfacing it. The substitution of tile drains for the old wooden ones has been made in many portions of the county.

There are 31 supervisors who receive $1.25 for every day they work upon the roads. The law provides that every able-bodied male citizen between 21 and 55 years of age shall work two days each year upon the county roads under the direction of the road-supervisor or pay $1.00 for each day. Where laborers are hired to take the place of those who do not work upon the roads they are paid $1.00 per day. The supervisors average about fifty days a year on road-work.

The road-machinery owned by the county consists of ploughs, drag- and wheel-scoops and 1 road-machine, the total cost of which was $500.00. Repairs to this machinery cost about $25.00 a year.

There are no wide tires on any of the farm wagons, nor are the farmers disposed to order them on new ones.

Oyster-shells are the only material at hand for surfacing the roads.

From the office of the County Commissioners it was possible to obtain records of the amounts expended for roads only as far back as 1896. The following table gives the amount spent on the roads and bridges for the past three years:

WICOMICO COUNTY.

Year.	Total amonnt levied for roads and bridges.	Amount spent for bridges.	Amount spent for new roads.	Amount spent for shell roads.	Amount spent for road-repairs.
1896......	$2,600.00	$ 440.00	$230.00	$ 300.00	$1,630.00
1897......	3,525.00	1,113.00	510.00	900.00	1,002.00
1898......	3,425.00	200.00	400.00	1,000.00	1,825.00
	$27,750.00[1]				

WORCESTER COUNTY.

In Worcester county there are 600 miles of road or 1.26 miles per square mile of area. The length of main roads as shown on the map on Plate XXVIII is 58 miles or 10 per cent of the total mileage. There are no toll-roads.

All the roads in the county are dirt roads, the majority of which are over a clay soil with a varying proportion of sand mixed with it; a few, however, are through a very sandy soil. The surface of the entire county is very flat, and consequently the roads are without heavy grades.

In the spring the ditches are opened and cleaned, the material generally being thrown in the center of the road where it remains for the travel to wear it down. Oyster-shells are used to fill up low places in the roads near some of the landings, but little is done to the level, sandy stretches. These could be much improved for travel during the dry seasons of the year by mixing clay with the road-bed and then thoroughly rolling. There are no available road-materials within the county.

There are 17 supervisors in general charge of the roads who receive $1.50 a day for about 40 days in each year. In addition to the supervisors every male citizen over 21 years of age is required to work 2 days, free of charge,

[1] Estimated total for ten years.

upon the roads or in default is required to pay 75 cents for each day. In case laborers are hired to work upon the roads, they receive a per diem of 75 cents.

The county has recently bought a road-scraper, ditch-plough, and horse-roller, the total cost of which was $600.00. Few, if any, of the farm wagons of the county have wide tires, 3 inches being the widest on any of the wagons.

Oyster-shells form the only road-material in the county, but these are not used to any great extent owing to their cost.

The amount spent upon the roads since 1894 is given in the following table. The figures were obtained from the office of the County Commissioners. The records for the years previous to 1894 were destroyed by fire. No separate account has been kept of the cost of road work of different kinds but it is estimated, however, that the amount spent on new roads has averaged approximately $150.00 a year:

WORCESTER COUNTY.

Year.	Total amount levied for roads and bridges.	Amonnt spent for new roads.
1894	$1,500.00	$150.00
1895	1,500.00	150.00
1896	2,000.00	150.00
1897	3,000.00	150.00
1898	3,000.00	150.00
	$18,500.00[1]	

SUMMARY.

The main facts connected with the maintenance of the roads in the different counties are summarized in the following tables. The first two of these give the amounts expended on the roads and bridges, the third the facts concerning the administration and machinery by which the work is carried on. In the first table the list of expenditures for the roads is not as complete as desired, owing to the methods of keeping the accounts in vogue in the different offices, but it has been possible to obtain the separate amounts spent on bridges, new roads, road-repairs, etc., in eleven of the counties. For this reason no totals are given except for the first column. Also some of the county records do not go back as far as 1889—the beginning of the ten-year period used for study—in which cases the amounts have been estimated as nearly as possible and this fact indicated in the table by an asterisk. The actual figures which were obtained from the county offices may be found in the reports on the individual counties.

[1] Estimated total for ten years.

The amount shown for Baltimore county, as has been previously mentioned, shows more than has been expended upon the county roads proper, as it includes the maintenance of village streets. The small amount spent upon the roads of Wicomico and Worcester counties is in part explained by the fact that only small sums are expended for labor, as every male citizen is obliged to work upon the roads or pay for a substitute.

In the second table the total amount paid in the state for the maintenance of the public roads is shown for each of the ten years. There is also shown the estimated amount paid in the state for the maintenance of the toll-roads which, together with that paid for the public roads, gives an estimated total of the cost of the present road-system, so far as this can be shown by reliable figures. In regard to the amount of tolls paid it should be noted that records for only four years, 1894-1898, were accessible. The estimate of the total for the ten-year period was made from an average of these four years.[1]

In the third table the column headed "Mileage of roads maintained by the county," is repeated from the table on page 191. The stone, shell, and gravel roads have been summed up for each county but do not include turnpikes which are maintained by private corporations, though in some instances they do include sections of turnpikes which were built by the companies but which at present are maintained by the counties. This is true of Allegany, Garrett and Washington counties, where 40 miles in the first, 22 in the second and 23 miles of the stone road in the third are the portion of the old National Road within those counties. The mileage of improved roads in Baltimore, Carroll, and Prince George's counties also includes a number of miles which were originally built by private corporations. In the instance of Washington county, which has built no stone roads, it should be remembered that nearly every important county road and all leading into Hagerstown, are turnpikes, and among the best in the state, so that there has not been as much need felt for the construction of stone roads at public expense as in most of the other counties. A

[1] See further on page 440.

condition very similar to that around Hagerstown exists in the vicinity of Frederick where the principal roads are toll-roads.

The list of machinery contains all that is owned by the counties, but does not include that owned by the cities. The Department of Parks of Baltimore owns one 11-ton steam-roller and three 3-ton horse-rollers, the total cost of which was $4,900. The city also owns two stone-crushers, but does not operate them. Cumberland owns one crusher and one horse-roller, the cost of which was not ascertained. Westminster owns one steam-roller which cost $2,700. With these additions, the approximate total value of the road-machinery owned by the counties and cities of the state is $56,000.

TABLE SHOWING THE AMOUNTS LEVIED BY THE COUNTIES FOR ROADS AND BRIDGES FOR THE TEN YEARS, 1889-1898 INCLUSIVE.

	Total amount levied for roads and bridges in the last 10 years.	Amount spent for bridges.	Amount spent for new roads.	Amount spent for stone, gravel or shell roads.	Amount spent for repairs.
Allegany	$ 269,042.00	$ 60,000.00	$ 8,000.00	$ 5,000.00	$196,042.00
Anne Arundel	311,121.23[1]	....	....	....	....
Baltimore	1,226,681.36	....	....	....	....
Calvert	45,650.00	....	....	....	....
Carroll	172,088.49	18,438.00	....	....	125,837.51
Caroline	68,000.00	....	....	....	....
Cecil	192,989.09	....	....	....	....
Charles	76,500.00	....	....	....	....
Dorchester	107,134.00	....	....	....	....
Frederick	308,817.40	62,819.93	13,436.94	3,000.00	229,560.53
Garrett	113,414.05	16,159.32	6,508.99	....	90,745.74
Harford	309,050.00	7,200.00	....	....	301,850.00
Howard	134,901.00[1]	52,520.00	7,619.00	....	74,762.00
Kent	198,205.60	13,075.19	12,867.28	....	172,263.13
Montgomery	232,917.78[1]	....	....	....	....
Prince George's	190,000.00[1]	....	....	....	....
Queen Anne's	153,500.00	46,824.03	6,111.00	18,940.38	81,624.59
St. Mary's	52,500.00	....	....	....	....
Somerset	89,736.00	19,450.00	2,775.00	20,362.00	47,149.00
Talbot	146,770.00	33,939.08	13,986.34	14,011.96	84,832.62
Washington	189,428.50	53,409.88	3,904.31	....	132,114.31
Wicomico	27,750.00[1]	....	....	....	....
Worcester	18,500.00[1]	....	....	....	....
Total for state	$4,634,696.50	....	....	....	....

[1] Estimated total.

It is seen that there are but four steam-rollers in the state, and only two of these, those owned by Baltimore county, have been used to any extent upon the county roads. As the modern macadam road cannot be properly constructed without the use of heavy rollers, one of the first acts for road-improvement is the purchase of such machinery. A good illustration of the close connection between the improvement of the roads and the use of road-rollers is found in the rapid increase in the number of steam-rollers during the past five years in the state of Massachusetts. In 1894, about the time the State Highway Commission first began work there, there were 25 rollers in the state, while at present, 1899, there are 152, representing an investment of more than half a million of dollars.

TABLE SHOWING ANNUAL COST OF PRESENT ROAD-SYSTEM FOR THE TEN YEARS FROM 1889 TO 1898 INCLUSIVE.

Year.	Total amount paid in taxes for public roads and bridges. Public roads, 13,986 miles.	Total amount paid in tolls to Turnpike Companies. Toll-roads, 497 miles.	Combined total paid in taxes and tolls for the present road-system.
1889	$394,772.96		
1890	406,838.64	Annual average	Average for
1891	355,413.64	estimated from tolls	ten years about
1892	497,267.38	paid 1895–1898,	$600,000.00
1893	501,856.84	$140,000.00.	annually.
1894	510,081.63	....	....
1895	492,315.57	....	....
1896	486,689.49	....	....
1897	476,010.65	....	....
1898	513,449.70	....	....
Totals	$4,634,696.50	$1,400,000.00	$6,034,696.50[1]

The table given on page 261 includes a list of the turnpikes in the state in actual operation at the present time, together with the mileage, counties traversed, and principal office. The mileage controlled by those turnpike companies who made no returns was scaled from the best maps available and the result in each case sent to the turnpike company in question for verification. An asterisk is placed opposite the figures remaining unverified.

[1] In addition to this amount considerable sums are raised by private contributions which cannot be reliably estimated.

TABULAR STATEMENT CONCERNING THE PUBLIC ROAD-SYSTEM OF THE STATE EXCLUSIVE OF CITY STREETS AND TURNPIKES.

Counties.	Mileage of roads maintained by the counties.		No. of road supervisors.	Pay per day.	Additional No. of men employed by supervisors.	Pay per day.	No. of days work done on the roads.	Road-Machinery owned by the Counties.					
	Dirt.	Stone, shell or gravel.						Road-machines.	Scoops and ploughs.	Crushers.	Rollers.	Cost.	Remarks.
Allegany	490	60	160	{ 1.50 / 1.25	260	1.25	40	4	..	1	..	$940.00	Crusher not used. Cost includes machines only.
Anne Arundel	470	51	by contract.	1.50	by contract.	1.00	..	7	..	..	..	1,050.00	
Baltimore	640	266	15	salary.	..	1.25	200	5	..	3	2 steam.	11,500.00	Rollers, 10 tons each.
Calvert	265	..	3	1.35	15	1.00	150	..	..	..	..	..	Owns only some small tools.
Caroline	537	10	85	1.00	425	.85	..	5	1	..	..	1,230.00	
Carroll	758	12	37	2.50	500	1.25	20	15	..	1	..	3,775.00	
Cecil	683	17	90	1.25	500	1.12	..	12	..	1	..	3,500.00	
Charles	365	100	9	1.50	27	1.00	125	1	..	..	..	200.00	Road machine not used. Cost approximated.
Dorchester	580	20	53	{ 1.25 / 1.00	53	.75	130	1	..	..	..	225.00	Road machine not used. Cost approximated.
Frederick	1150	11	346	{ 1.50 / 1.25	1000	1.25	8	15	..	4	..	6,100.00	Owns some smaller tools, cost included.
Garrett	628	22	167	1.50	835	1.25	6	5	..	..	..	800.00	
Harford	680	112	10	2.00	..	1.25	..	11	..	1	1 horse.	3,000.00	Cost approximated.
Howard	400	13	13	salary.	118	1.00	..	13	..	1	..	3,340.00	
Kent	430	5	110	{ 1.00 / 1.25	440	1.00	40	10	..	..	..	1,500.00	
Montgomery	790	8	290	{ 1.10 / 2.00	1450	1.10	6	15	..	1	1 horse.	4,000.00	Roller weighs 3½ tons.
Prince George's	480	50	35	{ 1.00 / 1.50	175	1.00	50	3	..	..	..	550.00	
Queen Anne's	555	8	32	1.00	..	1.00	..	10	..	..	..	2,005.00	
St. Mary's	505	30	17	1.12	50	.90	70	..	..	..	..	250.00	Owns scoops, ploughs, etc.
Somerset	465	30	33	2.00	150	1.00	50	1	..	..	..	235.00	
Talbot	380	20	64	1.00	40	1.00	100	6	8	..	..	1,300.00	Scoops.
Washington	672	23	273	1.25	..	1.00	..	1	1	1	..	750.00	Scoop.
Wicomico	595	10	31	1.25	Work out road tax.		..	1	..	..	..	500.00	Cost includes scoops and ploughs.
Worcester	600	0	17	1.50	Work out road tax.		..	1	..	1	1 horse.	600.00	
Totals	13,118	868	1890					142		15	5	$47,350.00	

LIST OF TURNPIKES IN MARYLAND.

Name.	Mileage.	Cou traversed.	Main Office.
Adamstown Turnpike.	3.5	Washington.	Adamstown, Md.
Back River Neck Turnpike.	7.0	Baltimore.	Baltimore, Md.
Baltimore and Fredericktown Turnpike.	57.0	Baltimore, Howard, Carroll, Frederick, Washington.	Baltimore, Md.
Baltimore and Harford Turnpike.	23.0	Baltimore, Harford.	Baltimore, Md.
Baltimore and Liberty Turnpike.	16.0	Baltimore.	Baltimore, Md.
Baltimore and Jerusalem Turnpike.	16.0	Baltimore.	Baltimore, Md.
Baltimore and Reisterstown Turnpike.	48.0	Baltimore, Carroll.	Baltimore, Md.
Baltimore and Yorktown Turnpike.	31.0	Baltimore.	Baltimore, Md.
Beaver Creek and South Mountain Turnpike.	6.0	Washington.	Beaver Creek, Md.
Bel Air Turnpike of Harford County.	2.5	Harford.	Bel Air, Md.
Boonsboro and Sharpsburg Turnpike.	5.5	Washington.	Shepardstown, Md.
Buckeystown Turnpike.	7.0	Frederick.	Buckeystown, Md.
Charles St. Ave. Turnpike.	4.5	Baltimore.	Baltimore, Md.
Downsville and Hagerstown Turnpike.	6.9	Washington.	Downsville, Md.
Dulaney Valley and Towsontown Turnpike.	4.0	Baltimore.	Dulaney Valley, Md.
Dulaney Valley and Sweet Air Turnpike.	4.6	Baltimore.	Dulaney Valley, Md.
Ellicott City and Clarksville Turnpike.	10.0	Howard.	Ellicott City, Md.
Falls Turnpike.	5.0	Baltimore.	Baltimore, Md.
Franklin Turnpike.	3.5*	Baltimore.	Baltimore, Md.
Frederick and Ballinger Creek Turnpike.	2.0*	Frederick.	Frederick, Md.
Frederick and Catoctin Mt. Turnpike.	6.0	Frederick.	Frederick, Md.
Frederick and Emmitsburg Turnpike.	21.5	Frederick.	Frederick, Md.
Frederick and Jefferson Turnpike.	7.9	Frederick.	Frederick, Md.
Frederick and Monocacy Turnpike.	2.4	Frederick.	Frederick, Md.
Frederick and Opossumtown Turnpike.	3.0	Frederick.	Frederick, Md.
Frederick and Woodsboro Turnpike.	3.3	Frederick.	Frederick, Md.

* Mileage obtained from maps, not verified by the turnpike companies.

Name.	Mileage.	Counties traversed.	Main Office.
Gapland Turnpike of Washington County.	1.3	Washington.	Gapland, Md.
Hagerstown and Conococheague Turnpike.	7.5	Washington.	Hagerstown, Md.
Hagerstown and Cross-Roads Turnpike.	4.5	Washington.	Hagerstown, Md.
Hagerstown and Middleburg Turnpike.	5.1	Washington.	Hagerstown, Md.
Hagerstown and Sharpsburg Turnpike.	12.0	Washington.	Hagerstown, Md.
Hagerstown and Smithburg Turnpike.	9.0	Washington.	Smithburg, Md.
Hagerstown and Waynesboro Turnpike.	10.0	Washington.	Leitersburg, Md.
Jarrettsville Turnpike.	8.0*	Baltimore.	Jacksonville, Md.
Liberty and Frederick Turnpike.	9.0	Frederick.	Ceresville Mills, Md.
Liberty and New Windsor Turnpike.	6.0	Carroll, Frederick.	New Windsor, Md.
Liberty and Pipe Creek Turnpike.	10.4	Frederick.	Johnsville, Md.
Marsh Run Turnpike	3.5	Washington.	Wingertown, Pa.
Monocacy and Urbana Turnpike.	7.0	Frederick.	Frederick, Md.
National Turnpike.	11.6*	Washington.	Hagerstown, Md.
Triadelphia Turnpike.	5.0	Howard.	Triadelphia, Md.
Union Turnpike Co.	25.0	Montgomery.	Olney, Md.
Washington Turnpike.	2.8	Frederick.	Frederick, Md.
Washington, Colesville and Ashton Turnpike.	12.5	Montgomery.	Burnt Mills, Md.
Western Run Turnpike.	6.0	Baltimore.	Western Run, Md.
Westminster and Meadow Branch Turnpike.	2.0	Carroll.	Meadow Branch, Md.
Williamsport and Greencastle Turnpike.	8.2	Washington.	Williamsport, Md.
Williamsport and Hagerstown Turnpike.	6.0	Washington.	Williamsport, Md.
Woodsboro and Creagerstown Turnpike.	4.0	Frederick.	Woodsboro, Md.
Woodsboro and Double Pipe Creek Turnpike.	5.5	Frederick.	New Midway, Md.
Woodsboro and Frederick Turnpike.	8.0	Frederick.	Ceresville Mills, Md.
Total,	497.0		

*Mileage obtained from maps, not verified by the turnpike companies.

PART V

CONSTRUCTION AND REPAIR OF ROADS

BY

ARTHUR NEWHALL JOHNSON

CONSTRUCTION AND REPAIR OF ROADS

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The following outline of the construction and repair of roads has been written with a special reference to Maryland roads. In a general way their needs are much the same as those of the country roads throughout the Eastern States. The paving of city streets and the construction of bridges are not treated, but the more important features connected with the drainage, grading and surfacing of road-beds are given in some detail.

Road Location.

The first and one of the most important problems in the construction of a new road is the determination of its location. This part of the work is often slighted and left to those whose experience and judgment in such matters do not fit them to deal with problems of this character.

Only in new and unsettled sections of country does the problem arise of locating long stretches of highway. In most of the older states routes already exist between all of the principal towns and villages. Most of these roads were built previous to and during the first part of this century before the advent of railroads. Thus there are to-day already located intertown routes. While some of these ways were laid out with considerable engineering skill, very many of them were located with no apparent regard to the topography, but run straight across the country, up and down hill. When the location of a road is once determined and farms and villages have been established along the way, the problem of improving such a road reduces itself to making the best grade without departing any more than possible from the old location. To relocate entirely such a road would evidently be out of the question, for it would not meet the needs of the community which it now serves.

Although the problem of locating long sections of new roads does not often arise, that of locating short sections is of frequent occurrence. It may be that the building of a new railroad through a certain section will require additional short pieces of road to be built from the old highway to the railroad stations; or that the changing or establishment of a boat-landing may call for the construction of a short strip of new road. It also frequently happens that there are portions of old roads which can be advantageously relocated with a view either to shortening the distance or improving the grades. The last problem is the one most often encountered in the improvement of country roads.

It is perhaps well, however, to consider some of the factors that govern the location of a road which would be applicable to either a long or a short piece. They are:

1. The points between which it is proposed to build the road.
2. The topography of the country to be traversed.
3. The adaptability of the different soils encountered for making a good road-bed.

It is evident, with the terminals of a road given, the general direction is thereby fixed. If no hills or streams or other obstructions intervene the road would be in a straight line, as that would evidently give the most economic location; but such simple conditions seldom occur. If it is proposed to run through a settled country there would most likely be objection to an absolutely straight line owing to its running through farms, where fields would be divided. The possibility also exists of its running through some building. These difficulties could be avoided by a slight deviation of the road, and the expense from damages would be much decreased.

The most important conditions, however, are imposed by the topography of the country traversed. The terminals of a proposed road may be at the same elevation while the intervening country, perhaps, rises and falls many feet above and below this level, or one terminal may be much higher than the other. In either case the location of the road in a straight line would most likely result in grades far too steep for economical hauling. It is sometimes necessary, also, to swerve the course of a road in order to cross a stream at an advantageous point to save the expense of a costly bridge.

With a given difference of elevation between two points there is a minimum length of road possible when a certain grade is not to be exceeded. For example, suppose it is found that the difference in elevation of two points is one hundred feet, and a rise of five feet for every one hundred feet of distance, or what is the same thing, a five per cent. grade is to be the maximum grade allowed. It is evident that the shortest distance in which a hundred-foot rise may be gained, allowing a rise of five feet in every hundred, is two thousand feet. If the given points are not two thousand feet apart it will be necessary to lengthen the road by taking a circuitous route, since this must be at least two thousand feet long. It may be necessary, owing to accidents of the topography of the locality, to make a much longer route, but in the given instance it may be no less than two thousand feet long. For the same reason, if there arises a question of relocating a portion of a road which is already on a steep grade over the entire distance, no new location should be considered which shortens the distance, for by so doing the grade is increased.

Should it happen that two locations were possible with about equal advantages and disadvantages, except that one was over a different soil from the other, that location should be taken which traverses the soil best calculated to insure a good road-bed. For example, if it were possible to avoid going through a clay section when a more open soil could be had close at hand, much would be saved both in the cost of construction and in the subsequent maintenance by going over the more open soil. It is hardly necessary to state that crossing soft, boggy soil should be avoided whenever the expense of going around such a place would be no more than for crossing it. If possible it is always well to locate a road in the vicinity of good road-material, either a suitable stone or gravel, for the proximity of such material lessens for all time the cost of maintenance of the road, and when this point is considered such a location would be warranted even at an increased first cost.

Grading.

Perhaps the greatest improvement which can be made in a road is to lessen the grades. To calculate exactly in dollars and cents the saving that will accrue from a particular improvement of this sort is very difficult, as it would necessitate the possession of more exact statistics in each instance than is ever available. For example, even if the amount of traffic over a given road be known it would still be hard to say how much would be saved in the wear and tear to drivers, horses and wagons by a decrease in the grades. But if the consideration of such data as can be obtained, the amount of traffic over the road, the time occupied in hauling over any particular section, the length of proposed road and the cost of proposed improvement, indicates a saving in favor of the improvement, there can be no doubt as to the advantage derived, as it is surely greater than the figures express. The following supposed case shows the method of treatment of problems of this sort:

[1] "Take for example the elimination of a 5 per cent grade 1 mile long from an earth road. The observations on this grade show that the daily traffic over it is 224 teams, each dragging an average load of 800 pounds, equivalent to 24,000 tons per annum; that the time occupied in traversing it is half an hour; that the value of a team's labor is 30 cents per hour. Therefore the cost of haulage on this grade is 33-6/10 cents per ton-mile, or $8064 per annum for the total tonnage using it."

"From an examination of the ground we find that the grade can be reduced to 2 per cent by constructing a new piece of road 2 miles long, and that the cost of the change will be $18,000."

"From the resistance to traction opposed by the new road-surface plus the effect of gravity we find that a team will haul a load on the reduced grade, of 1200 pounds, and that the time occupied in traveling the 2 miles will be 1 hour. Therefore the cost per ton-mile will be 28 cents, or $6720 per annum, which substracted from the original cost of $8064 leaves $1144; which sum, with money at 6 per cent, represents a capital sufficient to make the proposed change."

"The money loss caused by grades may be approximately ascertained as follows: Ascertain the cost of hauling a ton on level portions of the same

[1] From Byrne's Highway Construction, p. 489.

road and on the grade; take the difference and multiply it by the annual tonnage: the product represents the annual loss. For example, the cost per ton-mile on a level is 22.50 cents, on a 5 per cent grade 33.60 cents; difference, 11.10 cents—loss per ton, or an annual loss on a traffic of 30,000 tons of $3330, which is the interest at 6 per cent on $55,000; which sum the community could borrow for the purpose of reducing the grade to a level, pay the interest and be no worse financially, and have a good road besides."

Greater appreciation of the hindrance to hauling caused by grades can be gained from a study of the following tables.

The first table shows a comparison of the amount that can be hauled over different grades and the amount which it is possible to haul under similar conditions over a level road. It is seen in case of an earth road that .41 as much can be hauled on a grade of 5 feet per 100 as on a level earth road, and but 10 per cent. as much on a grade of 15 feet per 100. Thus, if a horse can pull 1,000 pounds on a level dirt road, on a 5-foot grade he can only pull 410 pounds and on a 15 per cent. grade but 100 pounds.

TABLE SHOWING THE RELATION BETWEEN LOAD, GRADE AND SURFACE.[1]

Grade.	Earth.	Broken Stone.	Stone Blocks.	Asphalt.
Level	1.00	1.00	1.00	1.00
1: 100	.80	.66	.72	.41
2: 100	.66	.50	.55	.25
3: 100	.55	.40	.44	.18
4: 100	.47	.33	.36	.13
5: 100	.41	.29	.30	.10
10: 100	.26	.16	.14	.04
15: 100	.10	.05	.07	....
20: 100	.04	....	.03	....

The second table shows the equivalent length of level road over which the same amount of energy will be expended to haul a given load as would be required on one mile of road of different grades. Thus, for example, the energy required to haul a given load one mile on a grade of 1 foot to the 100 feet is the same as is required to haul the same load over 1½ miles of level road, the surface conditions being the same; while for a grade of 10 per cent. there is required to pull 1 mile on this grade energy equivalent to that spent in pulling over nearly 6 miles of level road.

[1] From Byrne's Highway Construction, p. 303.

TABLE SHOWING RELATION BETWEEN LENGTH OF HAUL AND GRADE.[1]

Rate of grade feet per 100 feet.	Equivalent length of level-road miles.	Rate of grade feet per 100 feet.	Equivalent length of level-road miles.
0.0	1.000	2.50	2.244
0.25	1.121	2.75	2.363
0.50	1.242	3	2.484
0.75	1.373	4	2.982
1	1.500	5	3.444
1.25	1.622	6	3.986
1.50	1.746	7	4.844
1.75	1.871	8	4.982
2	2.000	9	5.480
2.25	2.120	10	5.977

If properly graded, it is no exaggeration to say that one-third of the roads now frequently rendered impassable from washouts would be nearly free from the effects of such accidents. The wear to a road-bed increases with the velocity of the storm-water flowing down it, and the velocity depends primarily upon the grade. It is useless to hope to maintain a road on a steep grade under ordinary circumstances. Every year special appropriations are made to meet such emergencies. While it cannot be said that there would be no damage to a road from the storm-water even if it were properly graded, it is a fact that the amount of damage in a particular instance would have been much greater if the grades had not been reduced.

The saving in maintenance of a particular piece of road resulting from improvements in the grades can be at the best only roughly estimated, but it can be stated that the maintenance is surely less. There is thus an additional gain which is not included in the above estimate of benefits resulting from the reduction of a steep grade.

Roads situated on the side of a hill or mountain are dangerous to travel, and more so if the outer slope be precipitous. There seldom occurs an instance of a road thus located that does not follow a curve, which is an additional source of danger to vehicles. In such places every precaution should be taken to guard against accidents. Money so spent is well invested, for besides the loss and injury sustained by the traveler there is an expense to the community arising from damages which can very often be collected where such places are permitted to stand unprotected.

[1] From Byrne's Highway Construction, p. 304.

A generally convenient and cheap method of protecting roads under these conditions is to roll to the outer edge large stones, which should be at least three feet high and two feet thick, placing them 2 or 3 feet apart. This would allow water to escape between them while affording a barrier to a frightened animal. Another method is to form an earth mound or sometimes an earth mound faced on the outside by a stone wall. Where this is done provision must be made by frequent openings through the wall for proper drainage. The ordinary fence or guard-rail is of little real service in such places, as neither is firm enough to withstand the shock of a collision with a runaway team.

Drainage.

Closely associated with the establishment of the grade of a road is that of the drainage.

The local road-laws of the counties vary in the powers given to the County Commissioners. In some instances they are permitted to drain water from the roads onto adjacent property, taking care that cultivated fields are not injured; in others, the law absolutely prohibits such draining into private lands without the consent of the owner unless damages are paid. Thus the storm-water is frequently kept in the road-bed until some water-course is crossed. The amount of water actually falling upon the roadway is often less than the amount that is collected from the neighboring slopes. Where provision is made for intercepting the water from the sides by ditches made part of the way up the slope there is less danger of the roadway itself being seriously damaged by the storm-water.

No embankment of any sort should be allowed which keeps the storm-water in the roadway. Wherever it is necessary to dig a ditch through adjacent lands in order to dispose of the road drainage, it may be just that damages be allowed the landowner. As a rule, however, the actual damage can be made practically nothing, or at most very little, provided a little judgment is exercised in placing these lateral drains. The more frequent the outlets from the road of the storm-water the less the volume which it is necessary to carry in the gutters and side-ditches, and, consequently, the less the amount of wear and destruction of the road-bed.

The grade which the side-ditches may have and not be seriously affected by the wash of the water carried in them depends upon the length of the ditch and the character of the soil through which it passes. A steeper grade could be allowed in a coarse, sandy soil than in one of clay; for in the first instance much of the water percolates through the ground itself. Unless very long, and, consequently, required to carry a large volume of water, a ditch in a sandy or gravelly soil may have a grade of from 3 to 4 feet in the 100 feet

FIG. 7.—Laying side-drain for macadam road on state highway in Massachusetts.

and suffer little from the erosive action of the water. In a clay soil a ditch of the same grade soon becomes deeply worn and causes a rapid destruction of the road-bed.

Ditches should be far enough from the roadway to allow room for a strip of brush or small trees between the ditch and the road. The mass of roots forms an admirable protection against the washing away of the side of the ditches towards the roadway. In such a case the sod should be allowed to grow in the gutters and frequent openings made from them to the side-ditches. It is now generally the practice, and a very bad one, on most of the country roads to scrape the sod from the gutters by means of a road-machine or shovels. This is entirely wrong, an actual damage being done to the road, for it exposes the soft earth below to the direct action of the water which soon wears it away; whereas, on the contrary, if the sod had been allowed to remain the gutter would not have been deepened, and the formation of a deep and dangerous ditch at the side would have been prevented.

CROSS-DRAINS.

Whenever the road has been raised above the level of the surrounding surface, as in the case whenever a fill has been made, no underground water will reach the road-bed to endanger its solidity. If it is a dirt road the rain falling upon the surface will percolate through the surface and soften it to some extent, but the water soon

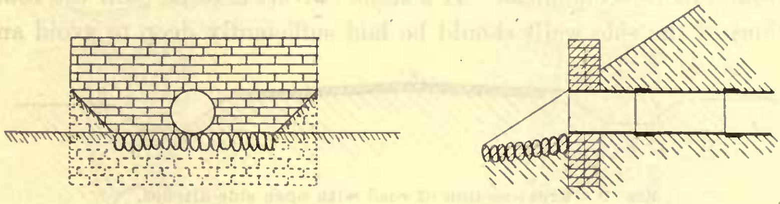


FIG. 8.—End elevation and longitudinal section of a pipe culvert under an embankment.

dries out, as there is no chance for it to be confined to the road-bed, as is the case with those sections of a road through a cut where the road-bed is below the general level.

The drains constructed where fills have been made are designed merely to provide free passage for the natural drainage of the land and to prevent the embankment from acting as a dam. The size of the drain must therefore be large enough to accomplish this purpose. The drains are located at the lowest points of the hollows crossed by the road, since these are the places where the water collects.

In taking care of comparatively small quantities of water the cheapest and best arrangement is the tile drain. If there already exists a small ditch or water channel this is cleared out, care being taken that it is not cleared too deep so that water will remain stagnant in the pipe. If the bottom is very soft the ditch should be cleared somewhat below the grade to which the pipe is to be laid and refilled with sand or gravel. The ends of the pipe should extend sufficiently beyond the embankment to avoid the possibility of any earth from the sides being washed down over the ends, which should be protected by masonry. The general method is shown in Fig. 8. Underneath the pipe at the ends is laid either a large flat stone or a small amount of cobble paving, forming an apron which extends beyond the pipe. Flush with the end is laid a brick or stone wall extending to such a height as will prevent any earth from washing into the pipe. Where necessary, two pipes could be laid side by side, forming a double-pipe culvert.

In special instances it might happen that it would be cheaper to lay up a stone culvert. Ordinarily, however, the pipe culvert will be found more economical. If a stone culvert is to be built the foundations of the side walls should be laid sufficiently deep to avoid any

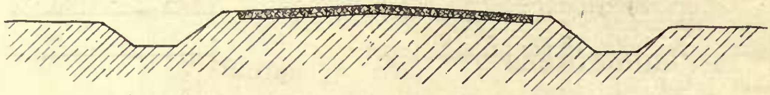


FIG. 9.—Cross-section of road with open side-ditches.

danger of the water undermining them. The side walls can be laid dry, but the stones must be placed carefully and the too free use of small pieces to fill the crevices should be avoided.

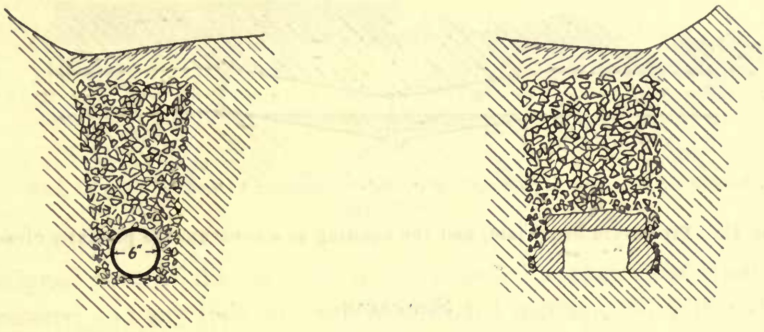
Where there is but little fall and the flow of water is slow it may not be necessary to pave the bottom of the culvert except a small amount at the ends. If, however, the soil is loose and sandy it would not be safe to allow any of the bottom of the culvert to remain unpaved.

Aside from culverts run across the road, no other contrivance is necessary for the underdrainage of those portions of the road which are on an embankment; the surface-water will, if the road be properly shaped, take care of itself. Washing away of the embankment can be prevented by sodding the slopes.

SIDE-DRAINS.

Portions of the road which require the most attention and which most readily become soft in wet weather are those through a cut where the roadway is below the surrounding natural surface. In such a case the water naturally collects in the roadway, and provision must be made for taking care of the same. In order to keep the water from the road-bed there should be deep ditches on each side of the road, so that the roadway becomes a sort of embankment which is underdrained by the side-ditches. In many places these ditches may be left open. The sides of the ditches should be sloping with a slope not steeper than 1 foot vertical to 1½ feet horizontal. This will prevent them from caving in and filling up the bottom of the ditch. Fig. 9 illustrates this method.

If the cut which it is necessary to make is deep this method requires a large amount of excavation. It is then cheaper to have "blind"



FIGS. 10 and 11.—Sections of lateral drains for under-drainage of a roadbed.

side-drains. One form of a drain of this sort is shown in Fig. 10. A ditch is dug to a depth of 2 to 3 feet below the center of the road. In the bottom is laid a six-inch tile drain surrounded by broken stone, the whole covered in with dirt. In place of the tiling an opening may be left made of large flat stones, Fig. 11. Such a drain as this, however, in some kinds of soil works badly, as the water soon scours out the bottom, undermining the stones which, falling, finally clog the drain. To make such a drain effective for all conditions, it would be necessary to lay a pavement of stone on the bottom, which will generally make it more expensive than a tile drain. All side-ditches should be carefully graded, and if pipes are used, care should be taken to see that they are laid to an established grade. If a pipe drain is put in hap-hazard, some sections will always be found too low, as is shown in Fig. 12. At the lowest point mud and sand will collect and reduce the full opening of the pipe. Another precaution to be taken in laying pipe drains is to have the bearing of each section of pipe where it rests on the bottom of the ditch near the ends. The workmen scoop out beneath the center of the section of pipe a small amount of earth, thus securing the bearing of the pipe at either end. This will prevent any tendency to rock and keep the different sections in alignment. If the bearing of the pipe is toward the middle when the earth is thrown in, it will very likely disturb that particular section and throw it out of position. Figure 7 shows a side-drain in process of construction.

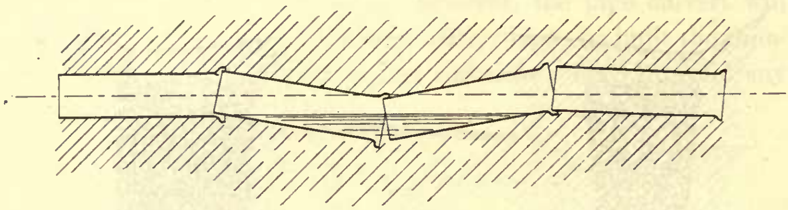


FIG. 12.—Pipe drain badly laid, and the opening as a consequence partially closed.

SURFACING.

PREPARATION OF THE FOUNDATION.

All of the methods described in the preceding pages may be regarded as merely preliminary work in the preparation of the road for receiving a pavement, whether it be of shells, gravel, or broken stone. Before a finishing surface of any material is applied to a road all the preliminary work should be completed. The road should have been graded, drains provided and the road made safe by proper guard-rails. With all this done, the dirt road is a foundation for the different materials that may be put upon it.

For country roads there need be considered only pavements that are put on in small fragments. The materials most commonly used are gravel and broken stone. Oyster-shells and slag from iron-furnaces are oftentimes employed in localities where these materials are at hand, while under certain conditions, when no other material could be obtained, burnt clay has proved serviceable. The object of a pavement is to furnish a wearing surface for the road and a protection for the foundation from water and consequent softening. It is in reality a roof.

When dry all but the very sandy soils are firm enough to support the weight of wagons of all kinds, but when wet little support is furnished. It is well known that sand, when confined, will stand any pressure that can be put upon it. Thus, if a sandy road-bed is covered with a surfacing material which will hold the sand in place, an excellent foundation is obtained. While a surfacing material is

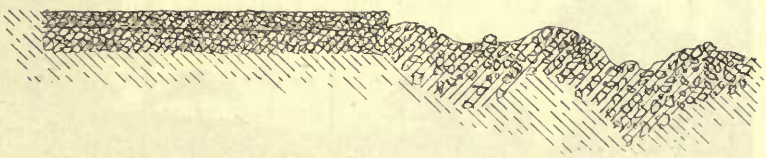


FIG. 13.—The effect of placing broken stone upon firm and soft foundation, respectively.

designed to take the wear, it is the foundation that must resist the pressure, and any road which is constructed without giving due attention to the foundation is wrong from the start and never will be a good road until the defect is remedied. To prepare a natural road-bed for surfacing-material it is necessary to bring it to a proper grade and to conform its cross-section with that of the finished surface. That is, no surfacing should be put upon a road-bed which is flat or, as is oftentimes the case, lower in the middle than at the sides. In such instances the proper shape should be given to the road-bed by filling in with such material as is necessary and then rolling the whole until it becomes firm and unyielding.

During the course of construction of a road-bed, if there are places that have a wet, springy subsoil, they must be drained and every precaution taken to make the foundation of the road dry. The pavement will keep water from going through from the top but it will not keep water from percolating into the foundation from springs at the sides or underneath. Therefore, where there is danger of water getting to the foundation from the sides or from below it must be cut off either by side-drains or by drains directly underneath the road itself, as shown in Figs. 10 and 11.

Where the soil is too light, gravelly or sandy earth should be carted in to take its place.

With the road-bed brought up to grade and provision made for thorough drainage, it is then compacted by rolling either by horse-

FIG. 14.—Applying broken stone for macadam road on state highway in Massachusetts.

or by steam-power. In the rolling of the foundation, perhaps quite as good results can be obtained with a horse-roller as with a steam-roller, and in some loose soils much less difficulty will be experienced, although more rolling will be required to compact the earth as firmly as by the heavier steam-roller. This is a part of the work that is too often slighted and is the cause of depressions subsequently appearing in the finished road. The rolling of the foundation will bring out the weaker places, where there will be a settling. The depressions should be filled and brought to an even surface with gravel if it is at hand. It is cheaper to even up depressions by rolling the foundation than by attempting to smooth the finished surface with additional broken stone. When the foundation has been rolled and all unevenness has disappeared, it is then ready to receive the surfacing.

It oftentimes happens, when grading a particular piece of road preparatory to surfacing it with broken stone, that it is necessary to do considerable heavy filling. In such instances it is advisable to delay the laying of macadam for at least a year in order to give the embankments time to settle, for it is impossible to construct an embankment of earth more than a few feet in height without having subsequent settlement. If this settling took place evenly all along the embankment no particular harm would be done to the macadam laid upon it, but owing to the difference in the soils composing embankments, and also the way the earth is dumped, there is always a tendency for some parts to settle more than others.

If there arise circumstances making it impracticable to wait for the embankment to season, as it were, every precaution should be taken in its formation to guard against uneven settling. This can be done by spreading the earth in successive layers of about a foot in thickness, which are rolled or tamped as solid as possible.

Another advantage in delaying the surfacing of a newly-graded road is, that a chance is given to observe the action under frost of certain sections, and so provide additional under-drains which, if omitted, might have caused a failure in that portion of the macadam.

STONE ROADS.

In regions where stone is obtainable there has been found no form of pavement so well adapted to the needs of country roads as a surface of broken stone. All things considered, first cost, maintenance, and efficiency as a pavement, this has proved the best and the cheapest. Among the many advantages of broken stone are the wide distribution of materials, ease of application, a hard, smooth surface which is impervious to water, and the ease of repair when properly applied. It has, however, the disadvantage of becoming dusty in dry weather and muddy in wet weather, so that it is not as desirable a pavement for towns as many other kinds. But for the ordinary country road and light traveled streets these faults do not form serious objections.

A surfacing of broken stone should never be applied to a road-bed which has not been properly prepared to receive it. Stones should not be thrown upon a road-bed that is full of hollows and on which there is more or less disintegrated and worn-out material. For the reception of the broken stone a trench is dug as wide as it is intended to stone the road and to a depth a little less than that of the thickness of the macadam, as the rolling will somewhat deepen the trench by the consolidation of the earth at the bottom.

The best practice growing out of long experience is to spread the broken stone in layers formed of equal-sized pieces. The advantage of uniform size is explained by the fact that the strength of a broken stone pavement consists in the firmness with which the different pieces are held against one another. To obtain this compactness, it is necessary to bring as many faces and as much of each face of the stones closely and firmly together as possible. If the stones are of various sizes, smaller ones will be found between larger ones preventing the latter from coming together, and thus increasing rather than decreasing the intervening spaces. At the same time it is very evident that there is less area of surface in contact with a large stone against the smaller one than when two stones with about equal-sized faces are in contact. There will, of course, always be voids. It would be better if they were filled, but the small material for filling them should not be thrown in with the larger material and all rolled together, for the object sought will not be accomplished in this way. The fine stone dust is put on after the large stones have been well compacted by rolling.

As the object of rolling broken stone is to bring the different pieces into close and firm contact, better results are obtained when thin layers are rolled than when the layers are thick. The best results are not obtained if layers of loose stone over 5 or 6 inches in thickness are rolled at one time. When it is attempted to roll a thicker layer than this, the stones, instead of compacting readily, have a tendency to slide one upon the other, and there is produced in front of the roller a wave motion. This breaks the sharper edges of the stone and wears them round, so that it is very difficult for the stone to become compacted, and then not until a considerable amount has been wasted in uselessly grinding up the individual pieces. Properly built macadam is in two layers. The bottom course consists of stones in which the longest diameter is not over $2\frac{1}{2}$ inches and which will not go through a $1\frac{1}{2}$-inch ring. This is known as No. 1 stone. To insure having the material evenly distributed, care must be observed as to

FIG. 15.—Rolling surface of macadam road on state highway in Massachusetts.

the manner in which it is spread. If possible, the stone should not be dumped upon the roadway itself, but near by at one side. It is then spread by shovels to a thickness of 4 or 5 inches, each shovelful being thrown in such manner as to spread the stones rather than to deposit them in piles. Where it is not convenient to have the stone dumped at one side, a platform about 8 feet square is placed in the roadway and the stone emptied from the carts upon it. Such a platform is provided with ropes by which it is dragged ahead from time to time. Carts specially designed for spreading stone to any desired thickness, greatly facilitate this part of the work. The cart is so arranged that it may be tilted to such an angle that the stone will slide out through an adjustable opening at the back. The opening is but a few inches from the ground so that the stones have no chance to scatter, but are deposited in an even layer over the surface.

Lines should always be stretched from stakes on which have been marked the grades to be followed. By measuring from these points uniform thickness of stone can be maintained and an even surface assured.

After the first layer of stone has been thoroughly rolled to a thickness of 3 or 4 inches, the second layer is then added, the same care being observed in spreading as with the first layer. The stones in the second layer are usually smaller than those in the first. The longest diameter should not be over 1½ inches; nor should any stone pass through a ¾-inch ring. This is known as No. 2 stone. The second layer, when thoroughly rolled, forms the wearing surface of the road, which should be about 2 inches thick, making a total thickness of 6 inches of macadam.

ROLLING.

It is the rolling which makes the road. This should begin at the outer edge, the outer driving-wheel of the roller having a bearing of about 12 inches on the broken stone, the remainder of the wheel compressing the dirt shoulder which should be left 4 or 5 inches higher than the broken stone, so that it may be compacted into a firm mass which will hold in place the edge of the road and prevent the stone from spreading sidewise. Oftentimes rolling is begun in the center. This has the effect of crowding the stone to the side and prevents the firm bonding of the pieces, besides wasting the rim of loose stone at the edge. Under "Instructions to Engineers" the following rules on the rolling of stone road are given by the Massachusetts Highway Commission and are the outgrowth of wide experience in the construction of the modern macadam road.

When possible roll the sub-grade with a steam roller.

If the sub-grade is too sandy to roll, cover with coarse gravel laid on to a depth of three (3) inches, or as much more as may be needed to give a good foundation.

Fill any depressions with the same material until the surface is true and even.

All broken stone must be rolled in screened layers.

After spreading the first course of broken stone, begin rolling at the sides, and continue thus by running ahead so as to allow from two (2) to five (5) inches of the driving wheel to pass over the shoulder, and backward with the outer edge of the driving wheel from five (5) to ten (10) inches inside the edge of the broken stone. Roll until the stone ceases to "wave" in front of the wheels, and until it seems firm under foot as you walk over it. Next begin on the other side and roll in the same manner. Then work toward the center until the stone is rolled. Roll each layer of stone in the same manner.

If the road shows a wavy motion after passing the roller over it three, four or more times, it may indicate too much moisture in the sub-grade. If, on examination, you find this to be true, stop rolling and move ahead, allowing for the sub-grade to dry out.

With some coarse, hard granite rocks it has been noted that after the roller passes over them a few times they begin to "crawl" and the sharp edges break off. A slight sprinkling of sand or stone screenings, or water, may prevent this. Try one after another of these means until the work progresses to your satisfaction. You must not expect to prevent the stone from shaking as you walk over it, but you need to continue the rolling until the fragments of stone adjacent to where the foot presses do not move as you walk. Most of the rolling must be done before you spread the screenings. After spreading the screenings, water and roll until the mud flushes to the surface. You cannot expect to prevent the stone from kicking out if the teams pass over the road. Keep watch, and in a few days have the roller pass once or twice over the road, after watering, until the loose stones are pressed down out of sight.

Before spreading any broken stone, great care must be taken to have the sub-grade carefully shaped and thoroughly compacted.

All shoulders must be shaped and left sufficiently high to roll to the proper grade before any broken stone is spread on the road.

In the case of heavy fills you must not run the roller to the edge of the shoulders unless the fill has had time to settle. Work out slowly on this kind of work.

In every case the screenings used on the surface as a binder course must be of the same material as the top course of the road.

Excepting where it may be needed to compact hard granite rocks, as before referred to, you will use water only on the top, or binder, course.

You will wet this binder course thoroughly before rolling, but not to the extent of saturating the foundation. You will get better results and prevent the screenings from being picked up by the wheels of the roller if you apply the water and allow it to settle down below the top surface before passing the roller over it. Too much water, or too little, will give trouble by causing the surface to be picked up.

You must not under any conditions roll the screenings while dry.

You must not under any conditions allow teams to pass over the road after the screenings are spread and before they are rolled.

In case of a deficiency in the water supply, you may have the screenings spread and await a rain before rolling; but in such case the road must be entirely closed to travel, and the rolling must be begun as soon as the road is wet and continue until the section covered with screenings is thoroughly compacted. In such cases it may be necessary to operate the roller day and night, and you must insist on this being done. In case you meet with any difficulty in compacting the stone, and fail to understand the cause, report immediately in writing to the office.

CROWN.

The crown or transverse slope of a road should only be sufficient to carry the surface-water to the gutters. On dirt roads where ruts are easily formed the slope needs to be more than on a macadamized surface, but never sufficient to cause inconvenience to travel. One inch to the foot or $7\frac{1}{2}$ inches on a 15-foot road will be found about right. A good macadam road does not ordinarily need so much crown, depending on the grades. On grades up to and including 4 feet per hundred, $\frac{1}{2}$ an inch to the foot is sufficient; from 4 to and including 6 feet per hundred, $\frac{3}{4}$ of an inch should be allowed. A transverse slope of more than one inch per foot gives too much list to a wagon when at one side. The advantage of as flat a road as possible is the lessening of the tendency for the travel to keep to the center of the road and the consequent avoidance of the formation of ruts and a horse-path.

THE THICKNESS OF MACADAM MATERIAL.

It was formerly the custom to build roads with what is now considered an excessive thickness of stone. The famous Roman roads to which allusion is made so frequently, were often over three feet thick. The lower course consisted of large stones with smaller ones in the upper courses, between which there was a layer of concrete and over all was laid a stone pavement composed of large flat stones nicely jointed. Most of the turnpikes of this state were built at least eighteen inches thick with the lower course of large stones ten to twelve inches in diameter, the top course being of smaller broken rock. If it is possible to lessen the thickness of the stone covering it is evident that the construction would be proportionately cheaper. The determination of the thickness required is therefore a very important consideration.

Those roads where the telford construction has been employed, that is, where the lower course consists of large stones from eight to twelve inches in size, have no more wearing strength than a road with a thinner stone covering, for as soon as they are worn down to the larger stones the surface becomes rough and uneven and requires resurfacing. It is well to keep in mind the object of the surface material, which is to afford protection to the foundation, so that it may not

Fig. 16.—Laying telford road on state highway in Massachusetts.

be softened by the rain or cut up by traffic. It must therefore be of such a nature as to resist the wear of the different kinds of traffic to which it may be subjected; but it should not be depended upon to hold up the entire load. This part of the work is done by the foundation, and when surfacing material is applied to a road-bed it should be in such condition as to support a loaded wagon. Dry, consolidated earth will do this, and if it can be kept in this condition no trouble will arise.

The actual pressure which the earth immediately below the macadam has to carry is less than is actually borne by the surface of the road, as the effect of the layer of compacted stone is to distribute the pressure over a greater area. In other words, the layer of macadam reduces the weight per square inch which the foundation is obliged to carry. The pressure will be practically the same with a very thin layer, while with a thicker one it may be conceived that the weight rests upon the top of a pyramid, which distributes it to the foundation over the larger area of its base. If the earth foundation will alone carry the weight of loaded wagons, any thickness of stone more than assures this. Thus only such a thickness of covering is required as will insure the formation of a compacted mass which will not be loosened by the travel over it.

When a thickness of metal has been put upon the road-bed sufficient to resist the pressure from traffic, manifestly the condition of the surface will not depend upon there being an extra thickness. Thus if there is a road with twelve inches of material and another with six inches, the six inches being sufficient to support the travel, the twelve-inch road is no better than the six-inch. It is merely so much money buried in the shape of broken stone. It is only the two or three inches of the top which receive the wear, for when these two or three inches are worn away it is necessary to resurface, as the road has become more or less uneven; owing to the fact that the wear is seldom equal over all portions of the roadway. The macadam road rolled to a thickness of six inches has been found everywhere to be all-sufficient. With the foundation well drained there are few places which require the telford construction. On a firm, dry soil, roads have been built with a covering of rock which compacts well, not exceeding four inches in thickness, over which there has been a great amount of travel, and they have proved satisfactory in every way. The following is a description by J. J. McLaughlin,[1] of a thin macadam road built in the village of Jamaica, Queen's county, N. Y.:

"In the village of Jamaica, in 1897, there was a stretch of street about three-fourths of a mile long, parallel to two roads then being improved. The work was done in the spring of 1897, after a sewer had been laid in the same street. It was built of four-inch stone spread loosely and then rolled. From actual count there were from eighty to one hundred heavy loads per day, carrying ten thousand and eleven thousand pounds each, for

[1] Quoted in Fifth Ann. Report Com. of Roads of N. J., p. 63.

over three months, running over this piece of road, and only in one case where there was some careless work over a sewer trench, was there any material sign of wear, and in no place a break. There was not a square yard of the street broken that had carried these wagons. A road may be built poorly, but if there is an adequate system of maintenance put behind the construction, the road can be saved and made very good. Queen's county has the best system of maintenance. After a road is well con-

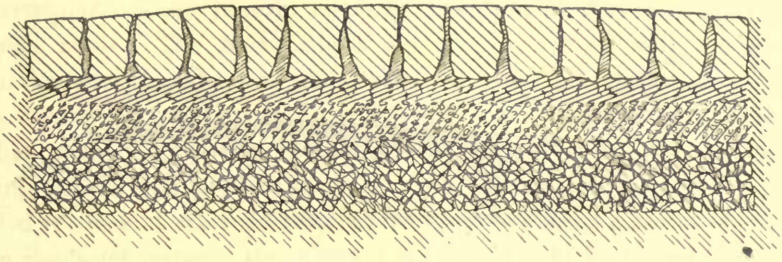


Fig. 17.—Roman road.

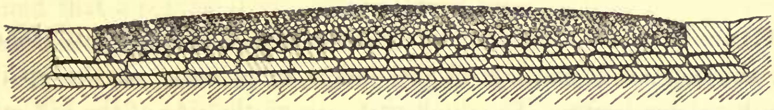


Fig. 18.—Early eighteenth century road.

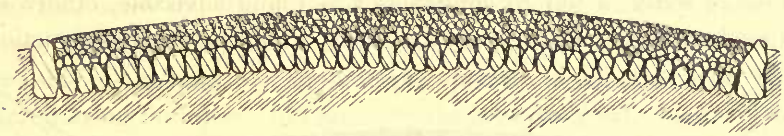


Fig. 19.—Late eighteenth century road.

Fig. 20.—Modern macadam road.

Figs. 17–20 show the relative thickness of old and modern roads.

structed, it is immediately passed into the hands of the parties who maintain it. The roads are divided into twelve-mile sections, and each section is in charge of a foreman, who employs a small gang of men. These men keep the stonework slightly covered with a mixture of gravel and loam, mend slight depressions, keep the gutters cleared out and the wings or earth shoulders free from grass and weeds. These earth wings are ploughed and re-formed when necessary, in order to provide the earth roads with good drainage."

Figures 17-20 show the proportionate thickness of the old and modern roads. In addition to their varied thickness will be noticed the difference in the form of the foundations which are now shaped to conform to that of the finished surface. This important change was introduced by the French engineer Trésaguet about the middle of the last century.

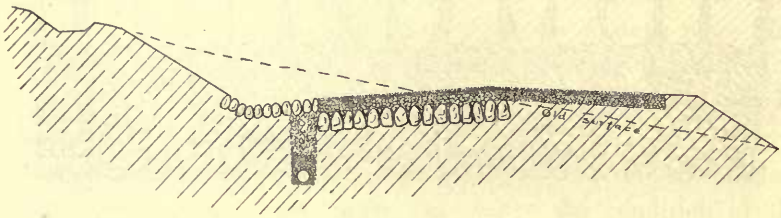


Fig. 21.—Section of road on sidehill with side-drain and telford foundation on up-hill side.

Figure 21 is the cross-section of a road located on a side-hill, showing the method of cutting off the underground water on the up-hill side by under-drains. The ditch part way up the side of the hill cuts off the surface-water from the roadway. When the soil is clayey and holds the water, a telford construction is found advisable, otherwise the road is apt to be thrown by the frost. This form of construction

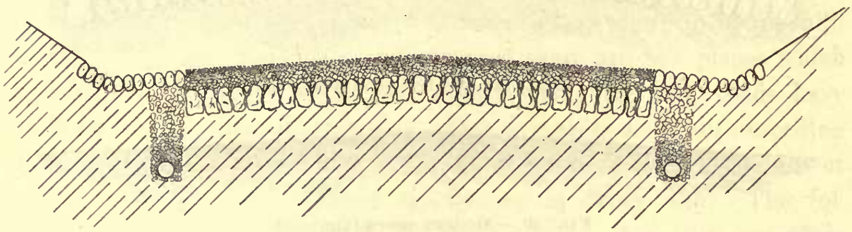


Fig. 22.—Section of a road cut through heavy or soggy soil with telford foundation and side-drains.

is also followed when there has been a cut. Fig. 22 illustrates the method usually followed. The under-drainage is effected by tiling surrounded by broken stone as previously described. If a clay soil, the telford construction is preferable. Where good gravel is at hand this may be substituted for the large foundation stones in the telford construction and is less expensive.

Figures 14-15 show a macadam road in different stages of construction and Fig. 16 shows the telford foundation used on part of the road.

MAINTENANCE.

All roads, whether of dirt, gravel, shell or stone, are alike in one particular. They require constant attention if they are to remain good roads. The well-made stone or gravel road will soon bear marks from the effects of travel and weather. The center of the road is usually the first to give way owing to an extraordinary wear of that particular portion by the traffic which is inclined to follow single lines. This effect is more often produced upon sparsely traveled sections of the road than where there is a large amount of traffic. In the latter instance the constant passing of vehicles causes the travel to leave the center of the road and utilize the sides. It is often found that a comparatively well-traveled piece of road is more easily maintained than a lesser traveled one.

Perhaps the best way to repair, and, at the same time, to throw the travel over the whole roadway is to place finely broken stone or gravel in the horse-track as soon as it is formed. Instead of rolling or tamping this down smooth, allow it to remain on the roadway loose. A horse will naturally turn to one side; those going in one direction to one side of the road, and those in the opposite to the other side, which would bring the wheels to bear upon the loose material which will soon be rolled down. At the same time the travel will have spread over the whole surface, and when this is once well distributed, there is not the same tendency to seek a single track as on a road which bears only the marks of a single track.

A horse-track should not be allowed to form so deeply that any other means is required to efface it than the application of small stone and screenings. If a track is formed to any considerable depth necessitating the use of larger stone, these should be compacted either by rolling or tamping and covered by loose screenings. These will not prove a great inconvenience to vehicles nor demand of them that they perform the service of a steam-roller.

As soon as a depression or hollow is shown in the road-surface by the presence of a pool of water after a rain, the mud should be scraped from the hole and the latter refilled with broken stone or gravel, as the case may be, and thoroughly rolled or tamped to form a uniform, smooth roadway. If such depressions are allowed to go unrepaired the collected water soaks into the road and softens the surface, while the hole rapidly increases by wear, as the bond between the pieces of stone is loosened so that they are easily kicked out by the horses' hoofs. Once begun, this unraveling process goes on at a rapidly-increasing rate. What in the beginning was a small depression, easily repaired with a few shovelfuls of stone, quickly develops into a large-sized hole requiring many times the material and labor to repair it.

The chief cause of the excessive cost in the maintenance of many roads is neglect. The old proverb, that a stitch in time saves nine, is nowhere more applicable. A description of the different systems for maintaining roads in various parts of the world will be found in a subsequent part of this volume.

The cost of maintenance depends in part on the degree with which the hardness of the stone is adapted to the individual road. A certain amount of travel is necessary to the preservation of a macadam road. The other conditions being the same, that piece of road which is well traveled will wear better than one but little used, paradoxical as this may seem. The effect of the travel is to wear away a small amount of the surface, making dust which is rolled and compacted to a cement that keeps the stone firmly imbedded; whereas, if the traffic is very light, there is little dust or binding material furnished, which is not blown or washed away as fast as it is formed. This soon leaves the stones exposed, and the small amount of traffic, instead of compacting them, serves merely to loosen them still further and kick them out. Thus what may be the best material for a well-worn thoroughfare may prove very poor for a lightly-traveled way. If a very hard stone is used where there is light traffic there is an insufficient quantity of dust formed, and the stones become loosened in the manner just described. Whereas, if a softer stone were used the light traffic would be sufficient to supply the quantity of dust necessary to keep the stones thoroughly imbedded. Consequently, in deciding which is the best rock to use, it is necessary to have some information as to the nature of the traffic that the road receives.

Again, the location has a bearing on the kind of stone that had best be used. A certain section of road may be so exposed to winds that a very much larger amount of dust is blown away than upon a more sheltered section. It is thus necessary to supply a large quantity of dust in order to prevent the stones from becoming exposed. This may be effected by using a softer stone. Coarse, sharp sand has also been found very helpful in preventing the blowing away of the dust.[1] It is a fact that a road is sometimes blown away; the action of the wind evidently causing its disintegration.

A great saving to the wear of a stone road is made by having the surface moistened during dry weather, as this keeps the dust compacted between the smaller stones, which are thereby held in place and prevented from being kicked loose.

GRAVEL ROADS.

There are many counties in Maryland where gravel of excellent quality is abundant, and where, at the same time, there is very little stone that is fit for road-construction. The gravel, however, properly applied, will make most excellent roads, far superior to any earth road, and while not possessing the wearing qualities of hard, broken stone, will answer sufficiently well for those country roads that have comparatively light traffic. On roads having very heavy traffic it will be found in the long run to be cheaper even at a very much greater first cost to use a macadam construction owing to the rapid wearing of the gravel road under such circumstances, and the consequently large expenses for maintenance.

A good gravel can almost always be told when inspected as it stands in place in the pit. Whenever it is hard and compact in the bank and requires the use of the pick to loosen it, it will form a hard and compact road. Gravel which contains a small amount of ferruginous clay and has angular, rough fragments of stone, is the best that can be obtained. Gravel mixed with sand or composed of smooth,

[1] The relative value of various stones as road-materials under different conditions is more fully considered on pages 327-330.

rounded fragments of stone does not compact and form a hard, smooth road-surface and is of little use except for general filling. To get the best results from gravel which is formed of various sized fragments it should be screened, all pieces over two inches in size being thrown to one side. There are found in many places gravel deposits which contain few fragments over two inches. Such gravel does not need to be screened, but could be spread upon the road directly from the pit.

The two-inch gravel is spread upon the road-bed to such a depth that, when rolled, it will have a thickness of three to four inches. Over this first course is spread the second course, composed of the smaller gravel, with fragments one inch or less in size. The second course is treated similarly to the first; the rolling is continued until there ceases to be formed any depressions. Whenever depressions are noticed during the rolling, material should immediately be spread upon such places and the rolling continued until the surface is brought up to true grade. The gravel should not be dry when rolled; if furnished dry, it may be sprinkled or the rolling put off until after a rain. The top course should be about three inches thick after rolling.

Usually a gravel road does not become firm and hard until after a considerable time during which it needs constant attention. Each year, however, the road-bed becomes firmer and ultimately nearly as solid as macadam.

SHELL ROADS.

Shells form a hard, smooth road-surface, but one which wears easily and needs frequent resurfacing, wearing many times faster than either gravel or stone. In counties where shells are plentiful they can be obtained at a cost of not over 1½ cents per bushel. A road 15 feet wide requires about 45,000 bushels per mile. They form the only material which has so far been used for improving the surface of the roads over a greater portion of the Eastern Shore.

At present, great waste is occasioned by the unskillful treatment the shell roads receive. From close observation of many miles of shell road in various stages of repair, it is no exaggeration to say that fully one-quarter of the shells applied to the roads at present are wasted by being uselessly ground up before they have become compacted under action of traffic, while many others are pushed to one side and serve no purpose whatever. Another source of waste frequently observed is the shelling of a section of road without filling the mud-holes and shaping the road before spreading the shells. Thus all the hollows which are now filled with shells could as well have been filled with good dirt. Besides, this method causes uneven places to appear in the roadway, since the rain percolates through the shells before they are compacted and settles in the hollows, softening the earth, into which the shells sink under the weight of traffic. In this way mud gradually works up between the shells, and there is formed another mud-hole in the roadway.

As with any road before applying the surfacing, the road-bed for the shell road should be first graded and given the proper cross-section. If there is a wet, springy soil, drains should also be provided. Before the shells are put on, the road-bed should be rolled firm and hard. If over a stiff clay soil which becomes sticky in wet weather and holds moisture, a layer of 3 or 4 inches of sand should be first spread on the clay road. Shells may then be spread, sprinkled with sand, and rolled with a light roller. Experience has shown that the shell roads constructed over a clay soil have broken through more easily than those over a sandy soil. This is a result of the non-drainage of the water which is held in the clay. To assist in compacting the shells, as in the construction of a stone road, a shoulder of earth should be formed at the side to prevent the shells from spreading.

When compacted, the shell road forms an impervious covering and would answer well as a foundation for a thin layer of stone. This construction would be especially applicable to the streets of the Eastern Shore towns where a good macadam pavement would meet every requirement and could be laid on the present shell foundation at a low cost. The method of applying the stone would be, first, to clean the surface of the shell road of mud or dust, as the case might be, then scrape the surface with a road-scraper and thus smooth down the small bunches. The hollows that remain should then be filled in with new shell and rolled until the surface is brought to a true cross-section which would ordinarily require from one-half to one bushel per square yard. When this has been done the road-bed would then be ready for a layer of broken stone. Stone 1½ inches in size, or "No. 2," should be put on to a depth of three inches to obtain a compact layer of about two inches. Rolling should be done with a 10- or 12-ton steam-roller. For a width of twelve feet, a mile of road would require about 590 cubic yards of broken stone as measured in the carts or bins. Fig. 23 shows a cross-section of shell road with stone surfacing.

Stone for this purpose can be obtained from ledges along the banks of the Susquehanna a few miles from its mouth. For a mile or more north of the Baltimore and Ohio Railroad bridge on either side there is an abundance of trap-rock, or gabbro, favorably situated for quarrying. On the west side are steep cliffs of this rock coming

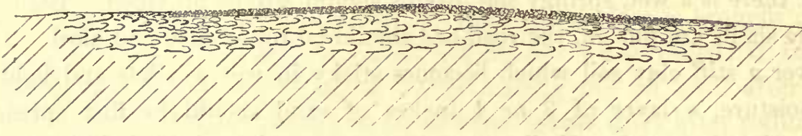


FIG. 23.—Section of old shell road surfaced with a thin layer of broken stone.

down to the old canal. It is possible at many points in this vicinity to set up the crushing machinery so as to quarry the rock from above. Thence it could be run into the crusher and screens and loaded on scows by gravity, the stone requiring but one handling. On the opposite bank on the Cecil county side are many good exposures close to the railroad track. The estimated cost of the broken stone at the crusher is 75 cents per cubic yard. The cost of transportation to different points on the Eastern Shore is about 70 cents per cubic yard. The stone delivered on the roads within two or three miles of a landing would thus cost approximately $2 per cubic yard. The estimated cost of a finished surface of stone over an old shell foundation is from 30 to 40 cents per square yard.

SLAG ROADS.

Considerable quantities of slag are found at the sites of many of the old iron-furnaces located at Muirkirk, Elkridge, Ashton, Harford

Furnace, and other places. Much of this slag is very hard and brittle, with a glassy appearance, and, except for foundations, is of little value as a road-material, and where put upon the roads has been quickly ground to a fine dust. Besides this glassy slag there is some which has more the appearance and character of a limestone, but this is below the average quality of the latter.

The slag from the present iron-furnaces has characteristics very different from that of the old furnaces. Much of it is very light with a sponge-like structure and contains a large amount of lime. When put upon the roads and rolled it compacts very readily and forms an even and smooth surface. The dust from this slag acts in much the same fashion as a cement, and it has been found that roads built from it become harder and harder, and in a short time are practically monoliths, absolutely impervious to moisture. Advantage was taken of this in constructing roads for the Centennial Exposition at Philadelphia. The ground was found to be soft and full of moisture, affording the worst foundation possible for a road. To overcome this difficulty there was first laid a foundation of slag which was rolled and compacted to form a solid mass. On this was built the road proper, which was thoroughly protected from the moisture in the subsoil by the impervious mass of slag. Slag of this nature is found at Sparrow's Point, Baltimore county, where it has been used to some extent on the roads about the steel-works with entire satisfaction.

USE OF BURNT CLAY ON ROADS.

In Illinois and other places in the West where there is at hand no hard material of any kind suitable for road-surfacing, recourse has been had to burnt clay, which is prepared in the following manner: The clay is cut to a depth of about two feet from the roadway during the dryest weather. The chunks of clay are piled so as to make an inclosure some 8 or 10 feet square and allowed to thoroughly dry. Within the inclosure is put dry wood and twigs and the whole covered over with more clay. The wood is then fired and allowed to burn itself out. The hardened clay is then broken in smaller fragments and placed upon the roadway, where it serves as a foundation and prevents traffic cutting through into the soft clay soil during wet weather. This process is an expedient, to be employed in those cases where the excessive cost of other materials absolutely prevents their use. It might, however, be used to some advantage, where the cost of harder materials is high, as a foundation on which to place a thin layer of some better road-metal.

USE OF OIL ON ROADS.

Considerable interest has been taken of late in the use of oil upon roads, and a brief account is here given of the present methods which are as yet somewhat experimental. It has been noticed in oil regions and in machine-shop yards that where the ground has become impregnated with oil, little or no dust arises, and that water does not soak into the ground. Advantage has been taken of this fact by railroads for reducing the dust raised by the trains. To effect this the road-bed between the tracks and a few feet outside is sprinkled with crude petroleum. This was first tried by the Florida East Coast Railroad, between Jacksonville and St. Augustine, and has since been very extensively used by the Pennsylvania Railroad with complete success.

The use of oil has recently been extended to ordinary country roads. In applying the oil it must be thoroughly mixed with the dust. If it is merely sprinkled on the surface only the top layer of dust will be impregnated; the wheels of vehicles will break up the cake thus formed, exposing the dust below, and the road will be more disagreeable than ever. Oil put on a hard road to prevent the formation of dust remains on the surface and is very objectionable. A practical process has been patented[1] in which there is mixed a high-test, heavy, crude oil with maltha, a mineral pitch. The compound is spread upon the road in parallel lines about six inches apart in sufficient quantity to saturate the dry dust with which it is subsequently thoroughly incorporated by the use of rakes. Seven and a half gallons are required to a square rod if the dust is a half inch thick. Water is then sprinkled upon the surface and the road thoroughly rolled; it is then ready for travel.

The objects which it is considered are gained by this treatment

[1] By Frederick W. Mattern, of Los Angeles, California.

are a dustless road, a non-absorbent surface, which will turn off rain-water, and a dark-colored road-bed, which is more pleasing to the eye than the ordinary light, dusty soils. A further advantage gained from a dustless road, of considerable importance to fruit-growers, is the prevention of dust upon fruits.

As stated by Mr. Mattern, this process is especially applicable to those sections of country subject to long dry periods, where the dust renders travel upon the roads most disagreeable and utterly precludes pleasure travel. In addition to this, as the surface is rendered impervious to water the absorption of the latter by the subsoil and the consequent cutting up of the road are thus prevented.

Another important use of oil in the construction of roads would seem to lie in applying it to the foundation of macadam roads, with a view to preventing the holding of water by the road-bed. For example, in heavy clay soil, instead of putting in an expensive telford construction as a protection to the macadam surface, a layer of oil-soaked soil might be substituted. The road-bed might be shaped in the usual way, and before it had been rolled might be saturated with oil. Over this a layer of dry earth might be sprinkled and the whole then rolled and brought to a true cross-section. This would prevent moisture from penetrating that portion of the road-bed and thus keep it in such a firm and solid shape that it would support all loads that might come upon it.

As already mentioned, a macadam road wears faster, other things being equal, when the surface is dry than when it is moistened sufficiently to have the dust act as a binder for the surface stones. If this could be accomplished by treatment with some mixture of heavy oils, a great saving would be gained in the maintenance of stone roads, for the dust would be permanently laid and would not blow away as soon as formed, leaving the stones unprotected and easily kicked loose.

With such a large and useful field for the application of oil in the construction of roads unexplored, the results of careful experiments would be particularly valuable.

Broad Tires.

It is generally admitted that broad tires are an advantage to the roads, but it is not generally recognized that they also benefit those using them. Conclusive evidence on this point is furnished by the experiments which have been carried on at the Missouri Agricultural Experiment Station. These experiments were made between January, 1896, and September, 1897, and include all the various conditions due to the seasons. Tests were made over wet and dry macadam, gravel, and various kinds of dirt roads, and every care was exercised to make the results of one set of experiments comparable with those of another. This series is the most exhaustive and reliable that has been made in this country.

The following extract, from a full account published in Bulletin No. 39 of the Missouri Agricultural Experiment Station, gives a complete summary of the results of the experiments:

"The draft has been determined by means of a self-recording dynamometer. The net load was in every trial the same, viz., 2000 pounds. Contrary to public expectation, in a large majority of cases the draft was materially less when tires six inches in width were used than when the tests were made with tires of standard width—1½ inches. The following is a summary of the results:

"I. On macadam street. As an average of the two trials made, a load of 2518 pounds could have been hauled on the broad tires with the same draft that a load of 2000 pounds required on the narrow tires.

"II. Gravel Road. In all conditions of the gravel road, except wet and sloppy on top, the draft on the broad-tired wagon was very much less than that of the narrow-tired wagon. Averaging the six trials, a load of 2482 pounds could be hauled on the broad tires with the same draft required for a load of 2000 pounds on the narrow tires.

"III. Dirt Roads. (a). When dry, hard, and free from ruts and dust, 2530 pounds could have been hauled on the broad tires with the same draft required for 2000 pounds on the narrow tires. (b). When the surface was covered with two or three inches of very dry, loose dust, the results were unfavorable to the broad tire. The dust on the road in each of these trials was unusually deep. (c). On clay road, muddy and sticky on the surface and firm underneath, the results were uniformly unfavorable to the broad tires. (d). On clay road, with mud deep, and drying on top, or dry on top and spongy underneath, a large number of tests showed uniformly favorable to the broad tire. The difference amounted to from 52 to 61 per cent, or about 3200 pounds could have been hauled on the broad tires with the same draft required to draw 2000 pounds on the narrow tires. In this condition of road the broad tires show to their greatest advantage. As the road dries and becomes firmer, the difference between the draft of the broad and narrow tires gradually diminishes until it reaches about 25 to 30 per cent on dry, hard, smooth dirt, gravel or macadam road, in favor of the broad tire. On the other hand, as the mud becomes softer and deeper, the difference between the draft of the two types of wagons rapidly diminishes until the condition is reached when the mud adheres to both sets of wheels; here the advantage of the broad tires ceases entirely, and the narrow tires pull materially lighter. (e). Clay road, surface dry, with deep ruts cut by the narrow tires in the ordinary use of the road. In every trial the first run of the broad tire over the narrow-tire ruts has shown a materially increased draft when compared with that of the narrow tire run in its own rut. The second run of the broad tires in the same track where the rut is not deep completely eliminated the disadvantage, and showed a lighter draft for the broad tire than the narrow tire showed in the first run. Where the ruts were eight inches deep with rigid walls, three runs of the broad tire in its own track over the ruts were required to eliminate the disadvantage. Three runs of the broad tire over this track have in all cases been sufficient, however, to so improve the road-surface that both the broad- and narrow-tired wagons passed over this road with less draft than the narrow tires did in the original ruts. In addition to the saving of the draft, the road was made very much more comfortable and pleasant for the users of light vehicles and pleasure carriages by the few runs of the six-inch tire. Summing up all the tests on dirt roads, it appears that there are but three conditions on which the broad tires draw heavier than the narrow tires, viz.: (1) when the road is sloppy, muddy or sticky on the surface and firm or hard underneath; (2) when the surface is covered with a very deep loose dust and hard underneath; (3) when the mud is very deep and so sticky that it adheres to the wheels of both kinds of wagons. It appears that the dust must be extraordinarily deep to show a higher draft for the broad than for the narrow tires. The three conditions just named, therefore, are somewhat unusual and of comparatively short duration. Through a majority of days in the year and at times when the dirt roads are most used and when their use is most imperative, the broad-tired wagons pull materially lighter than the narrow-tired wagons.

" IV. A large number of tests on meadows, pastures, stubble-land, corn ground, and ploughed ground in every condition, from dry, hard and firm to very wet and soft, show without a single exception a large difference in draft in favor of the broad tires. This difference ranged from 17 to 120 per cent.

" V. It appears that six inches is the best width of tire for a combination farm- and road-wagon, and that both axles should be the same length so that the front and hind wheels will run in the same track."

There are very few tires as wide as six inches in use in Maryland, though four-inch tires are very common in those counties having a large number of toll-roads. This is explained by the fact that one-half rates are allowed by the turnpike companies on all wide-tired wagons. This is so forcible an argument for their adoption that there are very few narrow-tired farm-wagons in the vicinity of the turnpikes.[1]

[1] For the proportion of wide tires in use in various sections, see account under the different counties.

The reason for their use in all sections is equally strong, but has not been so apparent to most farmers. There is, however, a growing sentiment in favor of wide tires, as is well shown from the answers made to the inquiries about them. A number of farmers stated that although they did not use them, they ought to do so, and in future would provide their wagons with them.

Maps of Roads.

A very convenient and useful addition to the County Commissioners' office is an accurate and well-drawn map of the county. On it should be shown the natural drainage-system, lakes, rivers, etc.; political boundaries of districts, towns, roads, canals, railroads, houses, and, in a general way, property lines as are generally given on good atlas sheets. In addition, conventional signs should indicate certain details concerning the county roads, such as the distance between forks or cross-roads, the width of roads between fences, the width of the traveled portion at frequent intervals, and the material from which the roadway is formed. The size and location of all culverts and drains should be given, and also the general character of the bridges, their span, width, roadway and the material of which their abutments are built.

The scale required to show the features outlined above with sufficient detail need not be larger than four inches to the mile. If it was found that by the use of this scale too unwieldy a map would result, in such case it could be made in sections of convenient size. The object of such a chart would be to afford a ready means of recording the changes that are made upon the roads in such a manner that the progress and location of improvements could be seen at a glance. It would be a simple matter to have some system whereby there could be shown the various changes which are made. In those counties which have been covered by the United States Geological Survey the cost of maps suitable for this purpose would be confined principally to the drawing of the map itself and verifying the detail of the topographic map. In those sections not covered by topographic maps considerable additional expense would be incurred owing to the surveys that would be necessary for mapping in the various features. The general plan of streets within corporate limits of cities and towns could be shown on the map, but owing to the comparatively small scale it would be impossible to show in many instances much detail. There should be, and generally are, maps on a much larger scale for this purpose.

Tools and Machinery.

While the success of any particular class of work depends in no small degree upon the use of proper tools and machinery, the amount of improved road-machinery owned within the state is so very small that only a very few communities have the benefits of such an essential piece of machinery as a road-roller. Before good roads can be made the community must be supplied with the requisite implements.

The following is a brief list of some of the common tools and machinery employed in road-construction, together with the cost so far as can be ascertained. The prices quoted are taken from the price-lists and catalogues of some of the larger manufacturers, and vary according to quantity purchased and the condition of the market. As a rule, they can be obtained at a discount from the price-list, if payment is made within thirty or sixty days.

Those having in charge the purchase of road-machinery would do well to write to the different makers for terms, stating in their letter as near as possible exactly what is wanted and the work to be done.

	Price per doz.
Bush Hooks (handled)	$17.00
Bill Hooks	19.00
Axes	12.00
Axes (handled)	15.50
Mattocks, cutters (without handles)	14.50
Mattocks, picks	14.50
Handles	$1.45 to 3.20

In opening a new road it is necessary to clear the road-bed of trees, brush, roots and other material which would hinder the excavation. For this purpose a number of different forms of axes, bush-hooks and picks are manufactured. Large stumps are best taken out by blasting-powder. There are many labor-saving devices employed in grading a road-bed or removing earth, rock or other materials, but where the work is light, as is more often the case in grading the ordinary country road, the most economical method of transporting materials from the cuts to the embankments is either by drags, wheel-scoops or carts. Occasionally there may arise conditions which would warrant the building of a temporary track over which to run dump-cars, hauled either by horse-power or contractors' locomotives. For light grading and shaping the road-bed, where the soil is free from large boulders and stumps, the work is much facilitated by the use of ploughs and road-machines or scrapers.

If the amount of rock excavation is considerable at any one place, holes for the powder are made with a steam-drill, but where there is a small amount of rock to be removed at any one place, so much time would be lost in moving the steam-drill equipment from point to point, it is cheaper to drill the holes by hand. The kind and amount of powder is selected according to the amount and kind of rock to be blasted. Hard and fine-grained rocks require different treatment from soft, shaly rocks.

Ploughs for tearing up an old road-surface and general grading are made extra heavy and strong and require from two to eight horses according to the character of the ground ploughed. They are furnished either with wooden or iron beams. Prices range from $13.75 for plain, heavy, swivel road-ploughs to $35 for heavy ditch-ploughs provided with wheel and cutter.

Road-machines or road-graders are designed to cut the earth from one portion of the road and carry it to another portion. They are of use in scraping loose and worn-out materials from the road-bed and in reshaping and crowning the roadway. The formation of a road-bed for new roads previous to rolling is much facilitated by the use of these machines. Side-ditches and gutters are also made by them. They perform with the aid of 3 men and from 2 to 14 horses the work of from 30 to 40 men working with hand-tools.

The main feature of these machines is a steel or iron blade 6 to 8 feet long which is attached to a frame carried upon 4 wheels. The blade is adjustable; can be set at any desired angle and dipped so that any slope desired can be given to the road-bed. The mechanism and different adjustments possible, vary somewhat in machines of different makes.

Road-machines should be as light as is consistent with the requisite strength necessary in construction, thus saving frequent repairs and loss of time from break-downs. They should be of as light draft as possible, that they may be hauled by a small number of horses. The prices of these road-machines vary from $150 to $250. Figure 24 shows one of these machines.

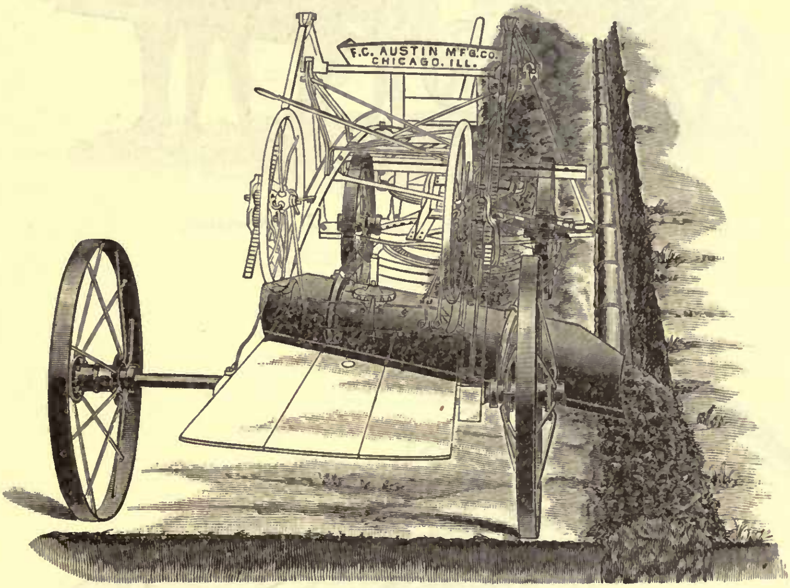


FIG. 24.—Road-machine or grader refilling earth over pipe drain.

The old-fashioned method of breaking stone has been supplanted by the use of various forms of stone-crushers. In preparing crushed stone for a road-bed the stone first has to be quarried and broken to such a size as will go in the crusher, from which it is automatically sorted in sizes by screens, when it is ready for delivery upon the road. The fewer the times it is necessary to handle the stone and the shorter the distance it is necessary to haul it, the cheaper can it be furnished. Where the supply of stone lies scattered on the surface along the roadway the most economical way is to use one of the various forms of portable plants. The crusher is set up temporarily and enough stone is crushed to supply about two miles of road. Then the plant is removed to another point and an amount of stone sufficient for

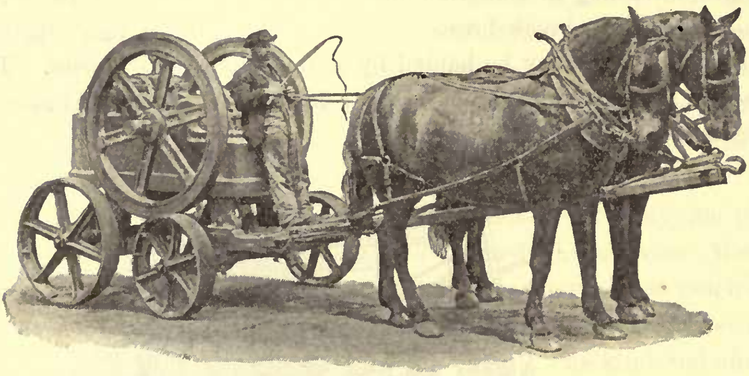


FIG. 25.—One form of portable stone-crusher.

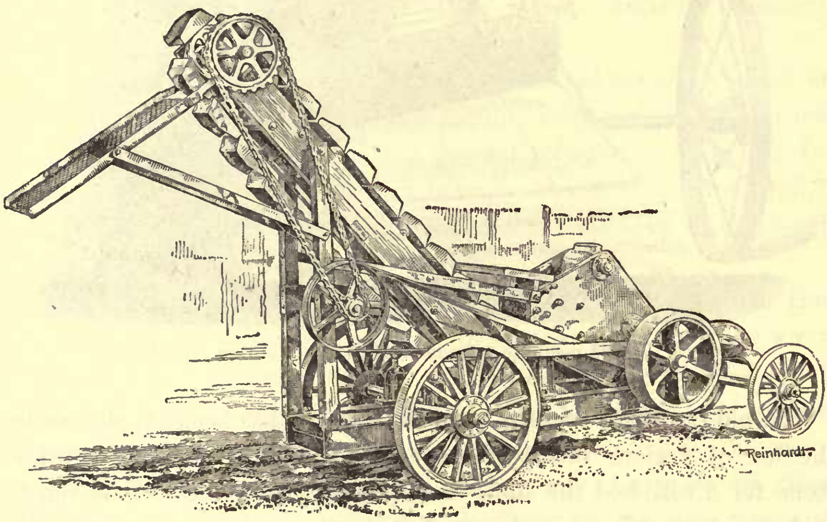


FIG. 26.—Portable form of combined crusher, elevator and screen.

another section is crushed. As a general thing, however, the supply of stone will be found more readily available at some particular place, so that it would be necessary to haul stone a somewhat longer distance than would otherwise be the case. Figure 25 shows a type of portable crusher whose capacity varies from seventy-five tons per day of ten hours to two hundred and ninety-five tons, requiring five to fifteen horse-power respectively. Prices are from $450 to $1,050. Other forms of crusher include not only the crusher, but an elevator for carrying the crushed stone from the crusher to the automatic screen from which it falls into the bins and thence to the carts. Such an arrangement is shown in Figure 26.

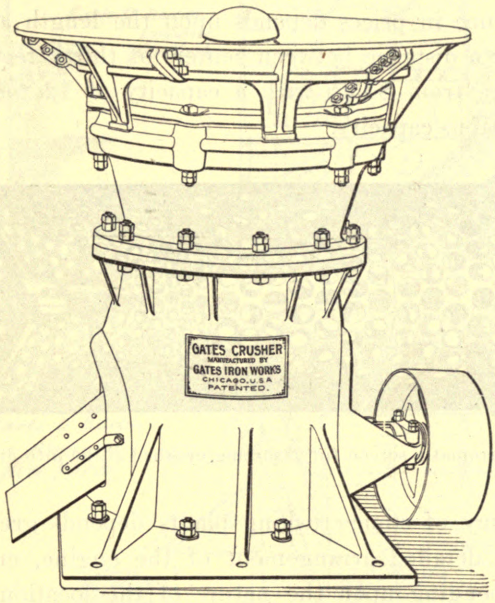


FIG. 27.—Rotary stone-crusher.

Each of the crushers shown in Figures 25-26 is of the jaw pattern, as are all the forms of crushers manufactured with the exception of the Gates crusher. This crusher is shown in Fig. 27, and is provided with a conical opening within which is a movable center steel core, which revolves eccentrically with respect to the outer shell. As the center core revolves it approaches and recedes from the sides of the outer shell, and the stone coming between the moving surfaces is crushed.

The automatic screens for sorting the crushed stone into the various sizes are shown in Figure 28. The different screens upon the market are of the same general design, differing only in material used in their construction and minor details of arrangement. Prices vary according to the size, from $275 for a 10 ft. 6 in. screen in three sections, to $950 for a 15 ft. 6 in. screen, corresponding diameters being 24 inches and 54 inches. The usual arrangement for conveying stone as it comes from the crusher to the screen consists of a number of steel buckets mounted upon a flexible belt.

The difference in prices depends upon the length and size of the buckets. For a distance between centers of thirty feet the prices of elevators range from $455, with a capacity of 12 tons per day, to $1,000 for 15 tons capacity.

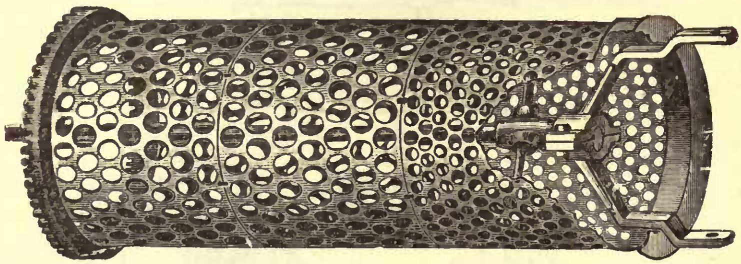


FIG. 28.—Automatic screen for assorting crushed stone into different sizes.

The efficiency of stone-crushing plants depends greatly upon the "set-up," the detailed arrangement of the engine, crusher, screen, bins, etc., depending upon the nature of the location, whether the rock is gathered from the side of a hill or from the level ground. Figures 29 and 30 show in outline the general arrangement for side-hill and level locations respectively.

COST OF CRUSHING STONE.

The following account of the cost of crushing stone, taken from the report for 1891 of the City Engineer of Newton, Mass., shows in detail the part of the total cost each item bears. The prices for labor are seen to be about 75 per cent more than is paid in Maryland, allowing for the difference between a nine- and ten-hour day. As about 75 per cent of the cost for breaking stone is for labor, the cost of crushing stone in Maryland would therefore be about one-third less than the cost as given in the following table. It will be noticed that the cost of breaking field stone is about two-fifths that of crushing stone from a ledge. Thus three-fifths of the cost of crushing stone is for quarrying.

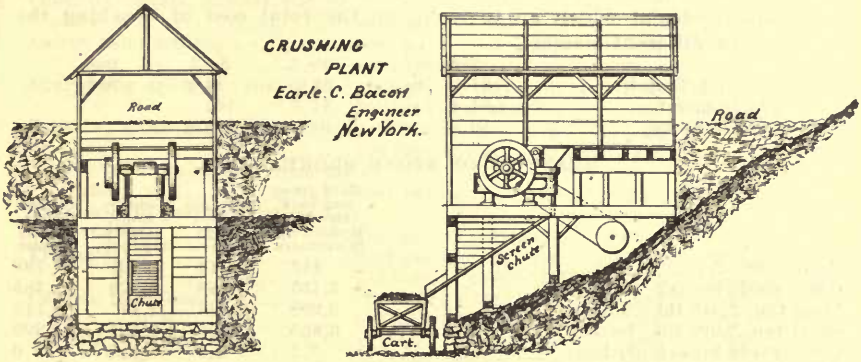


FIG. 29.—General arrangement of a crushing plant on sidehill location.

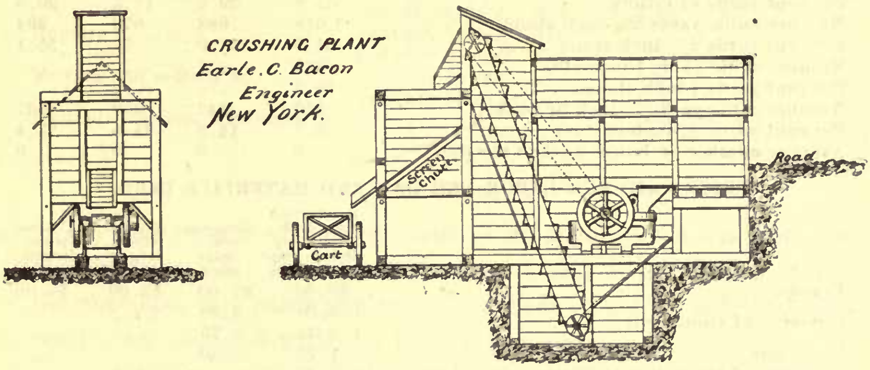


FIG. 30.—General arrangement of crushing plant on level ground.

" The stone-breaking plant consists of one stationary and one portable Farrel, Marsdon 9 x 15 stone-breaker, operated respectively by one Atlas engine with horizontal boiler, and one portable Lidgerwood double cylinder engine with vertical boiler. The stationary plant is placed near a ledge of hard green trap stone. The stone is drilled with a Rand Steam Drill and blasted with forcite powder.

" The drill is operated by steam from a separate boiler; the stone is broken to a size to go in the breaker by hand-drilling or with sledge hammers, and taken by horse and cart to the breaker a distance of 500 feet, and delivered on a platform level with the top of the hopper.

"It is fed into the hopper by two laborers. From the breaker the stone is delivered in four sizes into bins through revolving cylinders with casing of perforated boiler iron. The first is what is known as dust; second, one inch; third, two and a half-inch stone; fourth, tailings that have passed by the meshes and out at the end of the cylinder.

"The following is a record in detail of the cost of the various items of labor and material which go to make up the total cost of breaking the stone of the different classes."

	Tailings.	No. 3.	No. 2.	Dust.
Greenish Trap-Rock	91.0 lbs.	88¼	84⅛	95¾
Conglomerate	94.4 "	87.7	101	
Cobble Stone	99.6 "	98	102½	

QUANTITY OF STONE BROKEN.

	Hard green trap-rock resembling Hudson trap in hardness.	Conglomerate ledge stone.	Cobble-stone, largely trap-rock.	Cobble-stone largely granite.
Hours run	412	144	101	198
Cubic yards broken	3,155	1,288	1,178	1,785
Long ton, 2,240 lbs., broken	3,998	1,446	1,417	2,142
Short ton, 2,000 lbs., broken	3,805	1,620	1,587	2,399
Cubic yards broken per hour	7.7	8.9	11.8	9.0
Long ton broken per hour	8.2	10.0	14.0	10.8
Short ton broken per hour	9.0	11.2	15.7	12.1
Number cubic yards of tailings	1,004	378	205	365
Per cent yards of tailings	31.8	29.3	17.5	20.5
Number cubic yards 2½-inch stone	1,618	688	672	994
Per cent yards 2½-inch stone	51.3	51.9	57	55.1
Number cubic yards 1-inch stone	323	....	....	....
Per cent yards 1-inch stone	10.2	....	....	....
Number cubic yards ½-inch or dust	210	242	300	427
Per cent yards ½-inch or dust	6.7	18.8	25.5	23.4
Average number of hours worked per day	9	9	9	9

PRICE PAID FOR LABOR PER DAY AND MATERIALS USED.

	Hard green trap-rock resembling Hudson trap in hardness.	Conglomerate ledge stone.	Cobble-stone, largely trap-rock.	Cobble-stone, largely granite.
Foreman	$3.00	$3.00	$3.00	$3.00
Operator of stone drill	3.00 1.75	3.00 1.75	....	....
Ledgeman	1.75	1.50	....	....
Engineer of the boiler operating stone drill	2.25	....	....	....
Engineer of the boiler operating stone-breaker	2.00	2.25	2.00	2.50
Blacksmith	2.50	2.25	....	....
Watchman	....	1.75	1.75	1.75
Common laborer	1.75	1.50	1.50	1.75
Water boy	....	1.00	1.25	....
Two one-horse carts and one driver	5.00	5.00	....	....
Coal per ton, 2,000 lbs	5.25	5.25	5.25	5.50
Oil per gallon	.65 .15	.65 .15	.65 .15	.65 .15
Powder per box, 50 lbs	11.34	11.34	11.34	....
Waste per pound	9½	9½	9½	9½
Cost per cubic yard, stone in bin or crusher	.898	1.113	.445	.447
Cost per long ton	.834	.991	.37	.372
Cost per short ton	.745	.885	.33	.332

COST AND PER CENT OF WHOLE COST OF UNITS OF LABOR AND MATERIAL.

		Hard green trap-rock resembling Hudson trap in hardness.	Conglomerate ledge stone.	Cobble-stone, largely trap-rock.	Cobble-stone, largely granite.
Labor, steam drilling	cost per cu. yd.	.092	....	....	....
" "	per cent of cost	10.3	....	....	....
Coal, oil, waste, powder and repairs	cost per cu. yd.	.084	.018	....	....
Coal, oil, waste, powder and repairs	per cent of cost	9.4	1.6	....	....
Labor, hand-drilling	cost per cu. yd.	....	.249	....	....
" "	per cent of cost	....	22.3	....	....
Sharpening drills and tools	cost per cu. yd.	.069	.023	....	....
" "	per cent of cost	7.7	2.1	....	....
Breaking stone for crusher	cost per cu. yd.	.279	.42	....	....
" "	per cent of cost	31	37.8	....	....
Total cost of preparing stone for crusher	cost per cu. yd.	.525	.681	....	....
Total cost of preparing stone for crusher	per cent of cost	58.4	61.9	....	....
Filling carts	cost per cu. yd.	.098	.127	Wheel-	.144
" "	per cent of cost	11	11.4	barrows.	32.4
Carting to crusher	cost per cu. yd.	.072	.062	.314	.098
" "	per cent of cost	8	5.6	70.6	22
Feeding crusher	cost per cu. yd.	.053	.053	.033	.065
" "	per cent of cost	5.9	4.7	7.4	14.5
Engineer of crusher	cost per cu. yd.	.031	.038	.029	.036
" "	per cent of cost	3.4	3.5	6.5	8
Coal, oil and waste	cost per cu. yd.	.079	.05	.047	.044
" " "	per cent of cost	8.8	4.5	10.1	9.9
Repairs	cost per cu. yd.	.041	....	....	.011
"	per cent of cost	4.5	....	....	2.4
Moving and setting up	cost per cu. yd.	....	.023	....	.019
" "	per cent of cost	....	2.1	....	4.2
Portable crusher, watchman		....	4.4	5.4	6.6

ROLLERS.

The importance of rolling roads of all descriptions has been previously discussed. For light rolling, such as is required in preparing the road-bed, dirt roads and macadam made of softer materials, good results are obtained with the horse-roller.

A convenient pattern of this type is shown in Figure 31. This has a counterbalanced, swinging tongue, so that it is not necessary to turn about the roller itself in order to retraverse a portion of the work. No roller should be employed that must be turned about. The market offers rollers of different styles and of weights varying from 4 to 8 tons, which cost about $100 per ton.

Except on a very level road, so many horses are required to pull the heavier rollers that the cost of rolling is much more than steam-

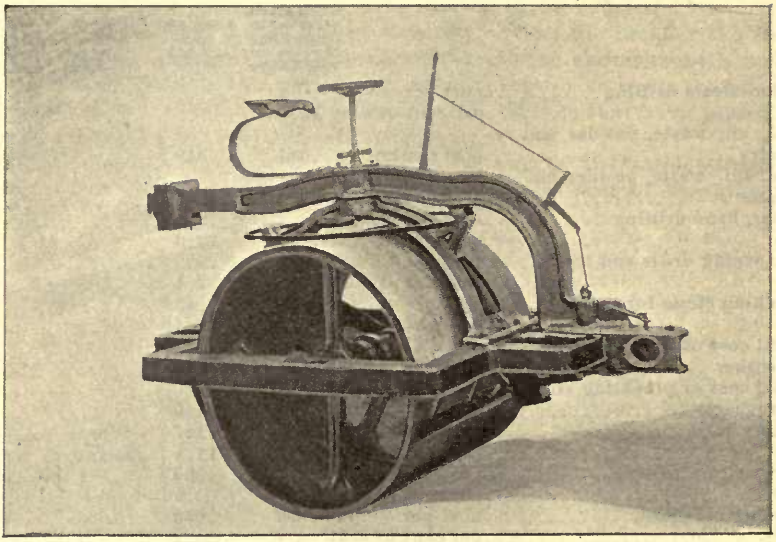


Fig. 31.—Reversible horse-roller.

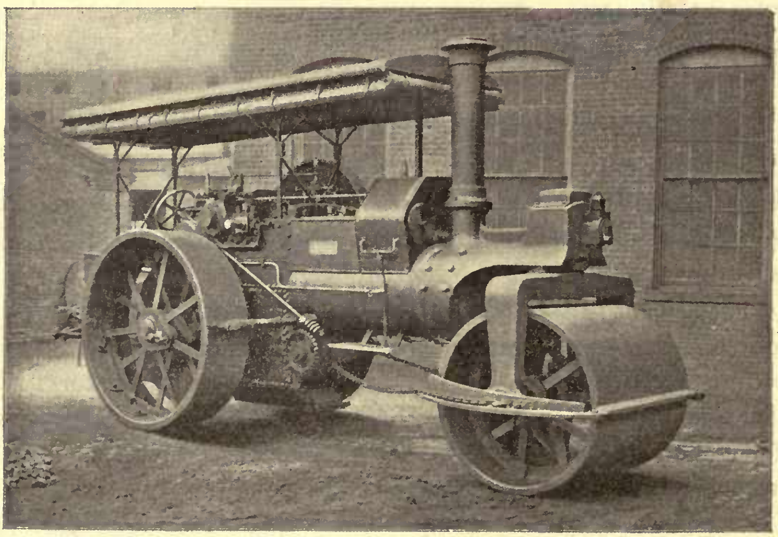


Fig. 32.—Steam road-roller.

rolling. Besides, for most macadam work the heavier roller would be required and better results can be obtained with a steam-roller. For all road-work a 12-ton roller will be found the most convenient. The weights range from 10 to 20 tons, but the ones in most general use are of the lighter kind. The pressure for each inch of breadth of a 10-ton roller is 450 pounds and of the 12-ton roller about 550 pounds. The extreme widths of the different makes vary somewhat, the average being about 85 inches for a 12-ton roller. Figure 32 shows one of these machines.

Prices of different makes of steam-rollers vary considerably, ranging from $3,000 to $5,000. If more than one machine is ordered at a time substantial discounts can be obtained.

Highway Literature.

For the benefit of engineers and those wishing reference to standard works on highways and their construction, the following list has been compiled. It makes no pretence to completeness:

Historical.

Bloodgood, S. A. Treatise on Roads. Albany, 1838.

Macadam, John Loudon. Remarks on the present System of Road Making. London, 1822.

Parnell, Sir Henry. Treatise on Roads. London, 1833.

Searight, T. B. The Old Pike, Uniontown, Pa., 1894.

Construction and Maintenance.

Bernard, H. Etudes des Differents Gervies de Pavages. Gérardin & Nicolle. Nancy, 1898.

Byrne, A. T. A Treatise on Highway Construction. John Wiley & Sons, New York, 1897.

Codrington, Thos. Maintenance of Macadamized Roads. E. & F. N. Spon, London, 2nd Edit., 1892.

Durand-Claye, C. L. Cours de Routes. Baudry et Cie., Paris, 1895.

Gillmore, Q. A. Roads, Streets and Pavements. D. Van Nostrand & Co., New York, 1876.

Gillespie, W. M. Roads and Railroads. New York, 1847.

Grant, W. H. The Roads of Central Park. [Gravel Roads] Jour. Franklin Inst., vols. lxxxiii-lxxxiv, Philadelphia.

Herschel, C. Science of Road Making. Wright & Potter, Boston, 1870. Reprinted by Engineering News & Publishing Co., 1877.

Law, Henry, and Clark, D. K. Roads and Streets. Crosby, Lockwood & Co., London, 1877.

Love, E. G. [comp.] Pavements and Roads. The Engin. & Bldg. Record Co., New York, 1890.

Meyer, Gustav, and v. Willmann, L. [edit.]. Handbuch der Ingenieurwissenschaften. 4 vols. Vol. I, in two parts, treats of road-construction. Engelmann, Leipsig, 1897-98.

North, E. P. Construction and Maintenance of Roads. Trans. Amer. Soc. Civ. Eng., 1879.

Owen, James. The Controverted Question in Road Construction. Trans. Amer. Soc. Civ. Eng., 1892.

Rockwell, A. P. Road and Pavements in France. John Wiley & Sons, New York, 1896.

Shaler, N. S. American Highways. The Century Co., New York, 1896. [A general discussion of American highways.]

Spalding, F. P. Roads and Pavements. John Wiley & Sons, New York, 1898.

ADMINISTRATION.

Angell, J. K., and Durfee, T. A Treatise on the Law of Highways. Little, Brown & Co., Boston, 3rd Edit., 1896.

Bavier, S. Die Strassen der Schweiz. Ordell Füssli & Co., Zurich, 1878.

Elliott, B. K. and W. F. The Laws of Roads and Streets. The Bowen-Merrill Co., Indianapolis, 1890.

Henry, Ernest. Traité des Chemins Vicinaux. Baudry et Cie., Paris, 1897.

Jenks, J. W. Road Legislation for the American State. Amer. Economic Assoc., Publ., Baltimore, 1889.

Neff, F. H. French Roads, their Administration, Construction and Maintenance. Jour. of Assoc. of Eng. Soc., 1892.

Potter, B. W. The Road and the Roadside. Little, Brown & Co., Boston, 1886.

Sax, Emil. Die Verkerstnittel in Volks- und Staatswirthschaft. 2 vols. Vol. I. Land- und Wasserweger. Vienna, 1878-9.

Sax, Emil. Nausport und Communicationswesen. Handbuch der Politischen Oekonomie. Tübingen, 1882.

Stone, Roy. New Roads and Road Laws. D. Van Nostrand & Co., New York, 1894.

Williams, Henry W., Chairman. Report of the Committee of the Maryland Road League, 1893. Bulletin No. 1 of the Office of Road Inquiry., Dept. of Agri., Washington, 1894.

OFFICIAL REPORTS.

California. Department of Highways. Bulletins and Reports.

Connecticut. Reports of the Highway Commissioner. New Haven.

Massachusetts. Reports of the Highway Commission. Boston.

Ministère des Travaux Publics. Annales des Ponts et Chausées. Paris, 1831- .

Ministère des Travaux Publics. Détermination Directe de la Qualité des Matériaux d'Entretien. Paris, 1880.

Ministère des Travaux Publics. Etat Itinéraires des Routes Nationales. Paris, 1889.

New Jersey. Reports of the Commissioner of Public Roads. Trenton.

New York. Good Roads, Report of Special Committee to the Legislature. Albany, 1896.

New York. Highway Manual of the State of New York. Albany, 1898.

New York, State Engineer and Surveyor, Bulletins of the office of. Albany.

New York State Museum, Bulletin of. Vol. iv, No. 17. Road-Materials and Road-building in New York. Albany, 1897.

North Carolina Geol. Surv. Economic Papers, No. 2. Some Road Legislation in North Carolina, J. A. Holmes. Raleigh, 1899.

Rhode Island. Reports of the Commissioner of Highways. Providence.

U. S. Dept. of Agriculture. Office of Road Inquiry. Bulletins and circulars. Washington.

U. S. Dept. of Agriculture. Year Books. Washington.

U. S. Dept. of State. Special Consular Reports. Streets and Highways in Foreign Countries. Washington, 1891. Reissued with supplements, 1897.

U. S. Geol. Survey. 15th Ann. Rept. 1893-4. Preliminary report on the Geology of the Common Roads of the United States, N. S. Shaler. Washington, 1895.

U. S. Geol. Survey. 16th Ann. Rept. 1894-5. Part II. Geology of the Road-building stones of Massachusetts with some Considerations of similar Materials from other parts of the United States, N. S. Shaler. Washington, 1895.

JOURNALS.

American Society of Civil Engineers, Transactions of. New York.

Association of Civil Engineers, Journal of. London.

Engineering and Building Record. New York.

Engineering News. New York.

Franklin Institute, Journal of. Philadelphia.

Good Roads. League of American Wheelmen. Boston.

Massachusetts Highway Association, Journal of (discontinued).

Municipal and Sanitary Engineers and Surveyors of Great Britain, Proceedings of. London.

Paving and Municipal Engineering. Indianapolis.

Van Nostrand's Magazine. New York.

PART VI

QUALITIES OF GOOD ROAD-METALS AND THE METHODS OF TESTING THEM

BY

HARRY FIELDING REID

QUALITIES OF GOOD ROAD-METALS AND THE METHODS OF TESTING THEM.

BY

HARRY FIELDING REID

INTRODUCTION.

The essential qualities of a good road-surface are hardness and smoothness at all times; its first cost should not be too great, and the annual expense of maintenance should be as small as possible. These qualities are obtained by two methods: first, by proper construction; second, by the selection of a good road-metal; and it is a matter of very great importance to determine before making the road what is the best available material to use on its surface. The methods of construction have already been given and the means of selecting the right material will now engage our attention.

Forces to be Withstood by a Road-metal.

The forces at work tending to destroy roads must first be considered in order to see what qualities the stone must have to resist them.[1] These forces may be divided into two groups: I, the wear and tear of travel; II, the forces of nature.

I. The travel on a road tends to wear it out in several ways: (1) by the blows of the horses' feet; (2) by the blows of the wheels, for no road is so smooth that the wheels do not at times strike against, and at times fall from, slight projections and thus produce blows against the road; (3) by the action of the horses' feet in pulling or holding

[1] An interesting article on this subject has been written by Mr. C. L. Whittle in Circ. 29, of the Office of Road Inquiry, United States Department of Agriculture.

back, tending to pull the stones out of place; (4) by friction of the wheels, especially when brakes are used; and (5) by the pressure on the road due to the weight of the vehicle and of the horses. It is evident that some of these causes (3, 4) tend to destroy the general cohesion of the road and to loosen the stones; others (1, 2, 4) tend to break up the pieces of stone themselves into smaller particles and to grind them into dust; the effect of pressure (5) is probably beneficial to a well-made stone road as it tends to consolidate it; but a soft road, or one with too thin a stone covering, is terribly cut up by the pressure of the wheels.

II. Natural forces are extremely important causes of the destruction of roads. They are: (1) Heavy rains, which tend to wash the road; (2) Winds, which tend to sweep away all the fine material ground up by the travel instead of allowing it to become consolidated again with the mass of the road; they are especially effective during long droughts when the roads become very dry.[1] (3) In addition to the washing effects of heavy rains, which can be largely obviated by the proper shaping of the road to allow the water to run rapidly off, there is the solution of the rock, and also the general chemical decomposition.[2] But it is probable that the wear of the road-metal by travel is so much greater than the action of decomposition or solution that we may neglect these agents. (4) Great changes of temperature. They produce contractions and expansions of the rock, which in extreme cases must break the bonds holding together the broken stone, and thus unravel the road. The last three agents (3, 4), however, have not been thoroughly investigated by observation, and we may leave them until our knowledge is greater. (5) Frost. The destruction of a road-bed by the heaving action of frost and the subsequent breaking up when the thaw comes on are too familiar to every one in the state to require special description. It is one of the greatest destroyers of roads without dry foundations.

In order to resist these various agents of destruction the stone of the road-surface must be so hard and tough that it will not be readily

[1] A discussion of the climate of Maryland and its relations to the roads will be found in the first part of this volume.

[2] Mr. Whittle has carefully considered these two actions.

broken or ground into small particles; the separate stones must be so firmly held together that they cannot be easily knocked out of place; and they must become so consolidated that all water will run off the surface of the road, and the foundation be kept perfectly dry. Moreover, the greater the specific gravity of the rock and of its constituent minerals, the less readily will the smaller particles into which more or less of the surface-rock is always broken by travel, be blown or washed away. It sometimes happens that so much of this finer material is carried off that the road's surface becomes a mass of loose stones.

Methods of Testing Road-metals.

The large amounts of money spent on the maintenance of roads make it a matter of very great importance to select a material that will wear well; a great saving can be effected if we can know before building our road what is the best material to use. Undoubtedly, experience is the best test of road-materials; and if we could build a mile or two of roads of various materials and in different parts of the state and open them for travel for a period of years, and if at the end of that time we could make a careful examination of the wearing down of the road-surface and other disruptions of the road-bed, this would undoubtedly be the best means of determining the relative merits of the various materials. But as the number of available materials is very large and the wear on the road is very uneven, it would be necessary to make a very large number of measurements at different parts of the various roads in order to determine the average wear for each, and also to keep a careful record of the repairs that had been made in order to allow for them; and as it would require between five and ten years' time to get results of any value, this method is evidently not at all a practical one for Maryland at the present time. One must therefore turn to laboratory methods to determine the wearing qualities of a road-metal and its resistance to the weather, and the results are of great value even where they are not as accurate as might be desired.

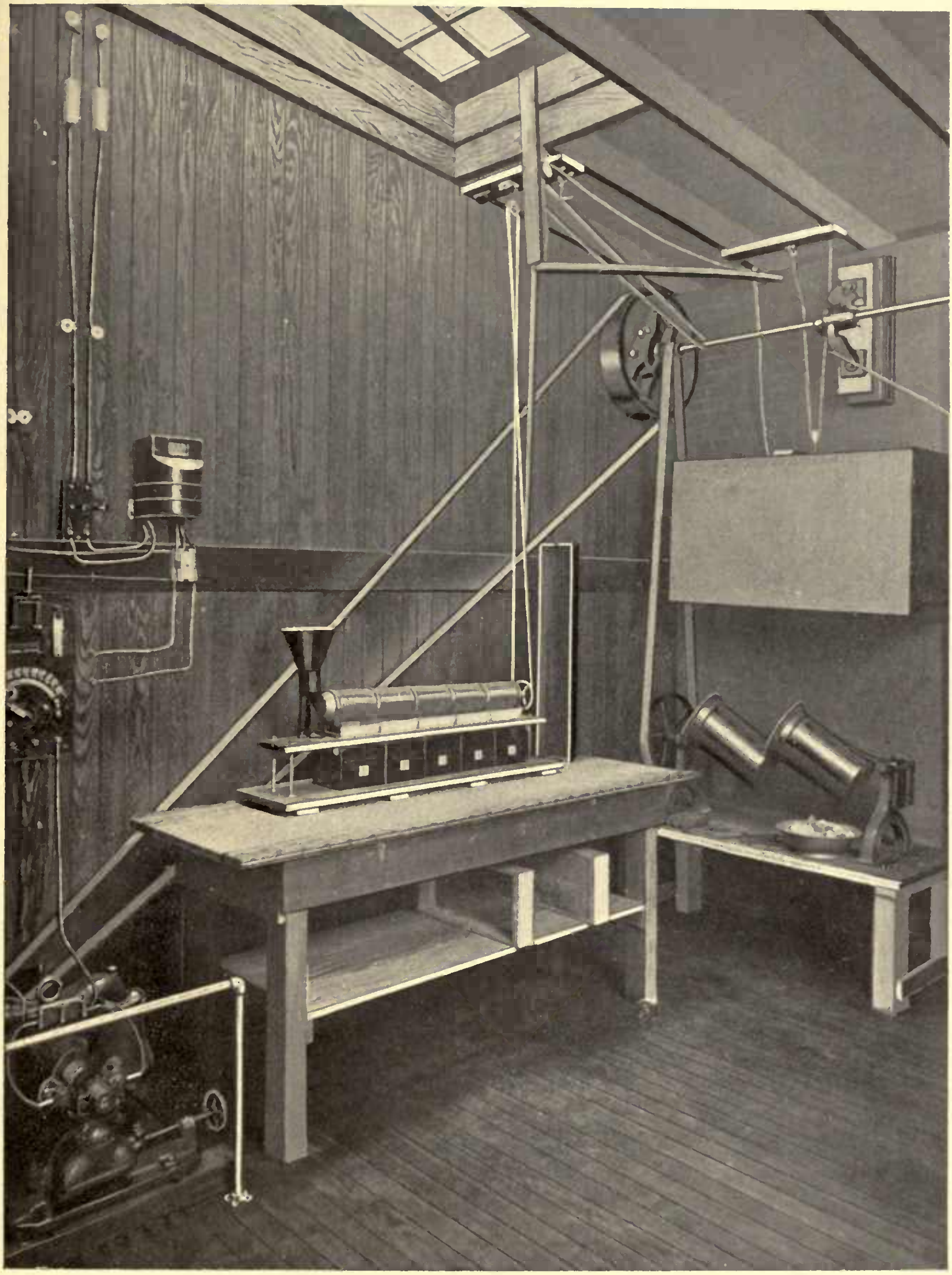
MICROSCOPIC TEST.

If thin sections of rock are made and examined with the microscope the structure of the rock itself can be distinctly seen. Examinations of this kind show a great variety of structure in the different rocks; and crystalline rocks show not only a great difference in the size of the crystals of which they are formed, but also a difference in the crystals themselves and the manner in which they are united. A glance at Plates VII-XI will show these differences. It will be seen that the diorites, the diabases and the related rocks are made up of minerals which are very much intertwined, and this accounts in a great degree for the toughness of these rocks and the difficulty in breaking them. The minerals of the granites and gneisses, on the other hand, are not well intertwined and these rocks crumble more readily. The quartzites, which are made up of particles of quartz cemented together but not intertwined, may be more or less easily disrupted according to the strength of the cement; and the same may be said of the sandstones. In marbles not only do the crystals themselves break very readily, but they are not strongly cemented together. The limestones, made up originally of small particles of fairly hard material, which are cemented together by a cement practically as strong as the particles themselves, form very compact rocks which do not crumble, but they are often not very strong. This method does not give the relative wearing powers of rocks, and cannot be looked upon as a satisfactory test; but it is valuable in making clear the causes of the differences in strength, and, therefore, in suggesting among what classes of rocks good road-making materials will probably be found.

ABRASION TEST.

In France, where the most careful work has been carried on for the greater part of this century, they have now adopted an experimental test of the resistance of rock to wear. The machine which they use for this purpose was invented by a French engineer, Deval, and is called by his name. It was first exhibited at the French Exposition in 1878, and was immediately adopted as the best method of determining beforehand the relative wearing powers of rocks.[1] By its use a large number of tests have been made of the various rocks used on

[1] Détermination Directe de la Qualité des Matériaux d'Entretien. Ministère des Travaux Publics. Paris, 1880.



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TESTING LABORATORY OF THE MARYLAND GEOLOGICAL SURVEY, SHOWING DEVAL ABRASION MACHINE AND REVOLVING CYLINDRICAL SIEVE FOR DETERMINING VALUES OF ROAD MATERIALS.

the French roads, and the results are in very satisfactory accordance with results obtained by many years' study of the roads themselves. The engineers in charge of the roads send samples of the various available materials to the testing laboratory in Paris, and their selection is governed by the result of the test. A machine of this kind has been used for some years by the Massachusetts Highway Commission, and one has been installed in the Maryland Survey laboratory, and has been at work for the past year testing the values of rocks from all sections of the state. The machine is shown in Plate XXIX. It consists essentially of an iron cylinder 20 centimeters (8 inches) in diameter and 34 centimeters (13½ inches) deep, mounted diagonally on a rotating axle. The stone to be tested is broken into pieces that will just pass through a 2½-inch ring and 5 kilograms (11 lbs.) of this broken stone are placed in the cylinder, which is then firmly closed and rotated at the rate of about 30 turns to the minute for 5 hours, making altogether 10,000 revolutions; a counter shows when the proper number of revolutions has been made. At each turn the stone rolls over from one end of the cylinder to the other and the edges are gradually broken off and the small particles thus formed are ground to fine dust. Before being placed in the cylinder the stone is carefully cleaned and weighed; after the experiment it is again cleaned and weighed together with all particles larger than $\frac{1}{16}$ of an inch. The difference between these weighings gives the amount of dust formed and is the test of the wearing quality of the stone. The French engineers have adopted a *coefficient of wear* to indicate the quality of the stone. They find that very few rocks when subjected to this test form less dust than 20 grams to each kilogram of rock (equal to about 2 per cent), and they adopt the number 20 as the coefficient of the best rocks. The coefficient of other rocks is obtained by multiplying this number by 20 divided by the amount of dust formed per kilogram of rock, namely:

$$q = \frac{20 \times 20}{u}$$

where q = the coefficient of wear,
u = quantity of dust formed per kilogram.

It will be readily seen that the rock which produces 40 grams of dust to the kilogram will have a coefficient of wear 10; and, in general, the coefficient is inversely proportional to the amount of dust formed in the test.

The machine installed in the Survey laboratory was made for us in Paris and has two cylinders so that two tests can be carried on at the same time. The time necessary to weigh the rock before and after the test and the time of the test itself rarely allows tests of more than two rocks to be made daily with our machine.

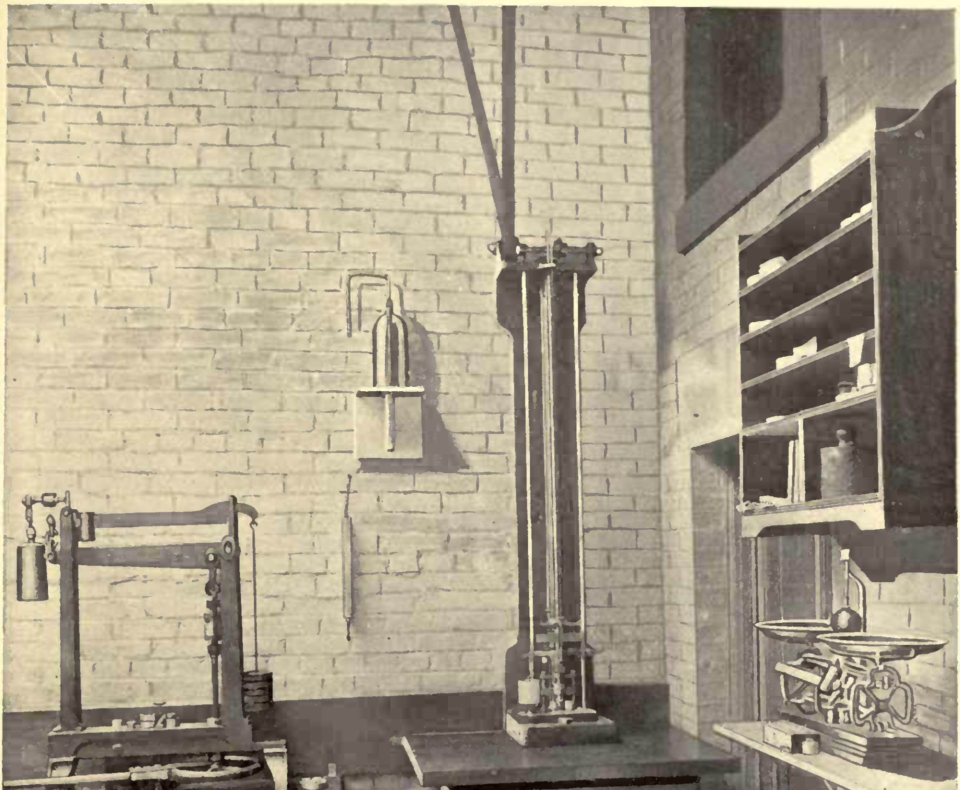
Objection has been made to this method of determining the wearing qualities of rocks on the ground that it does not exactly resemble the wear to which the rock is subjected on the road, and that it does not measure the resistance of the rock to the natural agents of destruction. This is perfectly true, but the experience of the French engineers for the last twenty years shows that the test is very valuable; and by supplementing it with other tests, a very accurate idea of the relative values of road-metals can be formed.

CRUSHING TEST.

The resistance to the crushing action of blows can be measured by determining the force of the blow necessary to fracture a piece of the rock of a given size. This test can be carried out by the machine described in the next paragraph, but up to the present there has not been any opportunity for applying it.

CEMENTATION TEST.

After resistance to wear the most important quality in a road-making material is the power of consolidating into a solid mass, which will shed water from the road-bed, and keep the foundation dry. This consolidation also holds the stones in their places, and prevents them from being kicked out by the horses. After the broken stone is laid the road should be thoroughly watered and rolled so as to bring the stones into as close contact as possible. But even when this is done it is found that the empty spaces amount to about 25 per cent of the total space occupied by the road itself. Screenings of the road mater-



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TESTING LABORATORY OF THE MARYLAND GEOLOGICAL SURVEY, SHOWING MACHINE FOR MAKING BRIQUETTES AND PAGE MACHINE FOR DETERMINING CEMENTATION-POWER OF STONE-DUST.

ial are usually put on the top of the road, watered and rolled in, for the purpose of filling up these spaces as far as possible and thus consolidating the road. Any fine material will do to fill the space, but it is important that this should be a material which will not only fill the space, but which will cement the stones together, as this makes a much more solid structure. The screenings made during the crushing of the stone are very suitable for this purpose, and the travel of the road, which will in time, by slight movement of the stones themselves, produce a small quantity of dust, also helps to fill the voids. If this dust and the screenings have a good cementing power they will hold together the larger pieces of stone and make a solid road-bed practically impervious to water. Therefore the determination of the cementing power of the dust formed by the grinding of the rock is a test of great value. For this purpose the dust produced in the Deval machine is passed through a rotating screen, having 100 meshes to the inch and all the dust that will go through is collected and formed into a briquette. If sufficient dust has not been produced by the regular test a heavy piece of iron is put into the cylinder with the stone and in a comparatively short time sufficient rock is ground up for the purpose. The dust, mixed with a definite quantity of water, is put into a small steel die and compressed by a machine under a pressure of 500 kilograms (1100 lbs.). The briquette thus formed is 25 millimeters (.98 inch) in diameter and 25 millimeters high. It is easy after the first briquette is made to determine the quantity of dust for that particular stone necessary to make a briquette of the proper size within a very small fraction. These briquettes are laid aside for two weeks to dry, and are then subjected to the test to determine the cementing power. This consists of striking the briquette a number of light blows with a hammer weighing one kilogram (2.2 lbs.) and the number of blows necessary to break the briquette is the measure of the cementation value. The machine by which this test is made was developed by the Massachusetts Highway Commission; so far there are but three of them in use, one in Massachusetts, one in New York and one in Maryland. It consists essentially of a hammer weighing one kilogram, which is raised a certain distance and allowed to fall upon the briquette. The hammer is connected with a screw which is continually rotating and is so arranged that it will be raised automatically and dropped through a distance which can be definitely fixed. The distance adopted on our tests was one centimeter ($\frac{3}{8}$ inch), and a slight adjustment of the scale enables us accurately to obtain this value even when the briquettes are of slightly different heights. A small drum carrying a paper on which a pointer marks, indicates the number of blows before the briquette is broken. It is found in the beginning that there is a certain rebound of the hammer marked on the drum, but when the elastic limit of the briquette is passed these rebounds no longer occur, although the briquette may not have been entirely destroyed; this point is taken as the breaking down of the briquette. The machine is a most excellent one and was made for us through the courtesy of Mr. L. W. Page of the Massachusetts Highway Commission, who designed and superintended its construction. Its general form will be seen in Plate XXX. A large number of these tests have been made with this machine of rocks taken from all parts of the state, and the results have proved very instructive. They show in general that quartzites, sandstones, granites, gneisses, and marble possess very little cementing power; some of them, indeed, breaking down with two or three blows; whereas limestones and some trap-rocks show a high power of cementation and stand thirty or forty blows before giving way. Other trap-rocks have not proved so good.

The cementation power of the dust is due in general to the oxide of iron or the lime which it contains. Mr. Whittle [1] has shown that the small amount of clay formed by the disintegration of the feldspar of igneous rocks is also an important agent of cementation.

VALUE OF THE TESTS.

The great importance of the experiments makes itself evident from the fact that rocks, which might be looked upon as practically equal in value as road-metals, show a very remarkable difference when subjected to the tests; thus enabling us to effect a material saving by selecting the better kind. An example of this occurred last spring

[1] Op. cit., p. 11.

FIG. 1.—MARBLE, BALTIMORE COUNTY.

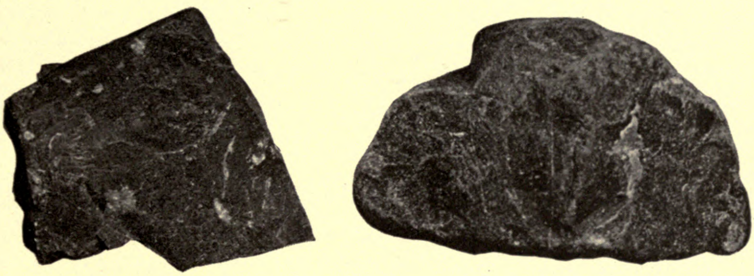

FIG. 2.—LIMESTONE, WASHINGTON COUNTY.

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FIG. 3.—TRAP ROCK, DIABASE, FREDERICK COUNTY.

VIEW OF ROCK FRAGMENTS BEFORE AND AFTER THE ABRASION TEST.

(TWO-THIRDS NATURAL SIZE)

when samples of rock were submitted to us for examination by the City Commissioner of Baltimore. The rocks were to be used in building roads in some of the outer portions of the city. Our results showed that the best of the rocks would give nearly twice the wear of the worst, and the engineers decided to use it. The costs of the rocks were about equal.

RESULTS OF TESTS MADE BY THE MARYLAND SURVEY.

The Highway Division has made tests of about a hundred and sixty rocks, gathered from different parts of the state; the results are collected in the table, and summarized as follows:

	Coefficient of Wear.	Cementation Test.
Trap-rocks	5.7–26.1	1–16
Serpentine	5.8–21.2	10–300
Granitic and quartzitic rocks	2.6–16.3	1–13
Limestones	4.8–16.8	1–73
Sandstones	5 –13	0–28

In this and the subsequent tables the figures signify:

Wear.	Cemen		Wea	ement.	
1–7	1–4	bad.	12–17	10–20	good.
7–12	4–10	fair.	17–	20–	excellent.

An examination of the table shows great differences existing not only between rocks of different kinds but between rocks of the same kind. Some rocks will have splendid qualities of wear, and poor qualities of cementation, and vice versa. They vary also in their specific gravity. The conclusion is therefore drawn that although in general the traps and limestones make the best roads, still this is merely a general statement, and it is always of great advantage to make a test of each rock before using it in order to find its individual value. It is hoped that the opportunities for doing this work provided by the Highway Division of the Maryland Geological Survey will be made use of by the people of the state as largely as possible. The time has been so short since this work was organized that it has been impossible to do more than adopt methods already in use, but it is expected that careful experiments will be made in the future with the hope of increasing the accuracy and reliability of the tests.

The selection of the road-metal for a given road is not always a perfectly simple matter. The problem consists in selecting the rock which will make a hard and smooth road-surface at the lowest cost for first construction and subsequent maintenance. To do this it is necessary to take into consideration the special conditions applying to the road, namely: (1) The amount and nature of travel. For a road subjected to a great amount of heavy traffic, wearing power is more important than cementation power, as the travel packs the stone down, whereas a lightly-traveled road does not require so hard a material, but it should consolidate easily. (2) The climate. In regions like parts of England and France, where there are neither heavy rains nor great droughts and no extremes of temperature, the binding power is of less value than in parts of our own country where opposite climatic conditions prevail, and we must even consider the differences of climate in different sections of our state. (3) The relative costs of different materials. This depends on the relative location of the materials with respect to the road and the different costs of preparing them. A careful balancing of all these factors will enable the engineer to choose the material which will be the most economical on the whole, but evidently great care and skill will have to be exercised to prevent considerable waste of money.

Laboratory of the Highway Division.

The laboratory in which the machines are placed is a small brick building erected for the purpose on the south side of the Johns Hopkins University. Besides the regular testing-machines which have been described, there are in the building a lathe, apparatus for grinding thin sections of rock, and a rock-saw. The machinery is run by one of two small electric motors, one wound to 110 volts, the power for which is furnished gratuitously by the University for about eight and one-half months of the year. During the time when the University power-house is not running, power is obtained from the United Electric Light and Power Company, and as their voltage is 220, it was necessary to have a second motor wound to its voltage. These motors are both C. & C. and have given excellent satisfaction.

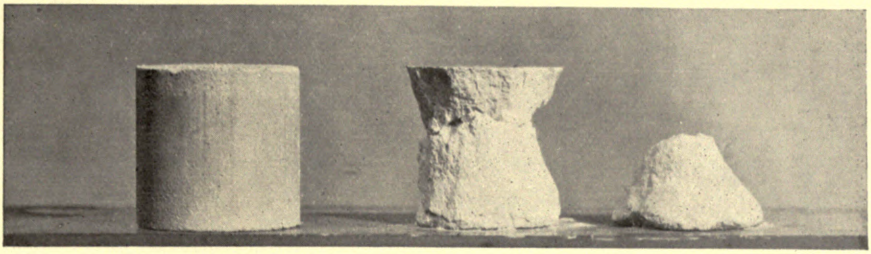


FIG. 1.—MARBLE, BALTIMORE COUNTY.

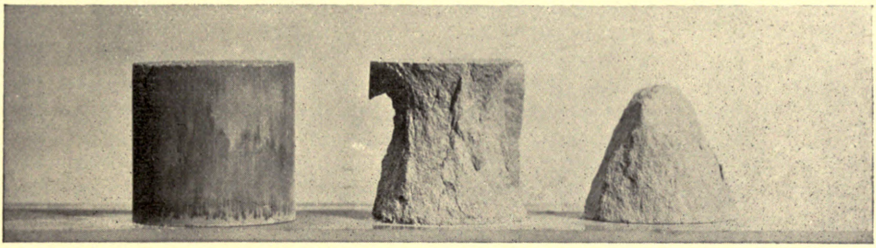
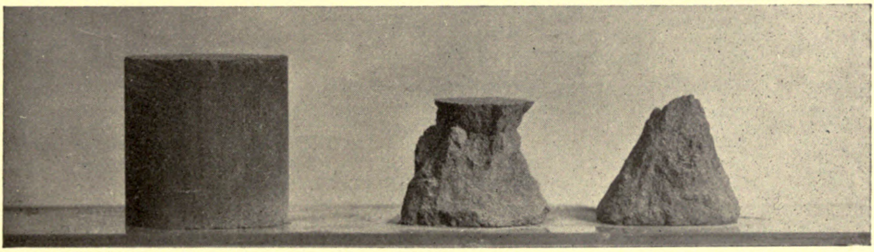


FIG. 2.—LIMESTONE, WASHINGTON COUNTY.

FIG. 3.—LIMESTONE, WASHINGTON COUNTY.



The Friedenwald Co.

FIG. 4.—TRAP ROCK, GABBRO, BALTIMORE COUNTY.

VIEW OF BRIQUETTES BEFORE AND AFTER THE CEMENTATION TEST.

(SLIGHTLY REDUCED IN SIZE.)

RESULTS OF TESTS OF ROAD-METALS

Obtained by the Highway Division, Maryland Geological Survey.[1]

TRAP ROCKS.

No. of Test.	County.	Scientific Name.	Common Name.	Coefficient of Wear.	Cementation.
86	Baltimore City	Gabbro	Trap (or Nigger-head)	20.9	3
66	Baltimore City	Gabbro-schist	Trap (or Nigger-head)	5.7	3
75	Baltimore City	Gabbro-schist	Trap (or Nigger-head)	6.7	6
71	Baltimore City	Diorite	Trap (or Nigger-head)	13.4	4
73	Baltimore	Gabbro	Trap (or Nigger-head)	15.4	2
79	Baltimore	Gabbro	Trap (or Nigger-head)	12.6	...
80	Baltimore	Gabbro	Trap (or Nigger-head)	15.2	2
84	Baltimore	Gabbro	Trap (or Nigger-head)	11.2	1
129	Baltimore	Gabbro	Trap (or Nigger-head)	14.6	2
161	Baltimore	Gabbro-diorite	Trap (or Nigger-head)	16.5	...
162	Baltimore	Gabbro-diorite	Trap (or Nigger-head)	20.3	...
95	Baltimore	Gabbro-schist	Trap (or Nigger-head)	13.6	13
131	Baltimore	Gabbro-schist	Trap (or Nigger-head)	5.8	5
147	Baltimore	Gabbro-schist	Trap (or Nigger-head)	13.9	4
150	Baltimore	Gabbro-schist	Trap (or Nigger-head)	10.2	1
154	Baltimore	Gabbro-schist	Trap (or Nigger-head)	11.7	1
157	Baltimore	Gabbro-schist	Trap (or Nigger-head)	12.8	4
10	Baltimore	Serpentine	Serpentine	5.8	156
78	Baltimore	Serpentine	Serpentine	7.9	300
142	Baltimore	Serpentine	Serpentine	6.2	66
156	Baltimore	Peridotite	Serpentine	6.0	...
98	Frederick	Diabase	Trap (or Nigger-head)	23.7	1
100	Frederick	Diabase	Gettysburg Granite	9.9	1
121	Frederick	Diabase	Trap (or Nigger-head)	22.4	16
124	Frederick	Diabase	Trap (or Nigger-head)	20.1	3
132	Frederick	Diabase	Trap (or Nigger-head)	19.2	4
138	Frederick	Diabase	Trap (or Nigger-head)	26.1	3
126	Frederick	Catoctin schist	Chlorite schist	5.9	3
21	Harford	Gabbro-diorite	Trap (or Nigger-head)	13.2	4
22	Harford	Gabbro-diorite	Trap (or Nigger-head)	12.6	3
152	Harford	Gabbro-schist	Trap (or Nigger-head)	8.7	...
122	Howard	Gabbro	Trap (or Nigger-head)	19.5	7
85	Howard	Gabbro-diorite	Trap (or Nigger-head)	12.1	2
137	Howard	Gabbro-schist	Trap (or Nigger-head)	16.6	11
88	Howard	Diabase	Trap (or Nigger-head)	14.8	8
113	Montgomery	Peridotite	Serpentine	9.3	9
133	Montgomery	Serpentine	Serpentine	21.2	10
120	Montgomery	Diabase	Trap	18.7	...
134	Montgomery	Diorite	Granite	11.5	6

[1] The methods of testing are described on pp. 320, 322.

GRANITIC AND QUARTZITIC ROCKS.

No. of Test.	County.	Scientific Name.	Common Name.	Coefficient of Wear.	Cementation.
83	Baltimore City	Gneiss	Gneiss	16.1	1
87	Baltimore City	Gneiss	Gneiss	11.8	2
82	Baltimore	Gneiss	Gneiss	15.5	12
93	Baltimore	Gneiss	Elkridge Granite	16.3	1
148	Baltimore	Gneiss	Gneiss	9.4	1
149	Baltimore	Gneiss	Gneiss	5.7	3
92	Baltimore	Granite	Granite	9.2	2
112	Baltimore	Gneiss	Granite	6.3	..
63	Baltimore	Microcline	Feldspar	5.6	2
143	Baltimore	Quartz-schist	Sandstone	6.4	1
153	Baltimore	Quartz-schist	Sandstone	3.4	..
81	Cecil	Diorite	Granite	13.3	1
128	Cecil	Diorite	Granite	10.0	1
96	Frederick	Calcareous quartzite	Sand-rock	16.1	13
135	Harford	Gneiss	Gneiss	14.7	1
144	Harford	Quartz	Flint or quartz	6.2	2
145	Harford	Sericite schist	Micaceous sandstone	2.6	6
53	Howard	Hornblende gneiss	Gneiss	9.7	1
12	Howard	Granite	Granite	11.1	..
16	Howard	Granite	Granite	8.5	3
28	Howard	Granite	Granite	15.2	1
118	Howard	Granite	Granite	10.7	10
18	Montgomery	Micaceous schist	Gneiss	4.8	3
11	Washington	Quartzite	Quartzite	13.8	4
17	Washington	Quartzite	Sandstone	11.7	1
56	Washington	Quartzite	Sandstone	9.7	..

LIMESTONES.

No. of T	County.	Scientific Name.	Common Name.	Coefficient of Wear.	Cementation.
36	Allegany	Helderberg limestone	Limestone	9.8	12
37	Allegany	Helderberg limestone	Limestone	9.0	72
38	Allegany	Helderberg limestone	Limestone	9.2	10
40	Allegany	Helderberg limestone	Limestone	7.4	7
46	Allegany	Helderberg limestone	Limestone	7.9	30
51	Allegany	Helderberg limestone	Limestone	6.7	32
52	Allegany	Helderberg limestone	Limestone	8.0	12
31	Allegany	Greenbrier limestone	Brown limestone	10.5	73
41	Allegany	Greenbrier limestone	Sandstone	11.8	7
42	Allegany	Greenbrier limestone	Limestone	9.7	24
43	Allegany	Greenbrier limestone	Limestone	11.9	26
48	Allegany	Greenbrier limestone	Limestone	9.5	15
54	Allegany	Greenbrier limestone	Sandstone	11.4	7
58	Allegany	Greenbrier limestone	Sandstone	9.3	..
155	Baltimore	Marble	Marble	6.0	..
104	Carroll	Marble	Marble	9.2	..

No. of Test.	County.	Scientific Name.		Coefficient of Wear.	Cementation.
119	Carroll	Crystalline limestone	Crystalline limestone	4.8	1
103	Frederick	Shenandoah limestone	Shaly limestone	5.8	10
106	Frederick	Shenandoah limestone	Limestone	9.4	3
108	Frederick	Shenandoah limestone	Limestone	8.5	4
110	Frederick	Shenandoah limestone	Shaly limestone	7.3	15
115	Frederick	Shenandoah limestone	Limestone	8.8	6
140	Frederick	Shenandoah limestone (crystalline)	Marble	6.7	11
141	Frederick	Shenandoah limestone	Limestone	10.1	8
109	Montgomery	Triassic conglomerate	Calico rock	11.7	23
5	Washington	Shenandoah limestone	Limestone	16.0	18
6	Washington	Shenandoah limestone	Limestone	9.0	17
8	Washington	Shenandoah limestone	Limestone	16.8	7
13	Washington	Shenandoah limestone	Limestone	14.9	6
14	Washington	Shenandoah limestone	Limestone	8.3	7
27	Washington	Shenandoah limestone	Limestone	10.0	10
30	Washington	Shenandoah limestone	Limestone	7.5	14
70	Washington	Shenandoah limestone	Limestone	9.7	13
50	[Harper's Ferry]	Shenandoah limestone	Limestone	6.9	..
102	Washington	Helderberg limestone	Limestone	8.3	27

SANDSTONES.

No. of Test.	County.	Scientific Name.	Common Name.	Coefficient of Wear.	Cementation.
151	Calvert	Miocene sandstone	Sandstone	5.0	..
97	Carroll	Triassic sandstone	Brown sandstone	7.0	28
35	Garrett	Pottsville sandstone	Sandstone	8.9	0
39	Garrett	Pottsville sandstone	Sandstone	6.7	10
68	Howard	Potomac sandstone	Ironstone	6.4	2
9	Montgomery	Triassic sandstone	Red sandstone	10.4	13
23	Washington	Oriskany sandstone	Sandstone	6.5	1
25	Washington	Oriskany sandstone	Sandstone	9.3	1
19	Washington	Catskill sandstone	Brown sandstone	13.0	15
20	Washington	Catskill sandstone	Brown sandstone	11.7	20

MISCELLANEOUS.

No. of Test.	County.	Scientific Name.	Common Name.	Coefficient of Wear.	Cementation.
114	Howard	Magnetite-schist	Iron ore	6.8	0
146	Howard	Slag	Slag	8.8	2
158	[Chesapeake Bay]	Oyster-shells	Oyster-shells	1.1	100

This table is valuable to show the great differences that exist between various specimens of the same kind of rock, and to give information regarding the grade of road-metal which exists in a particular locality. Although it would be necessary to test any stone offered for use on a road, the table would show whether it was the best road-metal of the region; and if not, where to look for a better one. The greater the number of rocks tested from all parts of the state, and even from adjoining states, the more useful does the table become. This study of the values of rocks in all parts of the state is to the road-builder what a geological survey is to the mining-engineer.

The exact localities from which the specimens came have not been given in the table, but they are kept in the records of the Highway Division and can be obtained on application.

PART VII

THE ADMINISTRATION OF ROADS

BY

HARRY FIELDING REID

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THE ADMINISTRATION OF ROADS IN MARYLAND.

The method of administering the roads of Maryland is outlined in the laws of the state. These were codified in 1888, and since then amendments have been made and new laws added at every session of the General Assembly. They are divided into two groups: first, Public General Laws, applying to all the counties of the state; and second, Public Local Laws, applying to special counties or parts of counties. Some of the enactments relating to the subject of highways are of no general interest, such as laws allowing the building of a private road or a bridge at a particular point; or laws permitting the County Commissioners to levy a special tax to meet a deficit, and they will not engage attention. But the general regulations regarding the administration of the roads within the state are of especial interest in the present connection. They will be discussed in the succeeding pages in their relation to the establishment of roads, the source and expenditure of revenue and the manner of preserving the records of work accomplished.

The Opening and Closing of Roads.

It is sometimes necessary to open new roads or to alter or close roads in use.[1] For this purpose persons desiring the change must petition the County Commissioners, and general notice of this petition must be given the county in order that other persons opposing the change may have opportunity to offer counter-petitions. If the

[1] Frederick and Wicomico counties have very full laws on this subject.

County Commissioners deem it expedient to make the change or to look further into the subject, they appoint three persons as examiners, who carefully consider the whole matter, and, if necessary, have a survey made of the road; they determine the amount of damages which shall be paid to some property owners and the benefits to be paid by others, and submit their report to the County Commissioners, who may make such changes in it as they think best, rejecting it altogether if they so decide. It is also within the powers of the County Commissioners to decide whether the cost of a road shall be met by the county, by the petitioners, or by the two combined.[1] Any one to whom the decision of the County Commissioners is not satisfactory has the right of appeal to the Circuit Court. This is a general right, but it is especially mentioned in the laws of Baltimore, Frederick, and Wicomico counties.

When roads are opened under this law they must be at least 30 feet wide, but there are exceptions to this rule in the case of several counties.

All persons owning land have a right-of-way from their land "to places of public worship and mills, market towns, public ferries and court houses;" and if no suitable road exists for these purposes they may apply to the County Commissioners to afford them a private road. The County Commissioners then appoint three commissioners, who determine where the private road shall be located, considering the interests of the petitioners and of the persons through whose lands the road is to pass, and determine what damages shall be paid; the petitioners also pay the cost of construction and maintain the road. Private roads are not to be more than 16 feet wide. Any person who is not satisfied with the decision of the County Commissioners in granting or refusing to grant a private road may appeal to the Circuit Court of the county, and, if he so desires, may have the matter tried by a jury.

[1] In Frederick county the County Commissioners may take the opening of new roads entirely into their own hands, and not appoint examiners if they can obtain the right-of-way by agreement with property-owners; but if they fail to come to an agreement the examiners must be appointed.

Road-Taxes.

The expense of maintenance and of the occasional construction of a new road is met by a road-tax levied by the County Commissioners. The amount of this tax has varied during the past ten years in the different counties between $1,850 and $31,000 annually, with the exception of Baltimore county, where the average levy amounts to $122,680.

Some counties divide this road-tax into a general and a special road-tax; the latter is expended in the district in which it is raised, and the former is for general use in the county. In addition to this some counties allow a special tax to be raised and expended in a special district or in a town on the petition of a number of the residents of the district or town. In some counties, from a half to a third of the whole tax must be spent on stoning the surface of the roads.

Besides these taxes, special provision is made from time to time for special purposes; a good example of this is the law passed in 1898, allowing Montgomery county to bond itself for $25,000 to improve the road from Rockville to the District of Columbia.

The sums raised by these taxes are not always directly expended by the County Commissioners, Road Commissioners or the Supervisors. Incorporated towns generally receive from the County Commissioners one-half of the road-tax collected within their limits, to be expended by the town officers on the streets of the town; and sometimes the County Commissioners turn over a certain amount of money to local improvement associations to be expended by them. Usually, though not always, the association increases the amount it receives from the County Commissioners by a contribution from its own treasury.

Road-Commissioners, Road-Supervisors and Laborers.

The general control of roads and bridges in each county is vested in a board of County Commissioners, who are elected by the voters of the county. In many of the counties the territory is divided among the commissioners, each of whom takes special charge of the roads and bridges assigned to him. In some counties Road Commissioners are appointed, who relieve the County Commissioners of this duty. The number of Road Commissioners varies in the different counties from one, in Allegany, where he is called General Supervisor of Roads, to thirty-seven in Carroll. Each of them is expected to examine monthly the roads in his district. A large number of Supervisors are appointed by the County Commissioners or by the Road Commissioners. This number also varies greatly in the different counties. They have immediate control of from 2 to 60 miles of road and keep them in order; they generally hire men and teams to help them in the work, which is done during the spring and summer. In Charles county there are nine supervisors, each of whom has a more or less permanent gang of men working on the roads under his direction. This is much better than in the majority of the counties, where the supervisors have to accept one or two days' work from any one in his district, who wishes to pay his road-tax in this way. In general, the position of supervisor is coveted, but the law in Howard county, requiring those who are appointed to serve, or to show why they should not have been appointed, suggests that at one time there was difficulty in getting proper men for these positions. There was also a time in some of the other counties when it was difficult to obtain laborers to work on the roads,[1] and this condition is still reflected in the laws of Dorchester, Wicomico, and Caroline counties, which require all able-bodied men either to work on the roads a certain number of days annually, provide a substitute, or pay a fine. A special law requires all male inhabitants of Snow Hill to work on its streets, or to pay a fine of 75 cents.[2] In Caroline county

[1] In 1796 Kent and Talbot had a law compelling laborers to work on roads. See p. 150. The general law of 1704 also provided for compulsory labor. See p. 120.

[2] That this is not a dead letter is proved by a case which occurred last year. A man refused to work or to pay his fine. A judgment was entered against him by a Justice of the Peace. He appealed, and the court sustained the magistrate's decision. "In its opinion the court, through Judge Charles F. Holland, said: 'The act of Legislature is a substantial re-enactment of a law which has been in operation for over a hundred and ninety years, and its constitutionality has never been questioned until recently. It is in perfect accord with the state constitution, and the amendments of the United States Constitution. It has been so construed by our Court of Appeals, and the court gives verdict for the appellees, the County Commissioners of Worcester County.'" Baltimore American, Saturday, October 29th, 1898.

the law comes down from slavery days and reads: "All persons [when properly notified by the supervisor] shall furnish one-half of their able-bodied male hands," etc. It is curious that in spite of the great number of repeals which have been made in the local laws this should still remain.

In many counties farmers are permitted to work out their road-tax by hauling stone or by working on the roads a certain number of days, and this may seem a wise provision, as it is equivalent to hiring local labor, but it usually results in very poor work. This has been long recognized, for as far back as 1766 we find a law for Baltimore county requiring that the road-tax shall be paid and shall not be worked out.[1] The more progressive states and counties are now requiring that the road-tax shall be paid in money. The employment of convicts for work on the public roads was in vogue in the last century, but fell into disuse.[2] At the present time, however, Talbot and Queen Anne's counties authorize their use, but they have not actually been put to work on the roads, as there are so few convicts in jail at one time that the cost of caring for and guarding them would make their work too expensive to the county.

The supervisors make monthly or semi-annual reports to the County Commissioners or Road Commissioners, and have their accounts settled.

Elaborate laws exist in Cecil county (1884) and in Anne Arundel (1898) for keeping roads in repair by contract; but in Cecil the method has fallen entirely into disuse, as it was not found practical; and reports from Anne Arundel show that there has been no better care of the roads under the contract-system than under the old system of supervisors. In many counties, where roads are being substantially improved at considerable expense, the work is done directly under the charge of the County Commissioners or by contract, as it is recognized that the supervisors are unable to do more than follow their

[1] See p. 147.

[2] In 1788 a law authorized the condemnation of convicts to work on public roads, and the turnpikes of Baltimore county, built by the county, were largely built by convict labor. See p. 154-155.

customary methods. This, however, only applies to certain special roads, and is manifestly not feasible for all the roads of the county.

The general law allows the County Commissioners to appoint competent engineers to oversee the repairs of the roads, but it is ineffective. Special laws have, however, been passed allowing engineers to be appointed in Anne Arundel and in Somerset counties to prepare plans for the improvements of the roads and to supervise the work on them.

The ordinary police regulations with respect to the public roads and bridges, such as the prohibition of fast driving, and of shooting on the roads, or obstructing the roads, naturally belong to the County Commissioners, but we find a number of special laws in individual counties with regard to them. Uniformity and generality of these laws would be very convenient.

Road-Repairs and Drainage.

The large sums of money spent annually in the maintenance of roads without showing any definite improvement have led, in the last few years, to the passage of laws defining the methods of repairing the roads. These laws require a certain proportion of the general or special road-tax to be employed for the "permanent improvement" of the roads, designating that the improvements shall be made by putting stone, gravel, or other hard substance on the surface of the road. In the present state of our highways such work can hardly be looked upon as permanent, for roads badly located, or badly graded, can never be satisfactory, and when the county decides to make a real change for the better, by changing the location or improving the grades, it will find that the money spent on surfacing has been wasted. This is the condition of affairs on the road from Rockville to the District of Columbia. This road, built many years ago, was very heavily stoned, but not properly graded. Hence at the present time, when Montgomery county wishes to remove the high grades on the road, in order to make a modern road and one economical to haul over, it finds the old road-bed of no use, except as a quarry from which to procure stone.

In many cases great advantage would result from a better location or a possible straightening of a road, and it is wiser that these two classes of improvements, re-location and grading, should be undertaken before the expensive work of surfacing should be done. A badly-graded road is always a serious tax, for heavy grades greatly increase the work of hauling.[1]

The difficulty of properly draining the roads has led to special laws, requiring in Somerset county, and authorizing in Dorchester, the adoption of a scientific system of drainage, and permitting the appointment of an engineer to devise plans and to supervise their execution. The County Commissioners are also authorized to issue bonds to the amount of fifty thousand dollars in each of these counties for the purpose of meeting the expense of these improvements. In Dorchester this money must be used to develop the drainage system only, while in Somerset it may be applied to the general improvement of the roads. But the provisions of these laws have not been carried out.

Gates, Guide-posts and Bridges.

In earlier times roads ran through the large estates which then existed, especially in the tidewater counties of Maryland, and gates were erected across these roads, as it was, in general, easier to confine stock in this way than to build a fence on each side of the road.[2] But conditions have now changed, and the necessity of these gates is no longer very great. In fact, they are forbidden in Calvert, Carroll, Charles, and Queen Anne's counties, and are permitted only with the consent of the County Commissioners in St. Mary's county and in the first district of Cecil; or, as in Kent, upon the payment of an annual tax of one dollar.

Before the time of railroads, when persons traveled a considerable distance over the highways, it was very important to mark the roads and to indicate whither they led; and so in the early colonial times roads were distinguished by notches on trees or by sign-boards put up

[1] See p. 269.

[2] Forty years ago it was necessary to open forty gates across the main road in traveling from Marlboro to Washington.

as guides for travelers.[1] In a number of counties the laws still require sign-boards to be placed at cross-roads, but they are ineffective, for sign-boards are wantonly destroyed almost as quickly as they are put up.

In the tidewater counties the necessity for large bridges, requiring a considerable expenditure of money, has resulted in special laws being passed enabling the County Commissioners to build special bridges at a specified cost, and appointing the means of obtaining the necessary money, which is done either by the levy of a special tax or by the issue of notes of indebtedness, or of bonds, which are later to be redeemed by funds laid aside from a special levy. Provision is usually made, if necessary, for the construction of a draw to enable vessels to pass through the bridge. Many bridges connect two counties, and the expense of construction is then divided between them, but not always in equal amounts. As with the roads, the bridges are sometimes built and maintained by the County Commissioners (jointly in the case of two counties) and are sometimes built by contract. Important bridges are usually directly under the charge of the County or Road Commissioners, and if they have draws, keepers are appointed to care for them and attend to the draw; but the smaller bridges are cared for by the supervisors.[2] With the exception of the bridge in Anne Arundel county over Curtis Creek and Cabin Branch, the county bridges are free; but on the bridge just mentioned the tolls are quite heavy. This bridge was built under a law of 1898, and the money received from tolls is applied to pay the interest on the bonds after meeting the expenses of the maintenance of the bridge.

The bridges in Dorchester county do not seem to be built strongly enough for the traffic that goes over them, and to avoid large expense to the county by extensive repairs a special law was passed requiring that persons who injured bridges by hauling over them too heavy a load should repair the damage.

[1] See p. 120, 121.

[2] Baltimore county employs an engineer who designs and supervises the construction and repairs of the county bridges. He also measures the stone put upon the county roads, but has no other connection with these roads.

In Charles county we find a law somewhat similar with respect to the roads, namely, that all persons engaged in hauling heavy timber, not cord wood, for commercial purposes during the winter, must pay a special license of not more than five dollars a month; and this money is applied to the improvement of the roads. This is of the nature of a toll and it would be much better if, instead of making this charge, the roads were put in condition to stand the travel. In Anne Arundel county an individual or corporation damaging the roads by unusual use, is required to repair them.

A general law enacted in 1853 requires that all public roads opened in the state shall be at least thirty feet wide; this must mean between fences. Some of the counties have enacted similar laws, but in a number the width of the road may be less if the County Commissioners decide that it should be.

Provision is also made in the general law to allow passenger railway companies to lay tracks on the county roads with the consent of the County Commissioners; but for the sake of greater security, several companies have had this right secured by their charters or by laws passed especially granting it. These special laws rarely add anything of importance to the general law, and leave with the County Commissioners the right of making any conditions with the companies they think for the public good; but one or two specify the position of the tracks on the road and the breadth of roadway which must be left available for vehicles.

Road Records.

The records kept of the various roads are, in general, very meager. Some counties do not even keep a separate record of the amount of money spent on the repairs of individual roads, and Caroline alone has an accurate large scale map showing the location of the roads, the nature of the surface, and the position and size of the bridges.

Roads are usually designated by the towns between which they run, though occasionally they have a specific name. In Anne Arundel county, however, a very careful designation of the roads has existed since the last legislature. The election districts are divided into road districts and are lettered A, B, C, etc. The road districts are subdivided into sections which are numbered and the roads frequently have names. The roads are classified into (1) County High Roads, which are "the principal roads or public highways leading to or from any city or town or principal stations or landings," or portions of such roads. (2) First-Class Roads, "leading to or from any city, town, public station or landing," or parts of such roads. (3) "Second-Class Roads . . . . those not frequently used—ordinary roads of travel or cross-roads." The law requires that a map such as is made by the United States Geological Survey shall be adopted as official, and on this map the roads are to be clearly marked by different kinds of lines according to their classes; all the high roads, and the others as far as possible, are to have special names. In addition to this, a careful description of these roads shall be kept and recorded. This law has not been in effect very long and necessarily entails a great deal of labor, and, therefore, has not as yet been applied very generally to roads in the county.

It was rare that accurate surveys and careful plats of the early roads of Maryland were ever made, nor was the location of roads marked in any permanent way. As the result of this, roads have naturally become somewhat displaced by the movement of fences or from other causes, and as the roads are frequently the boundary between the properties of different persons, we should expect that more trouble would arise from this cause than has actually occurred. There are only four counties—Baltimore, Carroll, Harford, and Cecil—for which laws have been passed allowing the County Commissioners to re-survey and determine the true location of a road. The difficulty of deciding as to where a road originally was has led to a law for Carroll county, according to which examiners appointed by the County Commissioners "are authorized to adopt the center of such road as the center thereof according to the true location." The importance of a general law requiring that the positions of roads should be accurately known and marked is manifest, as the titles of many properties recite that the line shall begin at a certain point in the middle of a certain road and follow the middle of this road for a certain distance.

Corporations.

Corporations for making turnpikes, plank roads or passenger railways may use the county roads by permission of the County Commissioners, under certain restrictions, and they may obtain right-of-way across private lands by agreement or by condemnation. Turnpike companies are required to report their progress in building before they are allowed to charge tolls and their rates may be revised by the County Commissioners (or the Governor of the State in the case of turnpikes passing through several counties) so as not to yield to the company profits of more than eight per cent per annum on the money actually expended in the construction of the road. The corporation is required to keep its road in order, upon penalty of being debarred the right of charging toll over the bad parts. If a turnpike company persists in keeping the road in bad order, tolls may be forbidden in the entire county, and if this is not sufficient to remedy the evil, the road shall be forfeited by the corporation to the County Commissioners. On the other hand, persons using the road are forbidden to evade payment of the legal tolls.

THE ADMINISTRATION OF ROADS IN OTHER STATES.[1]

Alabama.

The Court of County Commissioners selects Apportioners for each precinct, and these appoint overseers, who attend to the general repairs of their sections of the roads. Every able-bodied man is liable to work ten days yearly on the roads; in some counties special acts allow the labor to be commuted in money.

In addition to this, in a few counties, there is a road-tax, which

[1] The information here given was extracted from the laws of the states, public addresses, letters from state officials and from private correspondence. See p. 43.

must come out of the general levy, and some counties have also been permitted to issue bonds, which must be redeemed out of the general tax receipts.

Every Legislature passes special acts for special counties and these are very varied in their provisions. Many miles of good macadam roads have been built in recent years, but they are largely confined to those counties which have borrowed money on bonds, or required the road-tax to be paid in money, and have given attention to the careful supervision of the work on the roads. The law requires the roads to be thirty feet wide.

Arkansas.

Road overseers are appointed by the County Judge; every able-bodied man may be required to work five to ten days a year on the roads, but so far very little improvement has resulted. The roads are very poor.

California.

The counties are divided into road-districts by the Board of County Supervisors, and the electors of the district vote annually for a Road Trustee, who serves for three years. There are thus three trustees, the term of one expiring annually. They have entire charge of the roads of their district and employ the necessary labor or make the necessary contracts for the construction, repairs and maintenance of the roads. Each one of them is required to view every road of his district at least once a year.

Three times a year there is an assembly of the qualified voters of the district to consult in regard to the general management of the roads, to determine what roads shall be permanently improved and how the improvements shall be made, the materials to be used and what action is to be taken with regard to any litigation about the roads.

The amount of the road-tax is determined by the Board of Supervisors, which levies a property road-tax and also a poll-tax, the latter of which may be worked out on the roads. In addition to this the Board of Trustees may submit to the qualified voters of the district a proposition to raise an additional tax for the improvement of specific roads. They may also submit to vote a proposition to issue road-district bonds in order to raise larger amounts for permanent improvements.

The public highways are to be at least forty feet wide and a law has been passed requiring the tires of all wagons in the state to have a certain width dependent upon the size of the axle. This law is to become effective in 1900.

This system of road-administration has not proven at all satisfactory. About two million dollars are expended annually on the roads and the results are extremely poor. Considerable interest has been shown in favor of improving the roads, and in 1895 a law was passed creating a Bureau of Highways, which consisted of three commissioners, appointed by the governor, who were required to investigate and report on the condition of the roads of the state and to recommend a practical road-law. An appropriation of $31,000 was made to meet the expense. The Bureau was only created for two years and presented a very interesting and complete report. It recommended the classification of the roads into state, county, and district roads, the creation of a permanent Department of Highways to control the state roads, and a redistribution of the present highway-tax, so that a part should be available for these roads. These recommendations did not become laws, but a Department of Highways was created to continue the work of the former Bureau in the investigation of the roads and in giving advice to road-officers. It has published one biennial report and is doing excellent work for the state. A rock-crushing plant has been established at Folsom penitentiary, near which excellent road-material is to be found and also good water-power. This plant is worked by the convicts and the stone sold to the various counties in the state at a small advance over the cost in order to meet the expense of setting up the plant. The convicts also cut stones to prepare them for use in small bridges or culverts. This plan has proved very successful, broken stone being delivered at various parts of the state at prices ranging from twenty-five cents to ninety cents per ton. Such a low price could not be given save by the co-operation of the railways which only charge the actual cost for the transportation of the stone.

Colorado.

The County Commissioners divide the counties into road districts and annually appoint a road overseer for each who sees to the repairs, etc., of the roads.

The County Commissioners levy a property road-tax, one-half of which must be spent in the district in which it is collected and the rest as directed by the County Commissioners. In addition, every able-bodied man pays $2 or works two days on the roads.

Connecticut.

The roads are under the care of the Selectmen of the town, who are elected annually by the voters. The Selectmen employ laborers and supervise the work of road-improvement. There are no special taxes raised for roads but the necessary money comes out of the general town tax-fund. The town is not divided into districts but is treated as a whole. There is still a survival to a small degree of the practice of working out taxes on the roads, but it is fast disappearing. No bonds have been issued to raise funds for the improvement of the roads either in the towns or in the state. A wide-tire law has been passed which will become operative in 1901.

The great desire for better roads has led to the matter being taken up by the state. Under a law passed in 1895, the Governor appointed three Highway Commissioners, and the state legislature appropriated $75,000 annually to be spent on the roads of the state. Every town voting to improve its roads under the act had a survey made, and specifications drawn up, and submitted them to the Highway Commission. If approved, the contract was let to the town or to private parties and the work supervised by the Selectmen of the town. The expense was met—one-third by the town, one-third by the county, and one-third by the state.

This law was repealed in 1897 and another one enacted, differing only in having one Highway Commissioner, who holds office for two years; in making the annual appropriation $100,000, and in dividing the cost equally between the town and the state.

These laws have proved popular and successful and during the four years of their existence one hundred and seventy miles of road have been built, and much grading has been done; in addition, about fifty miles of roadway have been straightened and widened; and many petitions for sharing in the benefits of the state appropriation have been received. The total cost of these improvements has been about $800,000.

Telford, macadam and gravel roads have been built. The cost of the latter is very moderate, being in one or two cases as low as $1,000

FIG. 33.—Gravel road in southwestern Connecticut.

a mile. One might suppose that the prospect for getting state aid would act as a deterrent to the general improvement of the roads, the towns holding back so that part of the expense might be shared by the state; but just the reverse has taken place; the great convenience and advantage of good roads when once experienced, have impressed themselves on the people, and towns have voted increased sums to improve roads more rapidly than could be done if they waited for the small sum annually available from the state. It is safe to say that four hundred miles of roadway have been improved in the state in the last four years.

Four annual reports have so far been published, containing important details of the methods of construction and of the costs of the roads.

Delaware.

There are two road-systems in Delaware; one applicable to New Castle county and the other to the other two counties of the state. In New Castle county, Road Commissioners are elected to serve four years, one being elected biennially for each hundred. The Road Commissioners have general charge of the roads and bridges in their hundreds, and annually appoint overseers to keep them in repair.

The Road Commissioners levy the tax which, in general, may be worked out, and any one has the right to do a certain amount of work on the roads in the payment of taxes. Persons appointed as Road Commissioners or Overseers are required to serve.

In Brandywine hundred, New Castle county, five supervisors are elected annually, and each has charge of one of the five districts into which the hundred is divided. They take the place of the Road Commissioners, fix the amount of the tax, and report to the County Court.

Certain bridges in New Castle county are maintained by the county as a whole.

In Kent and Sussex counties the Levy Court has general charge of the roads and appoints supervisors to see to the repairs. The Levy Court fixes the amount of road-tax, which may be worked out.

There are a number of acts applying to special hundreds which need not be mentioned, except an act in Mill Creek hundred in New Castle county, where sections of a road may be farmed out to various persons to be kept in order.

On petition for the establishing, altering or vacating of a road, the Court of General Session appoints five viewers to report on the project, and the Court decides the question; but the decision must be approved by the Levy Court of the county.

The public roads must be between 15 and 40 feet wide and guide-posts are to be put at places where they are needed.

Florida.

The roads are in charge of county officers. The road-tax is paid largely in money, but some of it is worked out on the road.

The nature of the soil is such as to make fairly good roads at little cost and the people are moving for their improvement.

Georgia.

The country is divided into road districts, in each of which there are three Road Commissioners. The commissioners divide the district into sections and appoint an overseer in each. All able-bodied men are subject to fifteen days' work annually on the roads, which must be done under the direction of the overseer. Counties are also permitted to levy a road-fund, organize road forces or make the repairs of the roads by contract. First-class roads must be 30 feet wide, and second-class roads 20 feet.

The roads are being substantially improved, many miles having been macadamized or graveled. Much of the work has been done by misdemeanor convicts, and the experiment of employing them on the roads is considered successful.

Idaho.

The roads are in charge of the County Commissioners who appoint road-supervisors to see to the repairs. The road-tax, which consists of a property-tax and a poll-tax, is levied by the county and is spent in the district where it is raised. It may be worked out in labor on the roads. In certain regions where the expense of building roads is too great for the locality, the cost is met by the state by legislative enactment.

Illinois.

In this state the township system is in general use and to some extent the county system, and what follows applies as well to the county as to the township system. One Commissioner of Highways is elected annually, there being three altogether, who have complete charge of the roads and bridges in the township. They may employ a general superintendent of roads or appoint overseers and employ laborers, or they may let the work by contract; the practice varies in different townships. They levy a road-tax, which consists of a property-tax and a poll-tax. The poll-tax may be paid either in money or in labor; but the tax itself may be abolished by vote of the township, as has been done in some cases.

The road-tax may be worked out if the township so votes, each man doing his share of the work, or furnishing a substitute, or paying his tax. In that case the Commissioners of Highways appoint an overseer for each road-district of the town, and they attend to the work and report to the Commissioners of Highways.

Where large expenses are incurred in building bridges, the County Board may help the township.

The Commissioners of Highways report semi-annually to the Board of Town Auditors, particularly in regard to their finances, and in regard to any other matters about the roads that they may think important.

Upon petition roads may be opened, altered or vacated by the Commissioners of Highways. They settle the damages by agreement, if possible, and if not, by recourse to a Justice of the Peace and a jury. Appeals may be taken to three County Supervisors.

An attempt has been made to improve the roads in Illinois by macadamizing or graveling them, and by vote of the township a special tax may be raised for this purpose. Some townships have taken advantage of this privilege and have graveled or macadamized all their important roads; others have not. In some instances engineers have been employed to superintend the improvement of the roads, though this is not the usual practice.

A public road must be 60 feet wide unless the Commissioners of Highways, on petition, decide to make it less; but it must never be less than 40 feet. In some townships sign-boards are usually found at the cross-roads; in others they are seldom seen. Wide tires are generally used in some parts of the state, and not at all in other parts.

Indiana.

The counties are divided into townships and these again into road districts, over each of which a supervisor is elected who takes charge of the roads and keeps them in order under the direction of the Township Trustee; or, if the latter thinks it advisable, the work may be partly done by contract. The Township Trustee, with the concurrence of the Board of County Commissioners, fixes the amount of road-tax to be paid. Some of this must be worked out on the roads under the supervisor, or a fine paid. When the ordinary levy does not produce enough funds for the roads an extra levy may be made.

In addition to these township roads there are a series of gravel or turnpike roads bought or built by the County Commissioners on petition or by vote of the electors. These have been paid for either by a special tax or by the issuance of county bonds. They are cared for by the township supervisor, under the direction of the County Commissioners. A special law forbids the hauling of heavy loads over the gravel roads during the season of the year when they are thawing. The county roads shall not be less than thirty feet wide nor the township roads less than twenty-five feet wide.

Upon the petition for the opening of a new road the County Commissioners appoint viewers who decide upon the location of the road and the damages to be paid. An appeal may be taken and re-viewers appointed to consider the matter, and the decision of the County Commissioners on their report is final. The County Commissioners report their decision to the Trustees of the townships through which the road passes, and the latter order the supervisors to do the work.

Iowa.

The Board of County Supervisors has general jurisdiction over the roads of the county, but the counties are divided into townships and the Township Trustees have special charge of the roads of their township. They may divide the township into several road-districts or may treat it as one. They determine the amount of the road-tax to be levied and how much of this is to be paid in money and how much in labor; there is also a poll-tax. The immediate care of the roads is in the hands of supervisors.

In the case of the township which is treated as a whole the Trustees may let some or all of the work by contract, or they may appoint a Township Superintendent of Roads. In the case of the township being divided into road-districts a portion of the road-fund is used for purchasing tools, sign-boards, and so on, for the township in general. The remainder is spent in the district where it is raised. The road-tax may be worked out to some extent, and all able-bodied men, if called upon, are required to give two days' labor for their poll-tax or pay a fine of $3.00 for each day that they do not work.

A county road-fund may also be levied by the Board of County Supervisors and be expended as they may direct on roads in the county. The work may be done by contract, or otherwise, as they decide.

The opening, altering or vacating of a road is accomplished by petition to the Board of Supervisors filed in the County Auditor's office. The Auditor appoints a commissioner to report on the matter, and if this report is not objected to the Auditor orders the work done. If claims for damages are filed, the Auditor appoints three appraisers, and the Board of Supervisors decides, on their report, whether or not the change shall be made, and fixes the damages. If the damages are not satisfactory, appeal may be taken to the District Court of the county.

The public roads must be sixty-six feet wide unless otherwise determined upon by the Board of County Supervisors, but they may never be less than forty feet wide; and the County Auditor is required to keep a plat of all the public roads in each township of his county on a scale of not less than four inches to the mile.

Kansas.

The roads are in charge of overseers who are elected for each township by popular vote. Some important bridges are in the hands of the County Commissioner. The road-tax, which consists of a property-tax and a poll-tax, is levied by the county officials, but expended in the different townships where it is raised. It may be partly worked out in labor.

There has been no special effort to improve the public roads, which are merely dirt roads without a hardened surface, and are extremely bad in wet weather.

Kentucky.

The Fiscal Court of each county has general charge of roads and bridges and levies annually a road-tax and poll-tax, which may be worked out at the discretion of the court. Able-bodied men must work on the roads or furnish a substitute; they are paid for this work. The County Judge divides the county into road precincts and appoints an overseer for each, who has charge of roads and keeps them in order, and has charge of all persons working on them.

In some counties a supervisor (a competent engineer) is appointed by the Fiscal Court, and he takes general charge of the roads of the county and lets out the work of repair by contract, and reports to the court. Some counties have issued bonds and borrowed money, the bonds generally being taken in the county. Convicts may be worked on the roads.

Over one thousand miles of excellent stone roads have been built in Kentucky, as toll, county, or state roads, under skilled supervision, and it is expected that the present system, adopted in 1894, will result in the permanent improvement of the dirt roads, which are often impassable. Thirty thousand miles of dirt roads are expected to be improved by the new law, especially in counties where the road-tax is paid and a competent engineer is in charge.

Louisiana.

The Parish Police Jury appoints road-overseers to look after the roads. There is no special money-tax levied for the roads, the expense being met from the general parish tax-fund; but all able-bodied men are subject to twelve days' work annually on the roads. This, however, does not appear to be rigorously enforced. A few parishes keep their roads in repair by contract.

Road-machines are being adopted with good results. Oyster-shells and brush covered with dirt seem to be the only surfacing materials in use.

There is some agitation in favor of good roads, but it has not been very vigorous, and so far no great improvement has resulted.

Maine.

The roads are controlled by township officers called Road Commissioners elected annually by the town, except in the thinly-populated parts of the state known as "plantations," where the County Commissioners control the roads.

In some of the smaller towns a special road-tax is levied and arrangements are sometimes made to allow it to be worked out in labor in whole or in part, but the usual method is to meet the road-expenses from the general tax-fund of the town and this cannot be worked out on the roads. Occasionally the state legislature makes an appropriation for a special bridge or road and the work is then done under the direction of a special agent appointed by the Land-agent.

Road-machinery is coming into more general use with good results; stone roads are being built by some of the larger towns and are proving very satisfactory.

Massachusetts.

This state is made up of incorporated cities and towns. The country roads, outside of the cities, are administered by the Selectmen or Road Commissioners elected by the people. When the Selectmen have the jurisdiction, they usually appoint a Superintendent of Streets to carry out their orders. When the roads are in the care of Road Commissioners, the members of the board, usually three or more persons, supervise the construction and repair of the highways themselves. No special road-tax is raised, the money for road purposes being obtained from the general tax-levy, and taxes may not be worked out on the roads. Some towns have issued bonds to obtain money for improving their roads, but this has not happened often.

This system has not proved satisfactory and efforts were made to change it. As a result of the agitation, the governor, in 1892, appointed three persons to make an investigation of the roads of the state and to report to the legislature. They found the roads very bad indeed, and the following year a bill was passed permanently creating the Massachusetts Highway Commission. According to it the Governor was required to appoint three Highway Commissioners to serve three years, one being appointed annually. They were to collect information regarding the roads and road-materials of the

FIG. 34.—Macadam road in eastern Massachusetts.

state, advise as to construction, and so on; to hold public meetings for discussion, and to report annually to the legislature.

When the County Commissioners or Selectmen of two or more towns petitioned the Highway Commission to have a road improved and maintained by the state, if the plans were satisfactory to the Highway Commission, they were submitted to the legislature and a special bill and appropriation asked for. If this was forthcoming the improvement was made at the expense of the state. This led to many delays, and later a fixed appropriation was made to the Highway Commission which they were to use for the improvement of roads without referring to the legislature, and the right to petition was broadened so that it might be taken advantage of by the Selectmen of a town, the Mayor and Aldermen of a city, or by the County Commissioners. This has proved very satisfactory, and the amount of money annually appropriated has grown from $300,000 in 1894 to $800,000 in 1897. Since then, on account of the war with Spain, the amount has been diminished ($400,000 in 1898 and $500,000 in 1899).

When the Highway Commission decides, in answer to a petition, to build a state road, they make careful plans and specifications and estimate the cost. The town in which the road is to be built may then contract to build the road at this estimated cost, or if it does not wish to do so, the work is done by contract with private parties. Both of these methods have proved fairly satisfactory, though it is generally found that it costs the towns more to build a road than it does private contractors, because the towns are very apt to pay higher wages and also to employ less competent workmen. The law requires that laborers should be citizens of the state, whether the work is done by the town or by private contractors.

The Highway Commission has an office in Boston, in a building owned by the commonwealth, and employs a staff of engineers and also appoints a resident engineer to supervise the work of construction of each road that it builds, and to see that all is done according to specifications. The total cost of the work is paid by the Highway Commission, but one-fourth of the amount, with interest at 3 per cent, is repaid in installments within six years by the county in which the work is done. This sum goes into the general treasury of the state. In order to meet the large appropriations for the Highway Commission, a highway loan has been made amounting to $2,700,000; 3½ per cent thirty-year bonds being issued to raise the money.

Roads built by the Highway Commission are state roads and are maintained by the state under the direction of the Highway Commission.

In addition to engineering and construction work the Highway Commission has undertaken a very careful study of the distribution of road-materials in the state, and has also introduced into this country the laboratory methods of determining the value of road-making materials. It has developed an important machine to determine the power with which rock on the road will consolidate into a solid mass, and this is one of the most important properties that a good road-metal can possess.[1] Up to the end of 1898, it had built about 206 miles of roads and had received 452 petitions to build roads. The people are gradually becoming convinced of the convenience and economy of good roads, and petitions are steadily coming in for a much greater amount of roadway than can be built even under the large appropriation made by the state.

Seven valuable annual reports have so far appeared, which discuss the working of the system and give in great detail the different items of expense, such as cost of rock, cost of crushing, hauling, spreading, and so on, for the various roads that have been made; also descriptions of the different rocks and of the experiments made to test their relative values as road-metals.

Too much cannot be said in commendation of the work of the Massachusetts Highway Commission. No state or commission in the country has done so much to improve the methods of road-construction, and to make clear the advantage of a proper selection of road-material, in order that the road should be both satisfactory and economical.

The high average cost of the roads built in Massachusetts, about $10,000 a mile, results from the policy of the commission to improve the worst and most difficult parts of a road before undertaking the better parts, and from the great cost of some of the roads in the mountainous parts of the state. They have not only built substantially, but have made many stone culverts and have put strong guard-rails wherever they were needed. Many of their roads are, however, built at less than one-half the above cost.

Michigan.

The counties are divided into townships and the townships into road districts. The roads are under the control of the Road Com-

[1] For a description of this machine see p. 323.

missioners of the townships and are actually kept in order by the overseers. The Road Commissioners and the overseers are elected annually by the electors. All state roads are under the charge of the township overseers.

The amount of road-tax is voted annually at the township meeting and the electors decide what proportion of the road-tax shall be paid in labor and what proportion in money. Any one may send a substitute to perform his labor tax. There is also a poll road-tax.

In the case where the expense on one part of a road or on a bridge is greater than $50 the work is done by contract. If the expense amounts to more than $100 the Road Commissioners must have the concurrence of the Township Board. In the case of special expenses on bridges not exceeding $1,000 the Township Board must decide on the advisability of the expense. If the expense is greater than this sum it can only be made by a vote of the electors. In some cases the county may appropriate a sum to be divided among the townships for the repairs of their bridges.

New roads may be opened, or old ones altered and closed, by the Road Commissioners, but there is always a right of appeal from their decision to the Township Board.

The public roads must be at least sixty-six feet wide.

In 1893 a law was passed allowing counties to pass from the township to the county system of road administration on vote of the electors, and a number of counties have taken advantage of it. In this system all the roads of the county are under the direction of County Road Commissioners, and the office of Township Road Commissioner is abolished.

MINNESOTA.

The roads are under the care of overseers elected by the voters of the townships. A poll-tax and a property-tax are levied, which may be paid in money or be worked out at the option of the taxpayer.

A law passed in 1895 permitted townships, by vote, to abolish overseers and the poll-tax, and to put the roads under the control of the Township Supervisors, who were to appoint superintendents to look after the construction and repairs of roads; and the road-tax must be paid in money. Only two townships took advantage of this law, and their roads have greatly improved.

In addition to the township system the County Commissioners may construct new roads and issue bonds to meet the expense, if voted for by the electors of the county. The county provides a special road fund out of the county levy to be used by the County Commissioners wherever they think advisable. These county roads are to be at least 66 feet wide.

In 1897 an amendment was passed to the state constitution, permitting the state to aid in the construction of highways, and this amendment was adopted by the voters the following year. In continuance of the same idea, a bill was introduced in 1899 to establish a State Highway Commission to investigate the roads and road materials of the state, and also to establish a State Highway Fund to meet one-third of the cost of making or improving important highways in the state, under the direction of this commission; the amendment to the constitution had not yet become sufficiently familiar to permit the passage of this bill, but there is considerable agitation at present on the subject, and it is expected that a similar bill will be passed before long. The interest in the object of good roads is growing and has already resulted in some marked improvement.

Mississippi.

The County Supervisor has control of roads and appoints overseers, who attend to repairs. The law requires able-bodied men to work ten days a year on the roads; but they rarely work more than two. Little interest is shown in the improvement of the roads.

Missouri.

New road-laws have recently been passed which go into effect in January, 1900. According to these the County Court divides the counties into districts and appoints three County Commissioners in each district to serve for a term of three years without salary. The commissioners have entire control of the public roads and may employ laborers to do the necessary work or may let the work by contract.

There is a property and poll-tax; the latter may be paid directly to the County Commissioners or may be worked out on the roads. These road-taxes must be spent or worked out in the district where they are raised.

In addition to these taxes there is a special tax of 15 cents on the hundred dollars assessed valuation of real and personal property to be spent on the roads of the county. This raises an annual fund of about $1,500,000. Some counties have been using the liquor license tax for road-purposes and have made with it many miles of macadam roads. Some of these roads have been well made but are being neglected and are deteriorating. The use of a portion of the liquor license and also of three-fourths of the fines from violation of the beer-inspection law has been made general in all the counties of the state; the sums thus realized together with the special tax mentioned above will largely increase the amount available for road-purposes, which has heretofore been more than $3,000,000.

The Interstate and State Good Road and Public Improvement Association has its headquarters in St. Louis, and is doing much to awaken interest in the subject of roads. Seventy-three conventions were held in various counties of the state last year. The new laws were largely due to this association.

Montana.

The County Commissioners divide the counties into road districts and one supervisor is annually elected for each district, to serve for one year. The Road Supervisors take charge of the roads under the direction of the County Commissioners and keep them in order and employ labor to help them in the work. There is a property- and a poll-tax levied by the County Commissioners and applied to the roads in the district where raised. Provision is made to allow persons to pay their tax in work on the public roads. The public highways must be at least sixty feet wide. Tolls on roads and bridges have been abolished.

In 1897 the roads were taken out of the hands of the Road Supervisors and the County Commissioners and put entirely in the charge of the County Surveyors. For some reason this plan does not seem to have worked well, for in 1899 the law was abolished and a return was ma'e to the former method of supervisors. It does not appear that the work may be done by contract.

Nebraska.

The townships when organized, and otherwise the counties, are divided into road-districts and overseers supervise the repairs of the roads in the territory under their charge.

A labor- and money-tax are levied for the maintenance of the roads. Three-quarters of the latter may be worked out in labor, but the other quarter must be paid in money. A part of this tax is kept as a general county or township road-fund; the remainder is spent in the district where raised.

The soil of Nebraska is of such a nature that it packs easily and naturally makes good roads. In the country regions it has not been found necessary to undertake any special construction, the roads remaining fairly good the whole year; all that is necessary is to provide proper drainage.

Nevada.

The roads are under the charge of the County Commissioners, who have full control in their respective counties. There are no roads built or controlled by the state.

New Hampshire.

Each town consists of one highway district, and annually at the town meeting one to three Highway Agents are elected, who have charge of the construction and repairs of all highways and bridges, and may employ the necessary men, teams, etc., to help in the work. These agents report monthly to the Selectmen of the town, with regard to their expenditures and the repairs of the roads. They hold office for one year.

At the annual election of the town the road-taxes are fixed as a certain proportion of the polls and of the general taxes levied. In

1899 an act was passed which became effective in such towns as decided by vote to adopt it, as follows:

Each town is divided into as many highway districts as the Selectmen think expedient, and the Selectmen appoint a Surveyor of Highways in each district who has entire charge of the roads under the direction of the Selectmen. The taxes are raised as in the former method, and are, in general, expended in the district in which they are collected; but if the funds of a district are more than necessary for its wants, they may, by order of the Selectmen, be transferred to a district where they are more needed. These taxes must all be paid in money. About one-quarter of the towns of the state have voted to adopt this law of 1899.

The roads and bridges of the state are, in general, in charge of the towns, but the state government annually appropriates money for the repairs of highways in the summer resort regions of the state, this being done under agents appointed by the Governor and Council. The last Legislature, at the suggestion of Governor Rollins, provided for the construction of two boulevards, one running along the seacoast from Salisbury to Newcastle and the other from Nashua to Manchester.

As there is no general standard or system of construction in the state, the highways vary in condition in the different towns. The state board of agriculture is about to take up as a part of its institute work the task of informing the people of the advantages of good roads and the manner of constructing them.

New Jersey.

The improvement of the roads in New Jersey is being carried on under three different systems. Formerly overseers were elected annually in each township, but this office has been entirely abolished, and the roads are now in charge of either the Township Committee, or the Board of Chosen Freeholders of the county. Excepting those which are controlled by the county, as described below, the public highways are, in general, under the direction of the Township Committee, which appoints supervisors to oversee the repairs to the roads.

The road-tax is levied by the Township Committee and must always be paid in money; it is spent in the township.

If certain persons desire to improve a road and will contribute towards this end, the township, on the vote of the electors, may then add an equal or less amount to that already contributed, and improve the road. Further, if one-third of the tax-payers of the township, representing at least two-thirds of the property, petition for the issue of bonds for the improvement of the roads, the question is submitted to the voters, and if they vote in favor of it, the bonds are issued by the Township Committee. There is a limit to the amount of bonds which may be issued.

According to the county system, the Board of Chosen Freeholders may take full control of any road in the county to improve and maintain it. The work of improving the road must be done by contract, and the money is raised by a special levy, or by the issue of county road bonds, these bonds being voted for by the electors. One-third of the cost is paid by cities, townships, or towns, and two-thirds by the county at large. The Board of Chosen Freeholders employs an engineer to make all the plans and specifications for the improvement of the roads, and then employs a County Supervisor to inspect the roads and to see to proper repairs when needed.

A State Aid Law was passed in 1891 for the purpose of encouraging the improvement of the roads throughout the state and has received several amendments since then; its action at present is as follows: The state now appropriates annually $150,000, and the Governor appoints a Commissioner of Public Roads to see that the provisions of the law are carried out.[1]

The appropriation must be distributed among the counties in a way which seems equitable to the Commissioner of Roads. If the Board of Chosen Freeholders thinks that a road should be improved under this act, or if the property owners on the road petition for its improvement, then specifications must be drawn up and preliminary bids obtained to ascertain the approximate cost, and these must be

[1] In 1891, the first year of the law, the state appropriated $20,000; the following three years, $75,000, and since then until 1898, $100,000 annually.

submitted to the Commissioner of Public Roads. If they meet his approval and he thinks the road of sufficient importance, and there is enough money remaining from the state appropriation, the improvement is made, the work being done by contract.

The Commissioner of Public Roads appoints a supervisor to oversee the construction, and to see that the specifications are carefully observed. If the road has been petitioned for, the property owners nominate a supervisor; but this provision has not proved useful, as different supervisors have been nominated even by the same property owners. The roads built or improved under this act are paid for as follows: One-third by the state, and two-thirds by the county; or, if petitioned for, one-third by the state, 10 per cent by the property owners, and the remainder by the county. Upon vote of the electors, the county may issue bonds for the payment of its share of the work.

These laws have proved of great value to the state, and have resulted in the building of many miles of most excellent hard roads by townships and by the counties. At first there was great opposition to the State Aid Law, so great, indeed, that none of the appropriation for 1891 was called for, and less than one-third of that for 1892; but it has rapidly grown in popular favor, and during the present year, 1899, about 120 miles of road are being built at a total cost of about $500,000. The amount of bounty applied for is many times as much as the increased appropriation, and the applications come more especially from counties which have already taken advantage of the law. Fourteen counties of the twenty-one belong to this category, and about 325 miles of road were built under the law between 1892 and 1898.

At this year's session of the Legislature the State Aid Law was extended so that a township or other municipality might obtain the state bounty for the improvement of their roads, if the authorities were petitioned by abutting property owners, who agreed to meet 10 per cent of the cost. The roads so improved remain under the care of the town, or municipality, and do not become county roads.

If certain individuals desire to improve a particular road and are willing to meet the whole expense of doing so, they apply to the

County Supervisor, who must then draw up the proper plans and specifications, and the road is improved by contract, and then becomes a county road or a township road, according to the decision of the Board of Chosen Freeholders.

A law has been passed permitting townships to offer a rebate in the road-tax to those using wide tires, and a few townships have done so, but the expense of changing to wide tires has been an obstacle to their use. Efforts have been made to make wide tires

FIG. 35.—Sandy road with improved gravel road in foreground, New Jersey.

compulsory, but have not succeeded on account of the opposition of the Governor.

The Commissioner of Public Roads publishes an annual report of the work done under the State Aid Law, and so far there have appeared five of these reports, which give very valuable information as to the best methods of road construction and the cost.

The road materials of New Jersey are very much like those of eastern Maryland, and the problems in the two states have many points of similarity. The excellent trap rock which occurs in the northern part of the state is extensively used, being sometimes transported half the length of the state. In the eastern and southern parts of the state gravels, very much like those of Maryland, furnish the materials for very good and cheap roads. The widths adopted are eight, ten, and twelve feet, according to the amount of travel; the cost of macadam roads is between three and five thousand dollars a mile; and one long piece of gravel road was built at a cost of $1,400 a mile. The new roads have been of great benefit to the state in the increase in the value of real property, and in bringing to the state many persons who might otherwise live elsewhere.

The excellent quality of the roads seems to be due to two causes: (1) That the roads are made by contract; and (2) That they are made under the supervision of trained engineers, and moreover, the improvement of the roads is stimulated by state aid.

New York.

The counties are divided into towns, and in each town there is an elected Highway Commission of one to three persons who have charge of all the roads and bridges of the town. They divide the town into highway districts, and appoint an overseer of highways for each district. An early law, which still holds, requires all able-bodied men to work at least one day annually on the roads of the district in which they reside; but the work may be commuted at the rate of $1.00 per day of 8 hours, except in Queen's county, where there is a special system. Towns may change by vote from this labor system to the money system of taxation. In towns which have adopted the money system, the Highway Commissioners are not required to designate highway districts, nor to appoint overseers, and they may let the work by contract, or have it done subject to such supervision as they think best. When overseers are appointed they take charge of the roads, keep them in order, and supervise the work of the men working out their tax, and also collect the commuted road-tax. They report to the Highway Commissioners. These latter report twice a year to the town board. The Supervisors of a county may authorize a town to borrow money for the improvement of special highways or bridges, upon vote of the electors, or upon petition of the Highway Commissioners and the Town Board.

The system of each township taking entire charge of its own roads has not proved perfectly satisfactory, and a law was passed in 1895 allowing the County Supervisors to take charge of all important roads in the county, to manage them, and if necessary to improve them. Very large sums of money were necessary for this, and the supervisors were authorized to issue bonds for the purpose. Every township in which a county road exists is required to adopt the money system of taxation and to abolish the labor system. County roads are under the charge of a county engineer appointed by the Board of Supervisors. A number of counties have taken advantage of this law and are improving their roads.

Following the example of New Jersey, Massachusetts, and Connecticut, the New York Legislature passed a law in 1898 providing for state aid to important roads. According to this law the County Supervisors of their own motion, or on petition of property holders with their approval, may request the state engineer, who is elected by the people, to improve certain roads of the county with state aid. If the engineer approves, surveys and plans are made and specifications drawn up, and the work is done by contract. The contract may be given to the towns through which the road passes, if their bid does not exceed the estimate of cost. In counties having a county engineer, he assumes supervision over the construction, under direction of the state engineer, and in other counties the state engineer employs a competent engineer as supervisor. The cost of making these roads is paid, one-half by the state, 35 per cent by the county, and 15 per cent by the town; but if the road is built as the result of petition, the last 15 per cent is paid by the persons owning property benefited by the improvement, and not by the town. On completion of the road it is turned over to the County Supervisors for maintenance, but this does not seem very satisfactory, for a bulletin issued by the state engineer in 1899 suggests that the control of these roads be put under the state department.

Persons owning property abutting on a state road must, after its construction, pay their road-taxes in money. The state engineer may require counties to complete small lengths of roads under this act for the purpose of connecting pieces of state road already built. The state engineer is expected to compile statistics regarding the roads of the state, to inspect the lengths of road under construction and to give advice to county and town officers.

There have been seventy-nine petitions for 450 miles of roads to be built with state aid under this law in the first year of its operation; and as the state appropriation is but $50,000, only a small number of these petitions could be complied with. Up to April, 1899, contracts had been made for about 15 miles of road, distributed in five counties.

The Highway Commissioners of their own motion, or on petition, may open, alter or vacate a road, provided no objection is made to their plans, but if any one interested is not satisfied he may appeal to the County Court, which then appoints three commissioners to report to them on the advisability of the change. Their decision is final unless an appeal is made to the County Court. The commissioners assess the damages. All new roads made in the state of New York must be at least three rods, or 59½ feet wide, and for the sake of encouraging wide tires, persons using tires at least three inches wide on two-horse wagons receive a rebate of one-half their road-taxes, within certain limits.

There is great improvement of roads in New York, and many miles of excellent roads have been constructed. A Manual of Highways has been published under the direction of the state, which gives all the laws, with a careful explanation of them, and also gives the best methods of road construction, and other subjects relating to roads. The State Museum has undertaken the study of road materials, and a very interesting bulletin showing the location of quarries and kindred facts, has been issued.

North Carolina.

The system of road administration varies very greatly in the different counties, but, in general, we may say that the counties are divided into townships, and these again into road districts. In some counties a road superintendent is elected by the people or by the County Commissioners, and he appoints supervisors of townships. In counties where no superintendent exists, the supervisors are elected by the County Commissioners. Under the supervisors come the overseers of the districts, who are usually elected by the Board of Magistrates, and who take charge of the actual work on roads.

Many counties levy both a property- and a poll-tax, and in some cases these may be worked out. The tax is spent on the roads in the district where it is raised. The Legislature has at various times passed special acts permitting certain counties, on vote of the people, to raise money by the issue of bonds. Some counties have done this, and they are making many miles of fine macadam and shell roads.

The Mecklenburg Law, passed in 1879, which was originally intended to apply to the counties and state as a whole, but which was limited to Mecklenburg county, has resulted in many excellent roads in the county. This law put the control of the roads under the Township Trustees, who divided the township into road districts and appointed a supervisor for each. Every able-bodied man was required to work four days a year on the roads or commute in money. There was in addition a money-tax, which might be worked out. Convicts were worked on the roads and their expenses met by the money road-tax. In Charlotte township a general superintendent of roads was employed, and the money-tax might not be worked out. The recent law of 1899, modeled after the Mecklenburg Law and applying to quite a number of counties seems to be popular and will probably gradually be extended to the whole state. According to this the County Superintendent of Roads, or the Township Supervisors, are elected by the County Commissioners, and they direct the repairs to the roads. Some counties levy a regular tax for the improvement of the roads, and, in addition to this, each able-bodied man must labor four days annually or pay $2. This method of working out the road-tax is to be gradually abolished, the County Commissioners having the right to reduce the number of days of labor and increase the money-tax, so that in a few years the working out of road-taxes will be entirely abolished. In addition to these county taxes, the townships raise a special tax for its roads. Convicts have been very generally employed on the roads with highly satisfactory results. The present law provides for their employment under the general direction of the County Superintendent of roads. Roads built under this law must be at least twenty feet wide, except under exceptional circumstances, and old roads may be relocated in order to avoid heavy grading.

In order to encourage the use of wide tires, a law authorizes the County Commissioners to make a rebate amounting at most to one-half his road-tax to any one using wide tires on his wagons. The width of tire required in order to obtain the rebate depends upon the capacity of the wagon.

The great improvement of the roads is largely due to the interest taken by the people of the state in the matter. A State Good-Road League, with several branches, works to increase public sentiment, and excellent work is being done by the State Geological Survey under its energetic director, in the study of the distribution and quality of available road materials, as well as in advocating the improvement of the roads.

North Dakota.

The roads are under the charge of the township officers.

The amount of road-tax is annually voted at the town meeting; and on petition the question of the maintenance of the roads by contract may be submitted to vote.

In addition, in counties of 5,000 or more inhabitants, there may be levied a county road-fund, which shall be expended under the direction of the County Commissioners for the improvement of important roads.

Ohio.

The system of road administration in Ohio is very confused. The laws are very numerous and different in different parts of the state. The roads may be divided into (1) state roads, which run between two counties, (2) county roads, and (3) township roads.

The first two groups are under the charge of the County Commissioners. The township roads are under the charge of the Township Trustees, who appoint supervisors to see to the repairs. Township roads may be substantially improved if so decided by the Trustees, but they must employ a competent engineer to oversee the work, and they may issue township bonds to meet the expense.

A somewhat similar rule applies to the improvement of county roads. There are also special laws allowing the building of *free* turnpike roads, *one-mile* turnpikes and *two-mile* turnpikes, with many provisions looking towards possible contingencies.

The county and state roads must be between thirty and sixty feet wide and must be marked by the County Commissioners with suitable stone monuments. The township roads must be between 16 and 60 feet wide. Sign-boards must be placed where needed.

The road-tax is levied by the County Commissioners for the county roads and by the Township Trustees for the township roads, and may be worked out.

Oregon.

The County Court has general charge of the roads, though in some counties, a "road-master" is appointed by the Court for their more immediate supervision.

The Court divided the county into road-districts over each of which the voters biennially elect a road-supervisor, who is required to serve or to pay a fine of $25.00. The road-tax is levied in labor, and consists of a property-tax of one day's work for each $1000 assessed valuation, and a poll-tax of two days' work for all able-bodied men. These taxes may generally be commuted in money, and the County Court may require the property-tax to be paid in money. No other road-tax may be imposed, but the County Court may order bridges built or repaired, and roads constructed from the general tax-fund, within certain limits. The supervisor has charge of all details and carries out the provisions of the law. He superintends the labor, collects the taxes and expends them, reporting to the County Court.

A certain proportion of the receipts from the sale of the public lands of the state, and the direct tax collected by the National Government in 1861 and afterwards returned to the state, is to be divided among the various counties for the improvement of roads and bridges.

In order to encourage the use of wide tires a law has been passed which will become effective in 1900 to give a rebate of $1.00 per wheel on all wagons having tires three or more inches wide and an additional rebate of $2.00 per wagon if the tires are four or more inches wide, provided the front and back wheels do not track.

In February, 1899, a bill was passed authorizing the employment of convicts to work on county roads under the control of the road-supervisor, but it is too soon to draw conclusions as to the success of the plan.

Roads are opened, altered or vacated by order of the County Court on petition, after receiving the report of three viewers who are appointed by the court. Public roads are to be sixty feet wide unless the County Court decides otherwise, but they must not be narrower than forty feet nor wider than eighty feet. Guide-boards must be placed where needed, and mile-posts or stones are to be placed along the public roads.

Pennsylvania.

The counties of Pennsylvania are divided into townships, and each township maintains its own roads. Supervisors are appointed, three for each township, who hire laborers to keep roads and bridges in repair. The supervisors themselves do not work on the roads, but correspond more to the Road Commissioners of some counties of Maryland. Three-fourths of the road-tax may be worked out on the road, but the Road Supervisors may collect some or all of the other fourth in money in order to buy road machinery or to meet other expenses requiring money. Roads are opened, altered or closed by order of the Court of Quarter Sessions, from whose decision an appeal may be taken to the Court of Common Pleas.

Persons using tires at least 4 inches wide on wagons carrying 2,000 pounds or over, are allowed a rebate of one-quarter of their road-tax.

Guard-rails and bridges, too expensive for the township to build, may be built by the county.

In 1895 a law was passed for the special purpose of allowing an improvement of the roads around Pittsburg, but it was made a general law of the state. The control of the roads of the county was vested in the County Commissioners, who were to decide on the improvements to be made. Their plans must be approved by a Grand Jury and by the Court, and then the work is to be done by contract, the

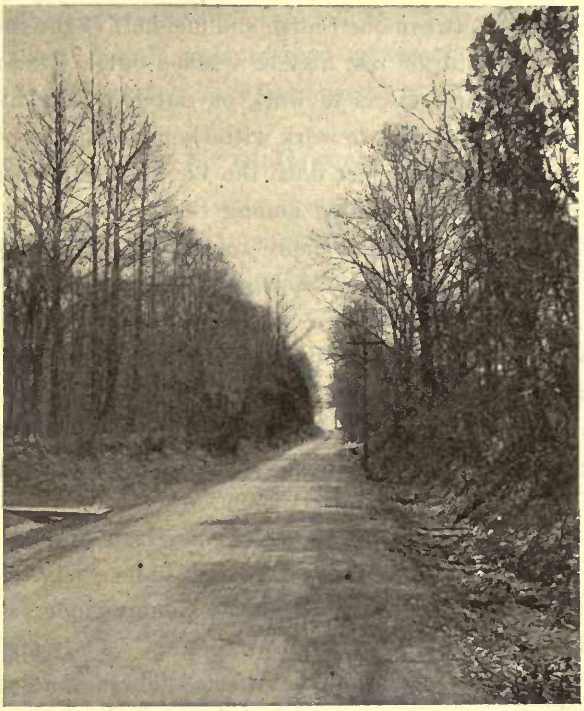

FIG. 36.—Macadam road at Bryn Mawr, Pa.

expense being met by the county. Roads built under this act are county roads and are under the care of the County Commissioners. The law provides for the awarding of damages, appeals, etc.

The above represents in general the state of the laws in Pennsylvania, but there are so many and such a variety of special laws for individual townships that it is impossible even to indicate them all in a short outline.

In 1896 the Department of Agriculture of Pennsylvania, under the supervision of Deputy Secretary of Agriculture John Hamilton, collected and published all the road-laws of the state. They consisted of a mass of special acts, so confused and cumbersome, that the following year Mr. Hamilton introduced into the Legislature a simple and comprehensive law, providing for township control of roads under three supervisors elected to serve three years, one supervisor being elected annually. Between one-fourth and one-half of the road-tax must be paid in money and the rest may be worked out. Road-masters are appointed by the supervisors to work on not less than five miles of road and to employ laborers to work with them. This law was passed; but it was not to go into effect until the Legislature appropriated one million dollars to be distributed among the townships in proportion to their road mileage, but no more to go to any township than is raised for road purposes in that township.

Although the legislators were pledged to appropriate this sum at the last Legislature, 1898, the difficulty of electing a United States Senator prevented the consideration of the subject.

Some wealthy townships, such as Bryn Mawr and Haverford, have built most excellent roads, but the roads in the state generally are not good.

Rhode Island.

The roads are in charge of the Highway Commissioners of the town, who are elected annually at the town meeting. They appoint supervisors to attend to the repairs of the roads. There is no special road-tax, but at the annual town meeting a certain sum is appropriated from the general tax-fund for the building and maintenance of the roads, and this of course may not be worked out in labor.

A law has been passed to become effective in 1902 according to which the tires of all wagons must have a certain breadth dependent upon the size of the axle and new wheels added to wagons after April 1, 1898 were required to comply with the law.

In order to educate the people to the benefits of good roads, a State Highway Commissioner has been appointed and authorized to build sample half-miles of roads in townships applying for them, three-quarters of the cost being met by the state and one-quarter by the township in which the road lies. A number of sample pieces have been built. This law has been repealed and at present Rhode Island is doing nothing as a state to improve its highways.

South Carolina.

Very little progress has been made and the roads are very bad.

The Township Board appoints road overseers, who supervise the work on the roads; convicts have been used.

South Dakota.

In some counties of this state the roads are in the hands of the County Commissioners, who appoint supervisors to keep the roads in order; in counties where townships have been organized the Township Trustees administer the roads, and the road-supervisors are elected. The County Commissioners levy the road-tax, which consists of both a property- and a poll-tax. It must be expended in the district where raised and may be worked out in labor.

In the eastern part of the state where the country is level the roads are good, but in the mountainous region to the west they are very bad, and no special movement has been inaugurated to improve them. Public highways are required by law to be 60 feet wide.

Tennessee.

Until the present year the counties were divided up into road districts, with a Road Commissioner over each, who appointed overseers to have charge of small sections of the roads, but the present law requires the County Court to elect a Road Commissioner biennially, who has charge of all the highways of the county. The office of overseer has been abolished and all the work on the roads is done by contract.

The County Court levies a property road-tax, and also requires every able-bodied man to work a certain number of days on the roads, but he may commute this by a small payment. The road-tax is spent in the district where it is raised, the contractors having the right to call on all persons liable to work who have not commuted their tax.

The opening, changing, or vacating of highways is done by petition to the Road Commissioner, who then reports to the County Court, which decides the question, with the right of aggrieved persons to appeal.

There are many miles of toll roads in Tennessee, for which the people pay annually a very large sum in tolls. Some counties are doing good work in improving their roads. Hamilton county in particular has made great progress. The convicts under punishment for small misdemeanors have been organized into a force to work on the public roads, and many miles of good telford roads have been built by them.

Texas.

Roads are under the control of the County Court, which appoints supervisors to oversee repairs to roads; there is a poll-tax of five days' work annually, but it is not strictly enforced. The roads in general are very bad, but there has been some interest aroused in the subject, resulting in the state convention of 1895, and some good roads have been built. Convicts have been employed to some extent on the roads.

Utah.

The County Court has general supervision of the roads of the county, which it divides up into districts; the court appoints a supervisor biennially for each. The supervisors take charge of the repairs of roads in their districts and see that everything is kept in order. They report annually to the County Court.

The roads are kept up by poll-taxes, which may be paid either by two days' labor or in money.

The opening, altering or vacating of roads is in the hands of the County Court.

Vermont.

Road Commissioners are elected annually by each town and have charge of all the highways of the town. The Town Selectmen levy a road-tax which must be paid in money and may not be worked out; this is applied to the roads of the town. The larger bridges are under the control of the Selectmen and are repaired out of the general town taxes.

County Road Commissioners are appointed by the County Court, whose duty it is to see that the Selectmen of the town keep in order the roads under their charge; but they do not themselves have charge of any roads.

At the last Legislature a bill was passed authorizing the Governor to appoint a State Highway Commissioner. This office is largely advisory. The State Highway Commissioner meets the Town Commissioners of each county and discusses with them the advisability of the improvements, and the best methods of improving the important highways in their county.

A state road-tax, which was formerly divided between the towns, according to mileage, is now used to pay one-half the expense of improving the main thoroughfares, subject to the approval of the State Highway Commissioner, who decides which roads shall be improved and makes the specifications; the other half is paid by the towns through which the thoroughfares pass.

If the Selectmen are petitioned to open, alter, or vacate a highway, they examine the premises and decide the matter; any one interested in lands through which the road passes may appeal to the County Court, which then appoints three commissioners to report on the project, and the court decides on their report.

Much interest is felt in Vermont in the improvement of the roads and already much work has been done.

The adoption of wide tires is also becoming more general, though there is no law requiring them.

Virginia.

There is no general system of road administration in Virginia, but the various counties have special methods of their own. In some cases the laws are administered by the counties or by the township officers, who are sometimes elected and sometimes appointed. These officers appoint Road Supervisors to attend to the actual repairs.

A property road-tax is, in general, levied, and to this a poll-tax is added in some counties, and in some cases it may be worked out in labor.

There is great interest in the subject of the improvement of the roads, and many meetings are held where the matter is discussed. The use of road-machines is becoming more general, but so far there has not been any marked improvement in the general condition of the roads.

Washington.

The counties are divided into road districts, for each of which a supervisor is annually elected by the voters. At the same time the voters decide on the amount of the road-tax to be paid for the year. This tax is to be expended in the district where it is raised, the people, however, being permitted to work out this tax on the roads. In addition to this there is a road-tax to be paid in money. On petition to the County Commissioners new county roads may be laid out in width between thirty and one hundred feet. The County Commissioners appoint viewers to examine the feasibility of the plan and decide on damages to be paid.

West Virginia.

The election districts in each county are divided by the County Court into a number of road precincts, over each of which it biennially appoints a surveyor of roads, who is obliged to serve or pay a fine. He has charge of the roads and bridges, keeps them in order and repairs them, and may hire such hands, wagons, and so on as he may require for the work; and he reports the work done and his accounts to the County Court. The work must be done during the summer and sign-posts are to be put up at cross-roads.

The County Court determines the amount of the road-tax and it is expended in the district where collected. This tax may be worked out on the roads in person or by substitute, but the court may require not more than one-third of the tax to be paid in money.

When large bridges are to be built the work is done under the order of the County Court, who may let the work by contract and pay for it out of the county treasury, by special levy, upon the vote of the people, or by issue of bonds.

When special work is done for the construction and improvement of the roads, the court appoints three commissioners, one of them being an engineer, to superintend the work.

Upon petition, roads, bridges or landings may be opened, altered or closed, the County Court appointing viewers to consider and report to them on the project, and they decide whether or not to undertake it. If damages cannot be settled by agreement then condemnation proceedings are resorted to.

Although nearly $700,000 are spent annually on the roads, very little improvement has resulted, but interest is aroused in the subject and improvements may be expected.

Wisconsin.

The roads are under the direction of the Town Supervisors, who are elected by the people, and they appoint superintendents to care for the roads. Formerly a "path-master" was in charge of the roads of each school district, but this office has been abolished. The Town Supervisors levy a property-tax and in some towns also a poll-tax, which may be worked out in labor on the roads. A town may also vote to levy a special tax to improve its roads, but there appears to be no provision for borrowing money on bonds for this purpose.

Public roads must be 4 rods, 66 feet, wide unless the Supervisors decide that 3 rods would be wide enough. Wagons with tires three inches wide are exempt from taxation.

There are some agitation and interest throughout the state in the improvement of the roads and some roads have been graded and macadamized. The Geological and Natural History Survey of Wisconsin is engaged in the study of the road-making materials of the state.

Wyoming.

The County Commissioners have general charge of all public roads in the county. The care of the roads is in the hands of a County

Supervisor, elected biennially; or the County Commissioners may divide the county into road districts, with a Supervisor elected for each; these Supervisors are under the direction of the County Commissioners.

The County Commissioners annually levy a property-tax for maintenance of roads, and in counties divided into districts may also levy a poll-tax, which may be worked out on roads.

Opening, altering or vacating a road is by petition to the County Commissioners, who appoint a viewer to examine and report on the matter. If damages cannot be easily adjusted, appraisers are appointed; and the County Commissioners come to a decision after they report. Appeals may be taken to the Circuit Court.

Roads, in general, must be between 60 and 100 feet in width, and sign-boards are placed where the County Commissioners think they are needed.

The Employment of Convicts in Road-Building.[1]

The employment of convicts for work on roads is a question that has been much discussed, arguments being used both for and against it. In some parts of the South they have been employed for a number of years, and so far with success. In 1895, Professor J. A. Holmes, State Geologist of North Carolina and Secretary of the State Road Association, wrote as follows:

"The use of convicts on public roads has been so intimately connected with the growth of the road movement in North Carolina that it deserves some special mention in this connection. Even prior to the first adoption of the Mecklenburg road law, the General Assembly of the State had made provisions (1867, 1873, 1875, 1877, 1879, and later, in 1889) for the use of convicts in case any county should desire it. But little was done in this direction, however, until the work was begun in Mecklenburg County. From that day down to the present the use of convicts has been an essential feature in Mecklenburg and in the majority of the counties of North Carolina which have joined in the movement. Indeed, this use of convicts has in the majority of cases been the most important factor in deciding these counties to vote a tax for the improvement of the public roads, and the result of the experiment in this State has been altogether favorable to the system, both in point of efficiency and economy and in the health of the convicts.

[1] See U. S. Dept. of Agric., Office of Rd. Inquiry, Bulls. 11, 16 and 19.

"The returns from eighty counties in the State show that the average cost of convicts when they are confined in the county jail is a little more than 30 cents per day; whereas the average cost per day per convict, including feeding, clothing, medical attention, and guarding, when they are employed on the public roads, is as follows in several of the more prominent counties: Mecklenburg, using 80 convicts, 20 to 22 cents per day; Wake, 57 convicts, 20½ cents per day; Durham, 40 to 50 convicts, 17 to 20 cents per day; Cabarrus, 20 convicts, 42 to 45 cents per day; Buncombe, 65 convicts, 35 cents per day; Alamance, 22 cents per day, Davidson, 20 cents per day; Forsyth, 25 cents per day; and Lenoir, using from 10 to 15 convicts, 15 cents per day—a general average of about 24 cents. In the case last mentioned (Lenoir) only short-term convicts are employed.

"In all cases these convicts are carefully described and photographed. They are offered certain inducements in the way of reward or shortening of term if they remain at their posts and faithfully discharge their duties. And with this they are employed on the public roads very much as hired labor would be, under the control of a superintendent or foreman, but without any guard, and they are allowed to remain at their homes from Saturday night to Monday morning. This novel experiment has now been in operation for a year, and not a convict has attempted to escape or declined to labor faithfully, and the result has been a decided improvement in the public roads.

"An examination of the records of all the counties that are using convict labor on the public roads shows that but few convicts have escaped; that the health of the convicts has been much better when at work on the roads than when formerly imprisoned in the jail; that their labor has proved more efficient than that which can be hired in the country at ordinary prices of from 50 to 75 cents per day; and that these figures show, it not only costs less to use the convicts on the public roads than it does to employ hired labor, but that furthermore, it costs less to maintain these convicts when at work on public roads than when confined in the county jail."

Since this was written the employment of convicts in North Carolina has increased, and many miles of excellent roads have been built by their labor, and no objection seems to be made against this work in that state. In Georgia a similar plan has been adopted, and there also it is looked upon as a great success.

When the question was before the New York Legislature some years ago, the Prison Association of New York objected very much to the use of convicts on the roads and passed a resolution "That this Association most emphatically deems the employment of convicts upon the public roads as demoralizing alike to the public and to the convicts themselves." The objections made by this Association were (1) that the employment of convicts would interfere with outside labor; (2)

that the state convicts could only be employed on state roads according to the law; (3) that a large force would be required to prevent escapes and that many escaping convicts would have to be shot; (4) that the prejudice against convict labor would necessitate a military guard to protect them; (5) that it is demoralizing to the convicts to employ them publicly, and also demoralizing to the public at large. The Legislature, nevertheless, passed the bill permitting the use of convicts on public roads within a certain distance of the prisons. The results have not justified the objections made by the New York Prison Association. The warden reports that the work has gone on very satisfactorily. On the other hand this convict labor has not been very profitable to the state. It was also found in Virginia that convict labor on the railroads was not economical. But the report of Professor Holmes just cited shows that in North Carolina convict labor is efficient; and this may also be said of Georgia.

Another method has been adopted in California. The convicts at Folsom Prison work a stone-crushing plant, and the broken stone is sold to the counties at a small advance on the actual cost of the production. There is natural waterpower at Folsom which is used to run the machinery. By this method large quantities of stone have been broken and have been distributed at very small cost by the railroads to various parts of the state, and the work is looked upon as extremely successful.

The objection to convict labor on the roads because it competes with free labor is not worthy of serious consideration; for it is certainly more to the advantage of the free laborers to have the roads improved for them than to pay taxes both for the improvement of the roads and for the support of the convicts also; and this is true even for the comparatively small number of laborers who might be employed on the roads.

In the following states convicts are employed on the roads: Georgia, Mississippi, New York, New Jersey, North Carolina, Oregon (recently), Texas, and Virginia. In other states either they are not so used or no information could be obtained in the matter. In response to questions asking the nature of public sentiment on this subject, many answers stated that the people were much opposed to the public use of convicts. The experience of the states where they are used seems to show that they can be used to advantage under certain circumstances, and, moreover, the work which they do seems to be healthful and advantageous to the convicts themselves. The objection to their exposure to public view is a valid one, but so far does not seem to be practically very serious. The other method of employing them in quarries to prepare stone for the roads is entirely free from all reasonable objections, and unless it should be found that the stone can be prepared more cheaply by free labor, this method seems to be extremely good. In determining the relative cost of stone produced by convict or by free labor, the only expense that should be charged against convict labor is the expense in addition to that which would be necessary if they were kept in the prison. This differs greatly in different localities, as has been shown, the convict labor being hardly profitable in New York, and there being a distinct financial gain in North Carolina. Talbot and Queen Anne's counties have laws permitting the working of convicts, but their number has been so small that it was not economical to employ them.

When the time comes for Maryland to undertake the improvement of her roads on a large scale, it is not improbable that convict labor may be used with advantage in certain parts of the work.

THE ADMINISTRATION OF ROADS IN EUROPE.[1]

Austria.

In Austria there are two classes of roads—State Roads and Provincial Roads. In 1873 there were 15,000 kilometers of state roads. They are entirely maintained by the state, and tolls are charged. These roads are generally of macadam construction, but in some regions are telford. They are very heavily built; indeed, far more heavily than is consistent with true economy. Wide tires are pre-

[1] Much valuable information on this subject is contained in U. S. Consular Reports on Streets and Highways in Foreign Countries. 1891.

scribed for wagons carrying heavy loads, but the details are different in different parts of the country.

The other public roads are maintained and controlled by the provinces or sections of the provinces. They are divided into (1) Provincial Roads, made and maintained by the provincial community out of its general fund. They are similar in construction to the state roads. (2) District Roads, which are under the control of the District Board and the general direction of the Provincial Committee. They are maintained by the district taxes, and are sometimes aided from the provincial fund. (3) Community Roads, which are built and maintained by the community through which they run, under the general control of the District Board, which sometimes subsidizes them. State and Provincial roads have, usually, a road-bed about six meters wide, whereas the community roads vary from three to four meters in width.

France.

There is no better or more complete system of roads to-day than that in France; indeed, the network of roads is so thorough that few new roads have to be built, the problem being to keep in good order the present roads. The highways have done more than the railroads to raise the value of lands and to make markets easy of access to small farmers; and to the splendid roads has been attributed the material development of the country, for they contribute largely to the success of the small landed proprietors and thus to the general distribution of wealth, a very great advantage to the state.

France is divided into eighty-seven "departments," each governed by a Prefect. These are again divided into about four "arondissements," each of these divisions corresponding in area, roughly, to a county in Maryland. The arondissements are divided into cantons, and subdivided into communes. The cantons are roughly equivalent to our election districts in area, and the communes have an average of about six square miles.

The roads of France are grouped into four classes: (1) National or military roads, which are entirely under the control of the national government. These are large and important highways connecting all the principal points of the state. (2) Departmental roads, which are entirely under the care of the departments; they connect the principal points of the department and form a system quite independent of the national roads. (3) Neighborhood roads, which are again subdivided into three groups are maintained by the communes through which they run. In some cases they receive help from the department or from the central government. (4) Rural roads, which are of comparatively small importance and of which very little record is kept.

The total length of roadway in France is very great, as is shown in the table below. The original cost of these can only be approximately estimated, as many were built so long ago that no records have been kept. Their annual maintenance is a great expense to the state, the departments, and the communes. They are kept in order by a large retinue of employees, but, as will be seen a little later, the cost of this work is more than made up in the saving in the cost of transportation. The following table gives some interesting statistics on this subject:[1]

TABLE OF FRENCH ROADS.

	Approximate cost of construction.			Annual cost of maintenance.	
	Length miles.	Per mile.	Total.	Per mile.	Total.
National roads	23,600	$12,880	$303,968,000	$258.00	$6,088,800
Departmental roads.	30,500	8,050	245,525,000	193.00	5,886,500
Neighborhood roads.	83,900	6,440	540,316,000	129.00	10,823,100
	47,200	3,860	182,192,000	97.00	4,578,400
	157,800	2,580	407,124,000	64.00	10,099,200
	343,000		$1,679,125,000		$37,476,000

It is estimated that on the national and departmental roads there pass each point at least 200 harnessed horses a day. Their average load, not counting the weight of the travelers, is about half a ton to a horse. Therefore, about one hundred tons are carried the whole length of this road daily, or seven and a half million tons are daily

[1] The table and much of this account of French roads are taken from Prof. Durand-Claye's treatise "Cours de Routes," Paris, 1895. Acknowledgment must also be made to an article by Prof. F. H. Neff entitled "French Roads, their Administration, Construction and Maintenance," Jour. of the Assoc. of Engin. Soc., Dec., 1892. The table does not include rural roads.

carried one kilometer. There are no estimates of the amount carried on the less important roads, but they doubtless amount to much more.

The great importance of having extremely smooth and well-made highways, which offer the least possible resistance, is shown by the following calculation. On the national roads, the only ones for which there are complete statistics, about seventeen hundred million tons are annually carried one kilometer; a saving of one centime, one-fifth of a cent per kilometer, would mean an annual saving of seventeen million francs ($3,200,000). If, in addition to this, we consider that the tonnage carried over the departmental and neighborhood roads is undoubtedly much more than double that on the national roads, we are perfectly safe in estimating a saving of fifty million francs, nearly $10,000,000, by the small reduction in cost just mentioned. If, in addition to this, we take into consideration other advantages gained from roads maintained in fine condition, we see the great importance of keeping the roads in the best possible order for travel.

The system of inspection and maintenance is very elaborate. In each department the national roads are in the charge of an engineer-in-chief, appointed by the Minister of Public Works. Under him are several engineers-in-ordinary, who each have charge of the roads of one arondissement. They are supposed to visit every road of this district at least four times a year. Under them, again, come the conductors, who have charge of from forty to eighty kilometers (50 miles) of road. Each is supposed to visit all his roads at least twice a month and to make his inspections on foot. He makes a written report, after each inspection, to the engineer-in-ordinary. All orders to the workmen for the improvement of roads are given through the conductor and he is responsible for the nature of the work. The workmen are divided into groups of from five to six, and each takes charge of from three to four kilometers (2 to 3 miles) of the roads, and keeps them in perfect order. His whole time is given up to this work; he is always on the lookout for any little damage to the road, and keeps it clear of dust and mud. Over each group is a foreman, who has charge of a rather smaller length of roadway than the others, and is expected to visit each of his men at least once a week and to see that the work is properly done. The foreman is expected to be the best workman of his gang, and his part of the road is supposed to be a model for all the others. The pay for this work is small, but the position is looked upon as one of honor and is eagerly sought.

Each workman has a small book in which the conductor enters his instructions and makes any notes he desires. The engineer-in-ordinary can tell by these directions and the observations that he makes in his tour how the workmen have done their work, and how well the conductor understands and does his.

The workmen also keep a record of how they have employed their time, and this furnishes a valuable means of determining the cost of the different elements of maintenance. Workmen are divided into three classes and foremen into two, the pay being graded according to class. A man is classed according to his work; he may be advanced for good work, or degraded if his work is bad. There is also a series of prizes and fines for assiduity or negligence.

The departmental roads are maintained under very much the same system, except that the engineer-in-charge is usually appointed by the prefect of the department.

The work on the neighborhood roads is done under the direction of the engineer-in-chief of the national roads of that department, or of commissioners appointed by the prefect.

Every laborer is required to work three days yearly on the roads, but this labor may be commuted by a small payment. It is usual to give to each man who prefers to perform the labor, and this is the common choice, a certain amount of work to do and to allow him to take as long over it as he chooses. The example of the excellent roads made by the government and by the departments, and the general standard of the community, is a sufficient incentive to make each man do his work well.

The large force of skilled engineers necessary for the direction of this work is supplied by the School of Bridges and Roads, which is part of the Department of Public Works. Certain students who do especially well in the Polytechnic School are sent to the School of Bridges and Roads for a course in engineering, and while there receive a small stipend. The winter months are spent in class exercises and studies under the direction of former graduates of the School who have attained the rank of Inspector-General, which is superior to that of engineer-in-chief. These instructors are at the same time actively engaged in government work. During the summer the students have practical instruction in the field in the maintenance of the roads and in other public engineering works.

The general system in use for the construction of roads is that of macadam; broken stone is put on the roads in layers and each layer is thoroughly rolled smooth; on top of this is placed a little dirt or sand, which fills the still remaining spaces between the stones and which makes the road perfectly smooth from the beginning. The usual thickness of broken stone is about six inches, but this of course wears down under travel, and in 1891 11 per cent of the national roads were not more than two inches thick, and 31 per cent were between two and four inches. These roads still gave good service.

The material used for making the roads is usually local material, though the French have devised a method of determining the relative value of rocks by rolling specimens in a machine known as the "Machine Deval," of which a description is given in another part of this volume.[1]

The road-beds are from fifteen to twenty-one feet in width, are flanked by a pathway from five and a half to seven and a half feet wide, and have ditches to carry off the water. The road-metal is furnished by contract and furnished in comparatively small quantities, so that the contracts may be taken by men of small means. The roads are well graded and rarely have a slope of more than three in a hundred, except in mountainous districts.

When new roads are to be opened an estimate, with designs, is forwarded to the prefect, and then civil engineers go over the region and decide upon the details. The report of the engineers is sent to the authorities, and if they decide to open the road, they arrange to acquire the rights-of-way, which can be obtained by a process of condemnation if not by agreement. The work is then let to contractors,

[1] See p. 320.

who must carry it out under the supervision of the engineers, and all disagreements are brought before the *Conseil de Préfecture*, from which, however, an appeal may be taken to the State Council.

All French roads, except the rural ones, have ditches for proper drainage, and the more important ones have rows of trees planted along their sides and sidewalks.

Every six or seven years a careful estimate is made of the amount of travel on the national roads; this is done by counting at many points the number of wagons, etc., traveling on the roads. The observations are continued for twenty-eight days distributed throughout the year. The results give a close approximation to the amount of travel, and therefore, to the relative importance of the different roads and they serve to determine the relative amounts of money to be expended on these roads.

Germany.

PRUSSIA.

The roads are divided into three classes:

(1) State Roads. These are the military roads and the most important roads of the state connecting the larger market-towns. They are entirely supported and managed by the state.

(2) Provincial Roads. These comprise the roads which connect the main roads and roads of importance principally for the use of the province itself. They are supported by the province with aid from the state.

(3) Local Roads. These, as their name implies, are of local importance, and are supported entirely by the district in which they lie.[1]

SAXONY.

At the organization of the German Empire in 1870, the public roads were not taken in charge by the general government, but were left in charge of the various states, which have their separate systems of control. That of Saxony is taken as an example of the sys-

[1] This account is taken from "Road Legislation for the American State," by Professor J. W. Jenks, American Economic Association, 1889.

tem in vogue in the German States. The roads are classified into (1) State Roads, (2) County Roads, (3) Private Ways.

Many important roads, especially former toll-roads, have long been in charge of the state, and they remain state roads, although the toll has been abolished since 1804. To this group belong less important roads built by the state on petition in districts too poor to build them themselves. The practice of building state roads has fallen into disuse, but the state appropriates annually 300,000 marks ($75,000) to aid in building and maintaining certain roads which are unusually expensive.

The state roads are in charge of the State Road Commissioner, who is assisted in the technical part of the work by the Road Director. The *Amtshauptmann*, or the chief executive and ministerial officer of the district, has supervision of the roads of his district (there are twenty-seven such districts in Saxony); whereas the engineering is in the hands of the "Inspectors of Roads and Navigable Ways," who are trained engineers and have direct management of the roads. They may order repairs made to the amount of $150, but beyond that must have the approval of the *Amtshauptmann*.

The inspectors have under them assistant-inspectors and road-masters; the latter are somewhat above the grade of our overseers. They direct the work of the road-guards and care for both state and country roads.

All public roads not state roads are called "Communicationswege," which we may call country roads. They are built and kept up by the parishes through which they pass, or by the district, which consists of several parishes, under the direction of the District Board. Every parish raises its road-fund in its own way, and in some cases is authorized by the state to charge toll on certain roads, principally on those used for through traffic.

The general construction is telford, with the upper layer of broken stone thoroughly rolled, a little gravel being added on top and also rolled in. Some unimportant roads are made entirely of gravel. Trees must be planted along all state roads, and, when practical, along country roads.

All important roads have mile-posts with sign-boards at the road crossings.

Wide tires with smooth surfaces are required, and wagons with nails projecting from the tires are not allowed to use the roads.

Great care is given to secure good drainage. Trees are planted along all important roads, and they serve not only to give shade and to beautify the landscape, but in winter, when everything is covered with snow, they locate the roads, as there are no fences on the roadsides.

In order to prevent ruts being formed, it is important that travel should go over all parts of the road-bed and not follow in the same tracks. The guards are instructed to place long, narrow stones, whitened to be more conspicuous, on one side of the road to force the travel to the opposite side (these stones must be removed at night), and they may also direct drivers to avoid certain parts of the roadway.

SWITZERLAND.[1]

Switzerland is noted for its excellent roads and for the great mileage in proportion to its area and population. The country derives very great benefit from these roads on account of the immense travel which they encourage, and this has been a great stimulus to their construction.

The very complete system of home rule which characterizes the Swiss cantons results in differences in details as to classification and methods of administration of roads in every canton, but the systems are, in a general way, alike and may be described with sufficient accuracy as follows:[2] The roads are divided into three classes. The first class comprises the most important roads connecting important districts in the same canton or in different cantons; they are built and maintained by the canton itself, though in some cases the communes through which they pass meet part of the expense. To this class

[1] "Die Strassen der Schweiz," S. Bavier, Zurich, 1878, contains an excellent account of the Swiss roads.

[2] The system followed by the canton of Tessin is quite different; the important roads are kept in order by contract, but are subject to inspection by the engineers of the canton.

belong the post-roads and the international Alpine passes. The national government exercises some supervision over these two groups of roads. The passes across the chain of the Alps are of benefit to the whole country and not simply to the cantons in which they lie; and, therefore, a contribution towards their maintenance is made by the national government.

Roads of the second class, which connect less important districts or lead to railway or steamboat stations, are built generally by the communes under the direction of the canton. Some cantons contribute to their construction and maintenance, and usually the canton constructs the bridges.

Roads of the third class are entirely under the charge of the communes.

Each canton has a department of public works which has general supervision over all the roads of the canton. The roads themselves are more immediately under the charge of the cantonal engineer and his subordinate officers. The arrangements for inspection and labor are practically the same as those in France.

As a class the Swiss roads are narrow. With the exception of the canton of Geneva, few roads exceed 8 meters (26 feet) in width and some are as narrow as 3 meters (10 feet). The majority of the first class roads are about 20 feet wide, the stoned part being somewhat narrower. The important post-road in the upper part of the Rhone Valley varies in width from 14 to 20 feet, the stoned part being from 10 to 16 feet. These narrow roads have, of course, been adopted on account of the great expense of road-building in Switzerland, but they have proved perfectly satisfactory and make clear the advantage in economy, without a corresponding disadvantage in inconvenience, to be gained by the narrow roads.

Perhaps the characteristic of the Swiss roads which most impresses the traveler is the remarkable adaptation of the location to the topography. This is not a new development, but has been the practice since the time of the Romans. It must have been developed by the extraordinary difficulties necessary to build roads across the great Alpine chain; and the advantage of good location is now generally recognized even in the less mountainous parts of the country.

The construction of the Swiss roads is very solid, probably on account of the severe climate that must be withstood. The general plan is practically that of telford, with a laid undercourse of larger stones covered by smaller ones; and generally some gravel is spread on top. Consolidation is left to the travel and is not generally effected by rollers. The thickness of the road varies from six inches to a foot or more.

The position of the Swiss roads, many of them far from railways, making it extremely expensive to bring rock from any distance; and the ease with which local stone is obtained, results in the general use of the nearest available stone for the road-surface. Much of this is poor material, but it is cheaper to use it, notwithstanding the higher cost of maintenance and repairs, than it would be to use better stone transported from a distance, with a considerable increased cost of construction.

In 1877 there were in Switzerland, outside of the cities, about 8,300 miles of principal roads which had been built at a cost of about fifty million dollars. Some of these roads were built in the last century and it is impossible to discover what was their actual cost; some were built by the communes, the labor being supplied by the inhabitants, no record of the money value of which was kept. In these cases the estimates are based on what it would cost to build the roads at the present time with paid labor. In some cantons no information is available as to the cost of the second and third-class roads, but it is estimated that their cost relatively to the first-class roads in the same cantons are practically the same as in the cantons for which data are available.

The actual cost of maintenance of about 6,000 miles of road for which information can be obtained, is over six hundred and fifty thousand dollars a year, so we may estimate for the total mileage of principal roads an expense of about nine hundred thousand dollars annually.

United Kingdom.

ENGLAND.

The highways of England are in charge of the parishes and are managed by an engineer, the parish Highway Surveyor, the money necessary for their repairs coming out of the parish tax-list. The road-rate is fixed by the Surveyor. Parishes are frequently united into districts under the supervision of the Highway District Boards, and the County Council has authority to require the District Boards or parish authorities to keep their highways in proper repair. In 1888 the maintenance of the main roads of the county was put under the direction of the County Council, thus enlarging the area under a central control. The actual work on the roads is done by laborers hired by the Surveyor, who, with or without the help of foremen, directs their work. It is becoming more and more customary to keep the same men continually in charge of the same piece of work.

The cost of maintenance of all the roads in England and Wales, exclusive of the London district, amounts to nearly twenty million dollars annually. These very large amounts show the importance which is put upon the maintenance of good roads.

IRELAND.

The counties are divided into baronies, and all the expenses relating to roads and bridges are met by the taxes of each barony. The County Surveyor, who is an engineer, has charge of all the roads and bridges and other public works in the county. He may make repairs to the roads within certain limits of cost on his own judgment.

The general financial transactions connected with the roads, together with the decision as to relocation or the building of new roads, lie with the Grand Jury, which also fixes the amount of the road-tax.

The maintenance, as well as the construction of roads, is usually done by contract, the expense, as already stated, being paid by the baronies through which the road runs; but important bridges are paid for by the county at large.

The County Surveyor is assisted by six or more deputy surveyors, according to the size of the county. The annual cost of maintenance of the roads in Ireland is about four million dollars.

PART VIII

THE ADVANTAGES OF GOOD ROADS

BY

HARRY FIELDING REID

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INTRODUCTION.

That good roads have many advantages is a statement that will provoke no contradiction, but that these advantages are commensurate with the cost of construction and maintenance will not be so generally conceded. Indeed, many people look upon good roads as a luxury far beyond their means. Much has been written and spoken on this subject in the last few years and although it is not possible to add much that is new it is worth while to bring together some of the available information in order to show that the luxury of good roads is but one, and perhaps the least important, of their advantages; and that the most valuable benefit is an economical one, resulting from pecuniary gains and savings which they cause. There are also benefits of an indirect kind which are of great value and must not be overlooked.

"Good roads, canals, and navigable rivers, by diminishing the expense of carriage, put the remote parts of the country more nearly upon a level with those in the neighborhood of the town. They are upon that account the greatest of all improvements. They encourage the cultivation of the remote, which must always be the most expensive circle of the country. They are advantageous to the town by breaking down the monopoly of the country in its neighborhood. They are advantageous even to that part of the country. Though they introduce some rival commodities into the old market, they open many new markets to its produce." [1]

[1] "Wealth of Nations."

So wrote Adam Smith in 1776 and with small changes the ideas are applicable to the present time.

As civilization is dependent on intercourse it has been argued that the civilization of a country may be measured by the condition of its roads and at the time that the statement was first made, that is, before the advent of railways, it was true enough; but the real argument applies not to roads, as such, but to means of communication.

Civilization advances by the development of industries, the raising of the standard of living, the increase of the comforts and conveniences of life and the elevation of morals. A nation sufficiently receptive to adopt improvements in these various directions wherever they may be found, and in such continual communication with other nations to find them if they exist, will advance rapidly in civilization; whereas nations like those in the far East, which for so long shut out all foreign intercourse, remain in a stationary state. And even the different parts of the same nation may be so isolated from each other as to be in very different degrees of civilization; but this could not be the case if easy and frequent intercourse existed. It is not important what the means of communication is. It is quite conceivable that a community entirely without roads but having a system of travel through the air might be in a much more advanced state of civilization than one with the finest road-system possible.

In this country there is such an excellent network of railways that it might be supposed that they have largely supplanted the roads; but this is not found to be the case. In Connecticut the railways have stimulated the improvement of the roads near them, and in Austria the traffic over the country roads has increased since the building of the railways. Indeed, the roads must be used to reach the railways, and whatever development the latter make in a region immediately increases the travel over the roads. And the ordinary intercourse within the limits of a neighborhood depends upon the roads. Although the argument really refers to means of communication, the ease of intercourse still depends largely on the condition of the roads, and to that extent the argument practically holds with regard to them.

Value of Good Roads in Foreign Countries.

In 1891 the U. S. Department of State published reports of American consuls regarding the streets and highways of many foreign countries, both with regard to the methods of construction and of administration. The consuls were also asked what benefit was derived from the excellent highways in Europe, and what effect they had on land values. They were unanimous in their high praise of the roads and in agreeing that they greatly enhanced the value of the land, although from the fact that many of these roads have been built for centuries, and most of them for fifty or one hundred years it was impossible to get any exact data.

From England the statement comes that it is "safe to say that land-values are improved, and that agricultural, commercial, and manufacturing industries are materially benefited through the operation of good public roads in the country. There can be no question but that the great industries owe much of their development and prosperity to the excellent roads," etc. From Scotland: "Roads are the life and necessity and hope of all Scottish industries, and their value increases rather than diminishes with railroad extension. Property would, without them, be comparatively valueless." From Belgium: "Roads compete with railroads. Wagons bring merchandise from Brussels (60 miles) or Antwerp (72 miles) to Liège, and one horse pulls an enormous load. Dog-carts come to Liège, 12 or 15 miles, laden with farm products, and two grown people ride back." In France the material development of the country has been attributed to its splendid roads.

Professor Richard T. Ely writes: "The great French reformer, Turgot, who did so much for the province of which he was governor, elevating it from the condition of one of the poorest to one of the wealthiest provinces in France, turned his attention first of all to the ordinary public roads and demonstrated . . . . the advantage of first-class highways. There can be no doubt that the excellent roads he constructed were one important cause of the prosperity of Limoges."[1]

[1] "Problems of To-day," p. 149.

The large sums of money spent annually in foreign countries for the maintenance of the roads (England and Wales, $20,000,000; Ireland, $3,000,000; France, $37,500,000) show the immense importance which is there attached to this subject and there is no indication of any retrenchment.

Increase in Land-Values.

Much has been said of the increase in the value of farm-lands due to the introduction of good roads. We must look for examples of this in our own country in places where the roads have recently been improved in order that we may separate the improvement due to the roads themselves from that due to other causes. Mr. Edward Burroughs, formerly Road Commissioner of New Jersey, has collected the opinions of a number of farmers in his state, who have lived in the neighborhood of the roads lately improved. These are too numerous to reproduce in full, but there is only one voice on the subject and that is that they would not go back to the old roads under any conditions.[1] One farmer writes: "I would not sell my house and accept another worth $7,000 as a gift and be obliged to live in it two miles from a macadam road. No farmer in the neighborhood would buy a farm not located on the macadam road. Now that they have a sample of the road they all want it." Similar statements come from Maryland.

Mr. Charles C. McBride, a resident of Elizabeth, writes of the improved roads in Union county, New Jersey, as follows: "The costs and expenses of these magnificent roads are easily computed. The total outlay of the Board of Freeholders has been nearly three hundred and fifty thousand dollars, and there are now nearly forty miles of telford and macadam road in the county. The figures are not in excess of what was expected by those who have given the matter careful study, thus showing that the management of the financial part had been as discreet as the preparatory work.

"But the question will arise at once, has this expense of nearly ten thousand dollars a mile proved wise, as well as beneficial? Good roads

[1] Bull. 9. Office of Road Inquiry, U. S. Dept. of Agric.

FIG. 1.—CLAY ROAD IN WET WEATHER, HOWARD COUNTY.

The Friedenwald Co.

FIG. 2.—HILLSIDE ROAD WITH "BREAKERS," HARFORD COUNTY.

TYPES OF BAD ROADS IN MARYLAND.

are, of course good things; but do they pay? The answer may in part be found in the fact that the property in Union county has actually appreciated in value far more than the cost of the roads; and this not only in cases of sale or exchange, but upon the tax-levy.

"Notwithstanding the fact that three hundred thousand dollars' worth of county bonds have been issued to build these roads, and the interest must be met annually, the tax-rate has not been increased in the county, or in any city in the county, in consequence of the extra interest expense; and it is but fair to say that the actual appreciation of property due to the increased values of lands benefited by the improved roads meets the increased taxes already. And none of our roads have been completed for more than a year, while some parts of them only within the present month. As an advertising medium alone, they have been worth what they cost; for they have brought county property into enviable prominence, have already caused the sale of many residential sites, have brought new wealth and new enterprise in the midst of us, have given direct impetus to building and improvements in every city and town touched by them, and as yet the benefits are only beginning to be realized. It is safe to say that the citizens and tax-payers of Union county would not go permanently back to the old system with its old roads, if they were paid many times the cost of the new roads."[1]

In 1896, Professor W. C. Latta of Purdue University, Indiana, collected some important information on the subject of the increased value of land in Indiana due to good roads, by sending a number of questions to about 60 farmers living in forty counties in the central parts of the state.[2] Over forty answers were received and from these Professor Latta draws the following conclusions:

"(1) The average estimated increase in the selling price of land due to existing improved highways is $6.48 per acre. The estimates from which this average is made refer in most cases to lands near the improved roads; but in a few instances they apply to all the lands of

[1] Isaac B. Potter, "The Profit of Good Country Roads," *The Forum*, Nov., 1891.

[2] Circ. 23. Office of Road Inquiry, U. S. Dept. of Agric.

the county. The average increase, therefore, of $6.48 per acre is lower than was intended for the lands near the improved roads.

"(2) The estimated average increase per acre that would result from improving all the public roads is $9.

"(3) The estimated average cost of converting the common public roads into improved highways is $1,146 per mile.

"(4) The estimated average annual loss, per 100 acres, from poor roads is $76.28."

But, as Professor Latta remarks, the farmer may object that the increased value of the land will only affect him, not by increasing its productiveness, but by increasing the taxes; and he shows that the annual increase in the taxes would be quite insignificant on the above increment in value. It may be added that the increase in the value of the land does not come merely from the pleasure of having good roads, but is due to the cheapening of the processes of raising or marketing the product. In other words, the increased taxes are more than balanced by the saving in various expenses which will be considered a little further on, and the increased value of the land may be looked upon as a bonus resulting from its greater earning capacity.

That the above estimate of Professor Latta with regard to the increased value of the land is not excessive may be shown from other sources. The farmers of Canandaigua county, New York, who have built themselves a number of miles of hard roads at a cost of $1.50 per acre of the adjoining farms, find that their land has increased in value $20 to $30 per acre; and in the southwestern part of the state of Connecticut there are three towns in juxtaposition, the outer two of which have improved their roads with the result that their land-values are 50 per cent higher than those of the middle town.

In order, however, to obtain information more directly applicable to our own state, a large number of farmers were asked their opinion on this subject, and the universal answer was that the lands would increase in value, though the estimates varied greatly.[1] Some good roads have already been built and their effect on land-values is quite definite. One of our correspondents who lives near Bradshaw, Bal-

[1] See pp. 37-40.

timore county, at which place an excellent piece of macadam road was laid down a year ago under the direction of Mr. Harrison of the United States Office of Road Inquiry, states that he hauls twice as much over this road in half the time as he formerly did and with less wear and tear on his team and wagon. He says that land has doubled in value. This is the result of a very short piece of good road. Another correspondent tells us that he added $850 to about an equal amount paid by the county in improving a certain road. He now hauls twice as many, and heavier, loads to market daily. He thinks the improvement has doubled the value of his land and calls it the best investment he ever made. The farms in Howard county situated on the turnpikes are said to be worth twice as much as those on the county roads; and a Frederick county farmer thinks his land would increase at least 50 per cent if good roads were made, basing his opinion on the price of land of equal quality not five miles distant situated on good stone roads, and he adds that he never saw a prosperous section of the country that did not have good roads. Another farmer in Prince George's county states that land in his neighborhood sells at from $12 to $30 per acre, whereas the land near Forestville in the same county, with better roads, brings from $40 to $100.

Opinions of this kind based on definite data could be multiplied, but enough has been given to show conclusively that the building of good roads would result in decided increases in land-values, which would be to the benefit not merely of the state or those desiring to sell, but also those holding and farming the land.

Good roads also increase land-values by increasing the demand for the land. For what farmer in changing his home would not, other things being equal, move to a region of good roads rather than to one of bad roads? Santa Clara county, California, has passed from the twenty-ninth to the fourth place in a list of counties arranged according to wealth and population out of a total of fifty-seven. This is ascribed to its good roads.

The reverse is also true; and bad roads tend not merely to keep off prospective settlers but they even drive away those who have already made a home in the neighborhood; and thus depreciate land-values. One of our consuls in Belgium says that emigrants refuse to go to a region of bad roads. From our correspondents in Maryland come statements that people would not come to live in certain neighborhoods on account of the roads; and one man wrote that he was thinking seriously of removing to some other state on account of the roads in the county where he lived.

Economies Effected by Good Roads.

In addition to the advantages of increased valuation there is also a great gain due to reduction in the cost of hauling. This occurs in three ways: (1) In the reduction of the number of animals which have to be kept. (2) In the reduction of wear and tear on horses. (3) In the saving of repairs to wagons and harness.

(1) There were in 1897 in the United States about sixteen and a half million horses and mules. If by the reduction of the number of animals necessary to haul a given load we could reduce this number by one-fourth, which is certainly not excessive, we can see what a very large saving would be effected. But farmers in general need a certain number of horses for the regular work on the farm, and especially so at times of harvesting, so that the majority of our correspondents have written that improved roads would not lead them to reduce the number of their horses; others, however, wrote that they would dispense with about one horse in four. In addition to the hauling done directly by the farmers themselves, there is a large amount done by fruit-growers, dairymen, lumbermen and others, who keep horses solely or principally for the purpose of hauling on the roads, and they would certainly require fewer horses if the roads were improved. As a matter of fact, the number of horses in comparison to the population is smaller in countries which have good roads than in countries where the roads are bad, notwithstanding the encouragement that good roads offer to pleasure driving and to hauling at all seasons of the year. In the United States and Russia there is 1 horse to about 4.5 inhabitants; in France and Germany, 1 to about 13; and in the United Kingdom, 1 to 18.

The loads which can be drawn by each horse depend upon the grades and surface of the roads. The following table[1] shows the

[1] Abbreviated from Byrne, Highway Construction, p. 6.

relative number of horses necessary to pull an equal weight on various surfaces:

Iron rails	1
Macadam	5⅞
Earth, dry	20
Sand	20

In foreign countries much larger loads per horse are hauled than in Maryland. In England the usual load is something over a ton; in Switzerland one and a half tons; in France, Italy, and Germany from one and a half to two tons. The largest loads are hauled in the neighborhood of Munich and Hannover where two horses will pull from five to six tons.[1] Compare these figures with the results obtained in Maryland where our investigations show that the average load hauled per horse is extremely small and varies according to the season of the year from one-half ton in winter to two-thirds in summer.[2] Some roads are at times in such a condition that it is absolutely impossible to haul over them at all.[3] Again, if the roads were good the relative amounts hauled in summer and winter would be reversed, for the bracing winter air would make the horses capable of doing more work than they could do during the warm weather of summer.

Another way in which good roads would increase the hauling capacity of a horse, is in the fact that much lighter wagons could be used than are now required to stand the jarring and shocks of our bad roads, and more of the horses' work would go directly into hauling the load and less into merely hauling the dead weight of the wagon.

(2) The wear and tear on the horses is a very serious item to farmers, both by reducing the life service of the animal, and also by increasing the necessary food. Stronger and more expensive horses are required in Baltimore than in Washington for the same class of hauling, on account of the difference in the grades, street pavements and car-tracks. It has been estimated that improved pavements in Berlin would save owners of horses there considerably over $25 a year

[1] Circ. 27. Office of Road Inquiry, U. S. Dept. of Agric.

[2] See table, p. 210.

[3] A correspondent in Calvert county writes: "The roads are such that hauling cannot be done by horses. In good condition a yoke of oxen hauls about one ton, and in bad condition about one half ton."

for each horse.[1] Estimates of this kind are very difficult to make accurately, but every one having the care of horses will recognize that the saving would be considerable.

(3) There is a very great saving in repairs to harness and wagons effected by good roads. A company doing a large business in delivering freight in Baltimore and in Washington finds that the annual repairs to their wagons in the former city are from three to four times as much as in the latter; and this is all due to differences in the streets and the car-tracks.

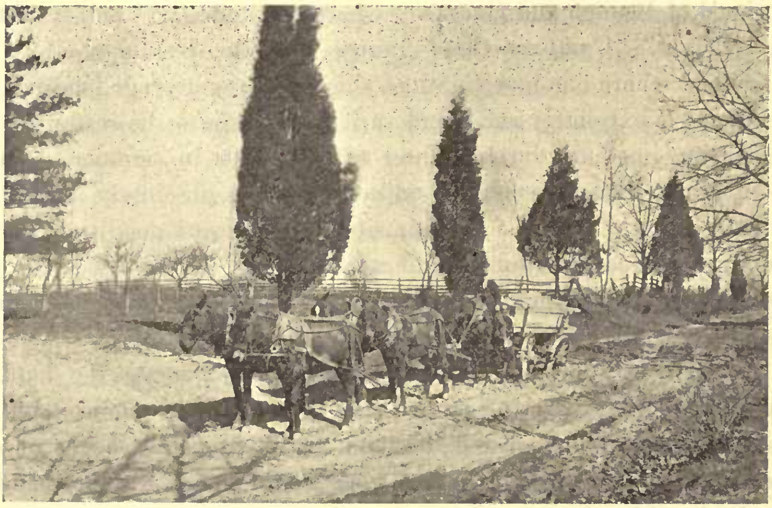

FIG. 37.—Six-horse load on a main road, Harford county.

The estimated difference in the cost of repairs to the farmer under present conditions and with good roads is hardly so great. The average annual cost of repairs to the wagons of our correspondents was $28.50 for each farmer, and the estimated saving about a third as much.

Good roads would save much time, the money value of which it is hard to estimate. All farmers recognize that much of the work of

[1] Ely, "Problems of To-day," p. 148.

the farm is concentrated in certain periods, and that at other times there is comparatively little work to be done. Now it is just at these times, when the farmer has leisure, that the roads are in their very worst condition and he is confined to the farm, whereas at the busiest season he must often leave important duties to haul products, which might well be done during the winter. One correspondent from Harford county writes: "We frequently delay hauling when the roads are bad, and then have to do it when we should be doing other work." Much of the fertilizers and wood and many other things

FIG. 38.—Two-horse load on a macadam road, North Carolina.

could be hauled with ease in the winter if the roads were good, and the farmer would be greatly relieved during his busy season; and, moreover, the hauling which must be done during the summer could be done in a shorter time with less interruption to other work; and the farmer could take advantage of rainy weather to haul when he could not work on the farm.

The answer that at certain seasons farmers have so little to do that the amount of labor necessary to accomplish a particular piece of work is of no importance to them, does not meet the argument; for in the first place it only applies to the season of leisure when very little hauling can be done; and in the second, the idea that a farmer's time, even in seasons of slack work, is of absolutely no value, will find few advocates.

Not only are the horses worn out by the hard work of hauling over bad roads, but the driver also suffers from the effort; and he alone can realize the difference in his feelings after a day's hauling over the ordinary county road in the winter time and after an even longer haul over one of the better turnpikes. One of our correspondents writes that although he could not estimate the pecuniary benefit good roads would be to him, he knew he would have a smaller score to settle at the end of the year with the recording angel if the roads were good. This sentiment will find many echoes.

A SPECIFIC ESTIMATE.

An approximate estimate of the actual amount of money that would be saved annually by good roads can be made.

General Roy Stone has collected some interesting facts regarding the cost of hauling in different parts of the United States. They were obtained from answers to 10,000 letters of inquiry sent to all parts of the country. He finds that the cost of hauling varies in different regions, being as low as twenty-two cents per ton per mile in the prairie states and as high as thirty-two cents in the eastern states. He estimates that nearly 220,000,000 tons of farm products and lumber are annually carried on wagons in the United States at a total cost of nearly a billion dollars ($1,000,000,000) and he thinks that probably two-thirds of this could be saved by good roads.[1] Similar inquiries made by the State Highway Division in Maryland show considerable differences in the cost of hauling in different parts of the state, but the general average for the whole state is twenty-six cents per ton per mile.[2] Comparing this average, with the cost in Europe, namely, 8 to 12 cents in England; 8 to 15 cents in France; 4 to 13 cents in Germany; 7 to 8 cents in Italy, the difference is very marked.

[1] Circ. 19. Office of Road Inquiry, U. S. Dept. of Agric.
[2] See p. 211.

Labor conditions in Europe and in America are so different that this comparison loses some of its weight; but conditions very similar to those in Maryland may be found in New Jersey. In the counties of that state which have improved roads, the cost of hauling is between 7 and 16 cents per ton per mile, and the general opinion is that it is about one-half of what it was when the roads were bad. There is no reason why the cost of hauling in this state should not be reduced to that in New Jersey, and the savings would then be enormous. Answers from correspondents in Maryland show that there are annually hauled from their farms 38,504 tons; and to their farms 17,541 tons; that is, the total freight moved is 57,045 tons. These farms have an aggregate area of 57,638 acres; one can, therefore, say with sufficient accuracy that there is annually moved one ton of freight for every acre of farm-lands. This ton is hauled an average distance of 6.7 miles[1] at an average cost of 26 cents per mile or $1.74 for the whole haul.

In 1890 there were 4,952,390 acres of farm-lands in Maryland; multiplying this by 1.74 the total cost of transportation to and from Maryland farms amounts to about $8,600,000. If the cost of hauling were reduced one-half by good roads, the annual saving would be $4,300,000. For freight hauled over toll-roads, which are already in fairly good condition, the saving would be much smaller. No statistics are available to determine what this tonnage is, and in order to be on the safe side a liberal allowance must be made for it. It may be objected that some of the roads over which this freight is hauled are too unimportant ever to be improved, and that the estimate of saving must be reduced accordingly. This, however, is more than offset by lumber and other freight hauled over the public roads to railways or factories or canneries, etc., which neither go to, nor come from, the farms and the amount of which is not known and has not been included in the calculation.

It is perfectly safe to assert that a sum in the neighborhood of three million dollars would be annually saved by improving the important roads of the state.

[1] See p. 208.

There is another way in which an estimate of the saving effected by good roads can be made. Answers to our inquiries showed that on an average farm of 210 acres there are six horses; and that good roads would diminish the cost of repairs to wagons and harness about $10. If we take $15 as the value of the annual saving on each horse as a result of less food needed and a longer life service, and $10 as the saving in repairs to wagons and harness, we find that there would be an annual saving of about $100 per farm of 210 acres, and as the total acreage of farm-lands in 1890 was about 23,600 times 210 acres, the saving for the whole state would amount to $2,360,000.[1] In addition to this there will be a saving by the reduction of the actual number of draught animals in the state which will easily bring this estimate up to the former.

The available data are not sufficient to enable more accurate estimates to be made, but they are quite sufficient to make it fairly certain that this estimate is too small rather than too large.

It must be remembered that only the saving in the cost of hauling has been considered; and if all the direct and indirect gains from good roads were counted this figure would undoubtedly be much increased. That the estimate is well within reason is shown by comparison with the calculation of Professor Durand-Claye, who shows on perfectly reliable data, that a reduction in the cost of hauling of one-third cent a ton per mile for freight transported over the national roads only of France would result in an annual saving of more than $3,000,000.[1] The practical appreciation of this by the French people is shown by the annual expenditure of over $40,000,000 for the maintenance of their roads.

[1] The estimate of six horses to every 210 acres of farm-land is the average for our correspondents; if this proportion is applied to the 4,952,000 acres of farm-lands of the state, we find 156,000 horses and mules on the farms of the state in 1890, against 144,456 as given by the census for the whole state; this discrepancy follows from two causes: (1) The census is for 1890, our numbers are for 1899. (2) Our correspondents belong to the more active and progressive class of farmers and probably keep more horses in proportion to the size of their farms than the average farmer in the state. The small error here introduced will not materially alter our calculation.

[1] See p. 386.

SPECIAL LOSSES DUE TO BAD ROADS.

Besides these savings there are occasionally special losses on account of bad roads. It is frequently impossible to haul over them. One correspondent from Cecil county estimates his loss last year on this account between $70 and $90. Another had been waiting two months to haul his hay. A third said he could not have marketed his wheat from February to April if the price had been $2 a bushel. Another said it is impossible to haul sometimes when profits would be the greatest. Another farmer lost his whole crop of corn because he was unable to haul it to a proper place of storage.

Although, with good roads, frequent opportunities to take advantage of high prices would occur, it must not be forgotten that the high prices are to some extent caused by the scarcity of the products, due to the condition of the roads. This, however, is not the whole cause of high prices, for in some products they are largely controlled by the abundance of the western supply, and by the state of the foreign demand. So far as the wheat is concerned, the condition of the Maryland roads has little to do with the price the farmer receives, for farmers may deliver their wheat in the autumn, and either fix a time at which they will receive payment at the market price, or reserve the privilege of taking the market price at any time they desire. But the roads do prevent the farmer from choosing his own time to haul to market and must, therefore, sometimes make him sell certain products to his disadvantage. To the extent that the bad condition of the roads affects prices, their improvement would tend to steady them to the advantage of the farmer and of the purchaser, both of whom could count on a market with smaller fluctuations.

Produce which is injured by railway transportation could be hauled long distances to town over smooth roads and remain perfectly fresh and unbruised; occasionally produce is lost because it cannot be marketed at the right time. Also the knowledge that the market can always be easily reached would lead to the cultivation of profitable crops which under the present conditions the farmer does not dare to risk.

Indirect Benefits.

Many indirect benefits result from good roads. It was in France that the bicycle was developed and it is there that the automobiles are most rapidly coming into use. This is not because the French are better than the American inventors, but because the French roads offer an opportunity to use these machines which the roads of our country do not. With good roads mechanical motors of all kinds would come into much more general use and be a great economic advantage; and, moreover, the cost of maintenance of the roads themselves would be diminished as horses and heavy wagons were to a greater and greater extent replaced by automobiles with pneumatic tires. Automobiles are especially fitted to be used as express wagons in the environs of towns and also for the delivery of mail in country districts. They would be very quickly adopted if good roads were made. These conveniences would add greatly to the comfort of country life and would encourage many persons to live in the country who now crowd into the cities. The isolation and practical imprisonment caused by the very bad condition of the roads during the winter is one of the strongest objections to the country at that season, but with good roads it would be largely done away with. In England and France a large portion of the population live in the country or in small towns, and this would become much more general in this country if the roads were good enough to allow easy and rapid communication at all seasons of the year.

The region in the neighborhood of Boston is very thickly settled and good roads run in all directions. Around Baltimore, however, until very lately, the country was almost wild, and even now a few minutes' ride on the trolley car brings one entirely outside the region of homes.

The post-routes maintained by the Swiss government are good examples of a system kept up for its indirect benefits. In 1852 about 64,600 persons travelled on the principal Alpine post-routes in the government diligences, at a loss to the government of about $1,500. In 1876 more routes had been opened and travel had greatly increased so that nearly 280,000 passengers were carried by the diligences and the loss to the state was more than $110,000. The greater the travel the greater the loss! Nevertheless, new routes are opened from time to time in order to attract travellers; for it is well recognized that although the government loses money on its post-routes, the people are greatly benefited by the large sums of money which travellers spend in the country.

A similar result on a smaller scale would follow the improvement of the county roads of Maryland. There would be more travel through the country in carriages, on horseback, in automobiles and on bicycles, and more money would be spent there to the advantage of the people.

After all the material advantages of good roads have been considered, there still remain the great benefits of easy intercourse with one's neighbors; benefits which are, perhaps, as important as the others, though it is quite impossible to measure them in dollars and cents. With good roads, social gatherings would be frequent during the winter when work is not pressing, in regions where, with present conditions, a few miles' drive would only be undertaken under very pressing need. With good roads not only could religious services be attended, but other religious activities could be cultivated; and the children could always be sent to school even though it were several miles distant. Indeed, good roads would work a revolution in the social life of the people who are buried in the country during the winter months; and the advantages to the coming generation cannot be overestimated.

Easy intercourse is especially valuable in a country like ours, where the policy of the government rests finally on the will of the people; for the judgment of the voters finds expression at the polls; and nothing helps more to a right judgment than full and free discussion, which in some sections is very greatly prevented for a part of the year by the almost impassable state of the roads.

GENERAL CONSIDERATIONS REGARDING THE IMPORTANCE OF STATE HIGHWAYS.

Of all the great nations of the world America has the worst roads; and in view of its great progress not only in the industries and in commerce, but also in the comforts and conveniences of life, this is a most surprising fact. Foreigners often speak of the reported condition of our roads in tones which show that they do not understand how so great a nation can submit to such a handicap to its industries and to all its activities. Why is Europe so far ahead of us in this particular? How did her roads become so perfect? Not because her people are more practical than ours, but because her political needs required them. The great road-builders of ancient times were the Romans, who built roads into the provinces to facilitate the movements of their armies, and so keep under control the countries they conquered. Being the greatest military power in the world, they had no fear that other armies might use these very roads to invade their land. In the middle ages conditions changed. Europe was divided into small states; clans, and even families, carried on warfare with each other; they were not strong enough to control their roads, but relied for safety on fortified strongholds, which they made as inaccessible as possible; the tendency was to destroy rather than to improve the roads.

In modern times other conditions prevailed; the petty states united to make great kingdoms; wars were waged in which large armies took part; the necessity was again felt for good roads to permit easy and rapid transfer of troops from one part of the kingdom to another, and a strong and highly organized central authority existed, able and ready to enter upon the large work of road-building. It was under Napoleon I. that this work received its greatest impetus. The common people were ignorant; they knew nothing of road-building and were accustomed to look to the king or the nobility for direction; they were not accustomed to take the initiative. Hence, when roads had to be made the work was put in the hands of engineers, who carefully directed it; and gradually the laboring classes learnt how the work should be done, and became competent to do properly the part entrusted to them. The military roads made the people appreciate the benefits of good highways, and gradually all the roads of the state were improved.

In America conditions were totally different; during colonial times and in the early years of the republic the energies of the people were taken up with more pressing needs, and when the subject began to engage their attention and great highways for commercial purposes were about to be built, the invention of steam railways and the building of canals opened up better means of transportation and the energies of the people turned toward their development to the neglect of the public roads. The struggles of the early settlers in this country developed an independence and self-reliance in the race which has had much to do with its later progress, but which has often prevented it from using the best means for development in certain directions. This self-reliance has led in some instances to the feeling that what one man has done, any other man can do; and to the rejection of the fact that there are always some men fitted by natural ability and training to carry out certain lines of work better than any other men. The harm of this appears most glaringly in those cases where political appointments are not made for fitness and where experience gained by service is not regarded as an important reason for reappointment. Our roads have likewise suffered because the necessity of skilled engineers is not appreciated; indeed, in many sections of the state, where there is not a single road that could be called even fair, there are any number of people who think they know all that is to be known about building roads.

We have seen in the last chapter what great economies would be effected by good roads. Why, then, have not they, like the railways, been developed and made economically efficient? Probably because the railways are carried on for gain by private enterprise and every effort is made to increase the profit; here any man who invents a new device, or develops a new method, can, if he knows how to take advantage of his improvement, obtain a reward. The benefit of a new process is measured by the profit it produces; and active railway managers are always on the lookout for means of increasing their profits. The system of managing the highways is quite different. The counties pay a certain sum annually to maintain the roads for the benefit of the people, but it is not a business enterprise carried on by the County Commissioners for gain. Furthermore, the County Commissioners have many and varied duties; the care of the roads can occupy but a small part of their attention, and the people who are most active in the election of the Commissioners often insist that political and not business methods shall prevail in the management of the public roads. They are not put under the immediate care of competent engineers; no reckoning is made of the advantages or disadvantages of one method of repair over another, or of one form of construction over another; and improved methods are not introduced. The people therefore suffer, and are put to heavy expenses which might be much reduced if efficient methods were employed.

Much valuable information applicable to roads can be gained by a study of ordinary business methods. During the years from 1893 to 1897, when the business of the country was in such a depressed condition that profits were extremely small, the necessity of reducing running expenses made itself felt, and if we look at the railroads we shall see how the reductions were accomplished. In addition to increasing the efficiency of the employees, immense sums of money were invested in straightening curves, reducing grades, putting down heavier rails, buying larger and more powerful engines and larger cars and thus increasing the train-load and reducing the expense of operation, so that at the present time the railroads are not only paying the interest on the increased capital but are making larger profits for their stockholders, though in many cases the freight rates have been lowered. Similarly, the roads must be improved in order to increase the efficiency of farmers by enabling them to haul heavier loads, and to do it at times when other work is not pressing, and thus reduce the time and expense of hauling. The saving thus effected would often make the difference between success and failure in farming.

But how is this to be done? Large sums of money are annually spent on the maintenance of the roads without appreciable results. Would anything be gained by spending more? Or are there any fundamental reasons why our roads are so bad which might be corrected?

An examination of the systems of administration of the roads in the several states of the Union and in foreign countries will throw much light on this question. These systems have been described in

FIG. 1.—SANDY ROAD, WORCESTER COUNTY.

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FIG. 2.—TURNPIKE ABANDONED FROM ROUGH SURFACE, MONTGOMERY COUNTY.

TYPES OF BAD ROADS IN MARYLAND.

another part of this volume, but they may be briefly summarized as follows:

In the United States the roads are in general under the control of County Commissioners or Township Trustees or Selectmen who appoint overseers to take charge of all repairs and of the maintenance of the roads, although in some cases overseers are elected directly by vote of the people. The road-tax may be levied or voted, and generally may be wholly or in part worked out. In some states the roads are divided into two classes, some under control of County and some of Township officials. In some states, as in Maryland, the laws are different for every county.

This system has proved very unsatisfactory as shown by the state of the roads, and by the frequent changes in the details of the law, which are rarely due to local conditions but to dissatisfaction with the results and an attempt to introduce methods which may prove more successful.

Glancing now at the systems in countries where the roads are good it will be seen that in France, for instance, there are three independent groups of roads supported by the national, departmental and communal governments, respectively. In the other countries of continental Europe very much the same system is followed; but in Great Britain and Ireland the roads are supported by the individual parishes, by groups of parishes or by counties, a system on which that in the United States is modeled.

Among the states of the Union which have made much progress in improving their roads, namely: Massachusetts, New York, New Jersey, Connecticut, Kentucky, North Carolina, Indiana, Illinois, and parts of Pennsylvania, it is found in the first four that the state itself has a highway commission under whose direction certain roads are being improved, and that a certain portion of the expense is met from the state treasury. In Massachusetts the proportion furnished by the state is three-fourths, in New York and Connecticut one-half, and in New Jersey one-third. In Massachusetts the roads made under this system are maintained by the state, in New York, New Jersey and Connecticut they are maintained by the counties or townships. In the last five states named in the list the old system of county or township control still exists. The conclusion must be drawn that no one system of road administration is fundamentally the right system, and will always produce good roads, for the roads of both England and France are excellent although their systems are different, and the roads of our country are execrable although our system is closely similar to the English. We find however in all countries which have really good roads that the following are regarded as essential: (1). Engineering skill. (2). High Standard. (3). Permanent tenure of office and personal responsibility. (4). A sufficient outlay of money. (5). Constant care. (6). Classification.

(1). *Engineering Skill.*—Nothing impresses one more in the examination of the methods of foreign countries than the fact that wherever the roads are good, engineers entirely direct and supervise their construction, repairs and maintenance; this is not considered the work of the farmer, but of men especially trained for the purpose; and the laborers on the road are taught by them just how their work should be done. The excellence and thoroughness of technical education in Germany is well known; and instruction in road-engineering is not neglected. France which has the best roads in the world, has a special school known as the *Ecole Nationale des Ponts et Chaussées* (National School of Bridges and Highways) for the training of engineers to be put in charge of the various public works of the nation. It is this system of training men for the work they are to do that gives such excellent results in that country. Although France carries the system to a greater extent than the other countries of Europe, they all recognize and act on this principle.

A glance at the portions of this volume treating of the construction and repair of roads, namely: road location, grading, draining, surfacing and the methods of selecting the best road-metal, will make it very evident that this is not the work of untrained men, but can only be done properly by engineers. Indeed, it can be definitely stated that no really good roads have been made without their aid.[1]

[1] The complexity of the problem of improving the Maryland roads and the need of skilled engineers in their construction were recognized in the report of the Committee of the Maryland Road League, Henry W. Williams, chairman; published in 1893.

(2). *High Standard.*—The government, the engineers, the workmen and the people, all hold a high standard of excellence for the public roads. The engineers and workmen would be considered very inefficient if they did not keep the roads up to the standard.

(3). *Permanent Tenure of Office and Personal Responsibility.*—This is a necessary condition of good work and is very rigorously insisted upon on the continent of Europe. Men enter the service of the state as engineers in their youth, to remain in positions of increasing responsibility for the rest of their lives. The workmen also are permanently employed. In Great Britain the road system is not so perfectly organized, and this principle is less well applied; as a result the roads are not so good, but the tendency is to apply it more and more thoroughly.

(4). *Outlay of Money.*—Good roads cannot be built for a song nor can they be maintained as cheaply. In France the first cost of the national roads is on the average about $12,500 a mile, and the annual cost of maintenance about $250.[1] This large cost is due to the breadth of the roads and to the ditches, sidewalks, trees, etc., with which they are provided. For other roads the expense is less, being as low as $2,500 and $65 for the cost of construction and annual maintenance respectively of the smaller communal roads.

In our country we find that the excellent state roads of Massachusetts have averaged about $10,000 a mile; though where no special difficulties have been encountered the cost has been from $4,000 to $5,000. These roads are excellently built and finished and have usually a hardened way fifteen feet broad; a breadth quite unnecessary outside of villages and cities, except for roads of very heavy travel. In Connecticut and New Jersey the cost is from $1,000 to $7,000. These figures are lower because the roads are narrower and are not provided with such excellent sidewalks, guard rails, culverts, etc. The lowest figures apply to roads built of gravel found by the side of the road itself, and they are distinctly inferior to macadam roads. These roads have not been built long enough to give any experimental value of the cost of maintenance. It is probably low.

[1] Durand-Claye, Cours de Routes, p. 5. See p. 385.

The expense of building new roads and improving old ones is met in Europe by the central and local governments and property owners in different proportions according to the importance of the road. In the most progressive American states this system is also followed and bonds are often issued by the state, county or township, and a sinking-fund established to pay them at maturity.

(5). *Constant Care.*—The method, so common in this country, of not improving a road until it is nearly worn out, is a very bad one; for not only does the travel have to put up for a long time with a rough, often nearly impassable, road but the actual cost of repairs is greater. In Europe men are kept permanently at work making all repairs on the roads as soon as needed; the principle of a stitch in time is rigidly applied and the roads are always kept in good order at a low expense. One workman has charge of a certain length of road to which he devotes his whole time, summer and winter, though in France the workmen are relieved during the time of harvest. They are under the continual care and inspection of engineers who give the necessary instructions and see that they are carried out. In addition to this general maintenance of the road it is necessary from time to time to cover the whole surface with three or four inches of new stone as the road under the wear of travel gradually becomes thinner and thinner.

(6). *Classification.*—The roads are divided into classes, and the amount of money spent on their maintenance depends on their relative importance.

These important principles are entirely neglected in Maryland. The roads are under the general control of County Commissioners or of Road Commissioners, who are only expected to give a small part of their time to their administration. The actual repairs are done under the direction of the supervisors. It is generally supposed that any man of ordinary intelligence is fitted to be a supervisor, whereas, it is probable that there is not a supervisor in the state who has had the training necessary for the proper performance of his duties. No fault attaches to him on this account, for it is impossible, under present methods, for him to obtain it. This incompetence is becoming evident, and an attempt is being made to guard against it by putting the work of constructing new roads directly in charge of the County Commissioners. Little will be gained by this change, for although the County Commissioners are usually men of intelligence, they are nevertheless not engineers and have not a practical knowledge of the right methods of road-construction.

This universal lack of expert knowledge is one of the most important causes of our bad roads, and if they are to be improved, it is absolutely necessary that they should not only be constructed, but also supervised in their maintenance, by competent engineers; until this is done it is useless to expect an efficient expenditure of the road-fund.[1]

The large majority of the people, including the officers in charge of the roads, do not travel far from home and do not know what a first-class road really is, nor the advantages which it offers; but occasionally when some one does, he is enthusiastic in his praises, and denounces the people at home for not improving their roads. He has had an object lesson not enjoyed by his neighbors. If the people at large were familiar with good roads, there is no doubt, judging by the result in other states, that they would be equally impressed with their advantages and would make the necessary effort and take the necessary steps to improve the roads. Something should be done to bring this knowledge home to the people, and the best method is to build some model roads for them; but it is absolutely essential that such roads be built under the direction of persons who know what good roads are and understand thoroughly how they should be built.

It is necessary not only to have skilled engineers at the head, but every one engaged in the work must be taught how to do his part. The necessary skill cannot be attained, if the men in charge of the roads are to be changed at every election. It is quite impossible to secure a trained set of engineers and workmen by whom the work will be well and economically done, unless, when once trained, they are

[1] The general law permits the counties to appoint competent engineers to take charge of the roads but it is not taken advantage of. Pub. Gen. Laws (1888), art. 25, sec. 1.

permanently employed; nor is it possible to get from them their best work unless they feel that the security of their position depends upon good work and not on other qualifications which have nothing to do with their devotion to their duties.

The sum annually spent on the roads of Maryland is over $800,-000.[1] This is not enough to improve the 15,000 miles of roads in the state; if, however, the roads were once thoroughly well built, this sum would go far towards keeping them up.

The American method of not working on the roads in winter is necessary from the nature of many of our roads, which in that season, are mere masses of mud, well-nigh impassable; and the ordinary methods of the supervisor would be of no avail. But well made roads require care at all seasons and should always be under inspection.

How can the principles mentioned above be incorporated in the management of Maryland roads? It does not seem possible to do so under the present system of control, and yet any violent or radical change is to be deprecated. Whatever new system is adopted, it should be introduced by degrees and should gradually replace the old one to the extent that may be found desirable.

Those states which have been most successful in the improvement of their roads have appointed a state highway commission which has general control over the roads built with the help of a contribution from the state treasury. The counties or townships petition for the improvement of certain roads and the commission decides whether these roads are of sufficient importance to receive state aid. If their decision is favorable, the necessary surveys and specifications are drawn up and the work is then done by contract, local contractors and laborers generally being employed. Engineers in the employ of the commission supervise all the work and see that the specifications are followed. When finished the road is maintained variously by the township, county or state. This method has proved successful and is gradually being adopted by other states. It will be seen to meet all the requirements laid down.

That the roads of Maryland will sometime be improved is quite cer-

[1] See p. 429.

tain, for the public opinion of the state will insist upon it; but unless some definite and well-considered plan is adopted the improvement will come very slowly and irregularly and at a far greater cost than is necessary. If, however, energetic steps are to be taken and the work is to be accomplished economically, some method similar to that just described will yield the most satisfactory results.

The state must lend its encouragement and substantial aid to establish a standard and to induce the counties to meet the heavy expenses necessary to realize it. There should be a highway commission to direct and supervise the improvement of all roads carried out by state aid. The selection of the roads to be improved should be left to the County Commissioners but should be subject to the approval of the state highway commission. The commission should supply all the necessary surveys and make the necessary specifications for the road. They should decide on the proper width, the amount of grading, the material to be used on the surface, on any slight change of location where desirable and, indeed, on all technical questions.

The roads should be built by contract under the supervision of the engineers of the highway commission, who should see that the specifications are fully observed. The cost of building these roads should fall partly on the state, partly on the counties and partly on the abutting property owners; the state, within certain limits, contributing in each county a sum equal to that supplied by the county and the abutting property owners.

Roads built in this way should be maintained under the direction of the state highway commission by funds supplied partly by the state and partly by the counties. This system seems necessary in order to introduce the proper methods of road-maintenance. In the future when a sufficient number of men in the counties have been trained to understand how to maintain a road properly the maintenance of these roads might be put into the hands of the county officials.

Objection may be made that roads should be built and maintained by those that use them, and they are almost wholly those who live in the country near the roads. This is a very plausible objection but fails upon examination. Good roads benefit not only those who use them but also those whom they serve. Would not Baltimore city profit by having good thoroughfares free of toll leading into the surrounding country and others radiating from the stations of railways running out of the city? Are the benefits of the Chesapeake Bay confined to those who own ships or boats? Does not the whole of Maryland and indeed many other states also benefit by this bay; and is not the National Government justified in making a ship-channel here with national funds? Do not benefits so widely distributed as those conferred by good roads affect the welfare of the whole state? Manufacturers and business men want consumers, persons who will buy their products and pay for them; and if they can reduce the cost of production their profits increase, and before long the consumer shares the benefit. The farmers also want consumers, and if they can reduce the expense of marketing their crops they will increase their profit and later the consumers get some of this saving in lower prices. Anything that helps men to produce more, by reducing the time and labor and cost of production leads to prosperity in which all share, and the reverse is also true. "The Chamber of Commerce of the city of New York says: 'We are handicapped in all the markets of the world by an enormous waste of labor in the primary transportation of our products and manufactures.'"[1] But even granting that persons living in cities bear their share of taxation already, still is it not good policy for the state to expend a sum of money which will increase the taxable basis by double the amount spent? It is not only to the advantage of the state as a state, but also of its individual citizens.

It may be urged that the richer counties would profit most by this plan as they would be able to supply a larger sum and therefore receive a larger share of the state's appropriation. But it must be remembered that the richer counties pay a larger proportion of the state taxes, and would only receive back sums which they have contributed; so no great injustice is done on this account. But, after all, the counties would all be greatly benefited by the adoption of

[1] Address by Gen. Roy Stone at Raleigh, N. C., 1897. Of. of Road Inquiry, U. S. Dept. of Agric. Circular 28, p. 21.

such a system, and the progress of the state should not be kept back because it is impossible to distribute the taxes and benefits with absolute equality.

From another side it may be objected that the state should not interfere in local matters, to which category roads belong, but should leave them to the counties. This is true enough, and it is not suggested that the state should control all the roads but only the most important, for the purpose of educating the people to know what a good road really is and how it should be made, and to bring about an improvement which could otherwise only be attained after very many years and at an unnecessarily high cost. Nor is it suggested that the roads built by the state highway commission should always remain under its control, but only long enough to teach thoroughly the lesson of the proper care of roads. There can be no doubt that the majority of the roads should always be under the control of county officials. In some states they are administered by townships, but the tendency is to abandon this system and to put the roads in charge of the county. The township seems to be too small a unit for the care of roads. There is little commercial advantage in building a very short stretch of good road as a link between bad ones for it is always necessary to adapt the load per horse to the greatest difficulties to be encountered, and if a single township should make good roads and be surrounded by other townships with bad ones, the area of the township being so small, there is continual travel beyond its boundaries, so that few hauls could be made entirely on good roads. Furthermore the machinery necessary for the construction of first-class roads is rather expensive and would not be bought by the less wealthy townships; and frequently a road in a township is principally used for through travel by persons living in adjoining townships. The county on the other hand is quite large enough to afford the expense of road-making machinery; and, moreover, a large part of the hauling is done within its own area, though here again the boundaries would be not unfrequently crossed, passing perhaps from good to bad roads; but the state is so large that the amount of travel across its boundaries is small in comparison with the travel within them. It would, however, be an unwarranted interference in local affairs for the state to undertake the control of a large proportion of the roads. The happy mean is adopted when the state controls a few of the main roads, especially those used for through travel between counties, and leaves all the others to the county authorities. Whatever objections may be advanced against state aid in the building and maintenance of roads, there are important advantages in the establishment of a state highway commission having control of certain main roads, which need only be mentioned to be recognized.

Advantages of a State Highway Commission.

(1). A state highway commission can study the resources of the whole state in road-metals. It will not always be advantageous to put upon a road material obtained in its immediate neighborhood or even in the county where it lies. A knowledge, therefore, of the location and quality of a road-metal in another part of the state would frequently result in considerable economy. As an example: certain roads in the tide-water counties could be advantageously built of material brought from the upper part of the Bay; the necessary information on this point is already in the hands of the Highway Division of the State Geological Survey. If this Division had not been created, it would have been necessary for each county to discover what road-material could be most advantageously used on its various roads and where it is to be found. It is hardly possible for county officials to gather very complete information of this kind.

(2). A state highway commission can collect all the reports of other states and of foreign countries and text-books or treatises in all languages and can take advantage of any improvement in methods or in economics that have been introduced elsewhere. These can then be applied to all parts of the state. It would be quite impossible for this work to be thoroughly done in each of the counties, and it would be a needless repetition if it were.

(3). A saving in the expense of administration would be effected by a state commission which had general supervision over certain roads in the state, and which could appoint assistant engineers as they were needed to supervise the roads of different regions. As these assistant engineers would be under the general direction of the chief engineer of the commission, they need not be so experienced or so expensive as engineers employed by a county to have entire and independent control of its roads.

(4). With individual engineers in each county the roads would undoubtedly vary much in excellence, but a state commission can introduce a high standard, and one uniform for the whole state.

(5). A state commission can make a careful study and comparison of the relative values of different kinds of construction and can even experiment to discover new forms of construction especially applicable to various sections of the state. Work of this kind can hardly be done by single counties. A single plant for the determination of the relative values of the different road-making materials such as is described on pp. 320-326, is quite sufficient to do all the work necessary for the whole state. It would be impossible and unnecessary to set up such plants in each county. The saving effected by the proper choice of road-metal is extremely great, far greater than the cost of a state commission. As an example of what a state commission can do which would be impossible for the individual counties to accomplish we may take the publication of the present volume. This work could not have been done by any one man, but required the services of a number of men each trained in different lines. Geologists were needed to locate and describe the road-materials, others to test the relative value of the materials, to examine the roads and to report on the kind of improvement needed, to give the history of road legislation in Maryland, to collect the laws of this and other states and to consider the advisability of introducing new methods in Maryland, etc., etc. The expense of this work would be too large for an individual county, but it is not too large for the state; its benefits, however, are distributed to all parts of the state, and are not confined to special districts.

The cost of a good road system in Maryland would be large. There are in the state about 1,500 miles of main county roads. To permanently improve them we must estimate an average cost of about $4,000 a mile.[1] Though some roads could be improved at a much lower figure, on others where much grading and perhaps some rock-cutting would be necessary the expense would be greater. This amounts to $6,000,000. To buy out the turnpikes, of which there are 497 miles, and bring them to a fair state of perfection would cost approximately another million dollars;[2] making $7,000,000 to improve all the important roads of the state. This is a large sum and the wisdom of expending it should be thoroughly discussed. No attempt should be made to do this work too quickly, but it should extend over a period of at least ten years, which would require an outlay of $700,000 a year. If this were divided equally between the state and the counties each would have to contribute $350,000 a year.

Under the present excellent condition of the state treasury a part of the state's share might be met from the general tax-list, and bonds running from ten to twenty years might be issued for the rest; or a small increase in the tax-rate might be made to provide the whole sum. The counties also might issue bonds for their share of the expense; but a wiser method would be to obtain the necessary amount by an increase in the road-tax, which apparently the people would willingly pay, as shown a few pages further on.[3]

The annual cost of our present road system is not small. The various counties appropriate annually $600,000 for the roads and bridges; furthermore, in some counties a large part of the tax is worked out on the roads and is not included in this amount. About $140,000 are paid by the people in tolls to turnpike companies; and besides, a large sum, the amount of which cannot be estimated with any degree of accuracy, is contributed by private persons for the improvement of the public roads.[4] In some counties it is an ordinary

[1] If road-building is entered upon extensively in the U. S., we can rest assured that our engineers will introduce improvements that will materially reduce the expense below these figures.

[2] See p. 440.

[3] By the will of the late Wm. Woolsey, Harford county will ultimately come into possession of $40,000 for road-improvement, provided the county supplies an equal amount. An act has been passed by the legislature authorizing the county to raise this sum. Laws of Md., 1890, ch. 43.

[4] For example, the Singerly road in Cecil Co. See p. 227.

occurrence for landowners to contribute a sum equal to that supplied by the County Commissioners to improve a certain piece of road which they frequently use. The total amount spent annually in Maryland on roads cannot be less than $800,000 and is probably nearer to $900,000. The amount of money, therefore, in addition to the present road-tax, to be contributed annually by the counties and property-owners towards the permanent improvement of the principal roads of the state would be a little more than one-third the amount now paid, or a little more than one-half the regular road-tax, and all the amount paid for toll would be saved, and the great annoyance caused by toll-gates would be removed.

The principle that capital may be invested practically to any amount if thereby running expenses can be reduced, or such great profits made that there is a decided gain after paying interest on the capital, is a sound one and is applicable to our roads; if we can increase the annual value of the industries and productions of the state or reduce the cost of production, by an amount greater than the interest on the capital necessary to make good roads, we are not only justified in investing this capital, but it is a great industrial error not to do it.

It has been shown that about $3,000,000 would be saved annually in the cost of hauling alone, if our roads were improved; and if other benefits were also considered the savings would be far greater.[1] The expenditure of the necessary amount to secure good roads is therefore from a business standpoint fully justified. But would it receive the sanction of the people?

The very active campaign made in its favor by the large number of wheelmen (30,000) in the state makes it quite evident that they would support the plan. They are continually spending money and urging the state and the counties to do the same in order to make better roads. Farmers' Clubs in all parts of the state are continually decrying the present condition of the roads, and they can confidently be counted on in favor of the plan. The various road-leagues of Harford Co. have already done much to improve the roads in their respective regions[2] and are strongly in favor of more energetic meas-

[1] See pp. 408-410.

[2] See p. 212.

ures. Two years ago there was a large gathering at Annapolis to urge the legislature to take steps to improve the roads of the state; but the time was not ripe for so great a step, and sufficient thought had not been given to the details to develop a satisfactory practical plan of procedure; and therefore the Highway Division of the State Geological Survey was created to consider the matter thoroughly and to report to the next legislature. A special law, however, allowed Montgomery County to raise $25,000 by bonds to improve the road leading from Rockville to the District of Columbia.

In order to get a general expression of opinion on the subject and to find out how much farmers generally would be willing to pay for the benefits of good roads, the following question was sent to our correspondents, and a large number of answers received from all parts of the state: "How much would you be willing to pay for the satisfaction of driving over good roads independently of any other benefit?" The answers, as may be surmised, were very various; some thought their road-taxes already sufficient to ensure good roads if properly used; others were willing to double their road-tax; still others mentioned various sums varying from $5 to $50; one amount being as high as $100. The average was $28.50. It must be remembered that this does not include what farmers would be willing to pay on account of any pecuniary benefit. The persons from whom answers were received must be classed among the more intelligent farmers of the state; so that this probably represents the more progressive and not the average opinion.

An estimate can be formed of how much farmers generally are willing to pay for good roads by finding out what they actually pay in tolls in a region well supplied with toll-roads. As an example of such a region we may take Washington County. The total number of miles of road is 799; of these 104 are toll-roads and 33 more are main roads. The county appropriates $18,000 annually for the maintenance of its roads and bridges and about as much is paid in tolls, so that quite one-half of all the money expended on roads goes to the maintenance of one-eighth of the total mileage of the county, and this, notwithstanding the fact that loose broken stone is placed on the toll-roads to repair them and the farmers themselves have to roll it down with their wagons. Until the stone is well compacted the hauling is even more difficult than over the ordinary roads.

As has just been shown the additional tax would only be on the average about one-half the present road-tax, and this is less than the majority of farmers would be willing to pay as shown above merely for the pleasure of good roads. Even if the counties met the whole cost of the improvement without state aid, the sum necessary could be nearly raised by simply doubling the present road-tax.

There seems, therefore, no doubt that the people would support a proper measure drawn up on the above outline, if they could be assured that its administration would be put in the hands of persons who would carry out its provisions economically, efficiently and wholly for the benefit of the people of the state.

It must not be supposed that the sum required to improve the principal roads can be taken from the money now spent on other roads; for there are nearly 13,000 miles of roads not included in those to be improved, which must still be kept in passable condition; and the present road-tax would be needed for this purpose. But the example of a system of well-distributed roads of a high quality would lead to more efficient work being done on the former to their general improvement. Indeed, instead of looking to a reduction in the road-tax it is far more probable that the people would insist on an increase in order to radically improve many of the less important roads. This has been the experience of Massachusetts, Connecticut and New Jersey, since the state-aid laws have been in force. The people have recognized the advantages of good roads, and have not been willing to have their roads improved so slowly as would be necessary if they waited to take advantage of the position of the state appropriation that would be available each year for their district. They have raised money by increased taxes or by bonds, to hurry the work on.

When the highway commission of Massachusetts began work in 1894, there were twenty-nine steam rollers owned in the state; now there are at least one hundred and fifty-two. This is a good example of the stimulus to road-building furnished by a well-equipped state commission. The same kind of activity might be confidently expected in Maryland.

It cannot be too strongly insisted upon that a work of such magnitude as that of permanently improving all the main roads of Maryland, should not be undertaken hastily or without careful deliberation; and that it should not be commenced unless it is the settled policy of the state to carry it through. It would probably be wiser at the present time for the state to aid the counties to build short pieces of model road. They would bring more vividly before the people the advantages of a comprehensive system of good roads and would furnish the opportunity to train supervisors, so that later, if the state should undertake an extensive improvement of the roads on some such plan as that suggested, there would be a number of trained men to form the nucleus of several permanent corps of road-makers. In anticipation, therefore, of a time when energetic measures will be taken to build good roads it is most desirable to determine the relative amounts of travel and traffic over the various roads of the state, in order to determine their relative importance; this will be a guide to point out the order in which the roads should be improved, the widths that are necessary, and the material that is most desirable for their surfaces. In France such an investigation is made from time to time and serves to determine the sums of money to be expended on the various roads for their maintenance. A large number of observers stationed along the roads keep a record every thirteenth day for a year, of all wagons and animals passing their posts. Observations of this kind furnished the data on which was founded the calculation of the great saving effected by an insignificant difference in the cost of hauling which would follow a slight change in the smoothness of the road surface;[1] and these calculations justify the enormous sum of $37,500,000 spent annually for the maintenance of the French roads. The economic information gathered by such an investigation is also of great importance.

Some Suggestions Regarding Road Improvement.

THE RELOCATION OF ROADS.

The first work to be undertaken in the improvement of a road is to see that it is properly located. Frequently small changes in the posi-

[1] See p. 386.

FIG. 1.—DUSTY ROAD, BALTIMORE COUNTY.

The Friedenwald Co.

FIG. 2.—UNDRAINED ROAD IN CUT, CHARLES COUNTY.

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tion of parts of a road will avoid heavy grades. If the surfacing is done on a road which is badly located or on which the grades are too steep the money is largely wasted. The road can never be first class, since heavy grades are a serious impediment to hauling and increase the cost quite as much as a bad surface.

WIDTH OF ROADS.

In building roads the greatest economy should prevail; and economy does not necessarily mean the lowest original cost, but the lowest amount necessary for building and maintaining the road in proper condition. In the application of this principle we should make our roads as narrow as possible and still meet the demands of the travel. The cost of surfacing a road is directly proportional to its width, so that much can be saved by not making roads broader than is absolutely necessary. The width of the level part of the road between fences should not be less than 30 feet except in very unimportant roads. This allows for a sidewalk, proper ditches and about 20 feet of road, all of which, however, need not be stoned. Indeed, it will rarely be necessary to stone more than 15 feet, and in many cases a stoned portion eight to ten feet wide will be quite sufficient; but it is better, when laying out a road to secure a right of way thirty feet wide and thus provide against possible developments, than it is later to require the owners of abutting property to move back their fences possibly to the detriment of their lots, and therefore at considerable expense to the county.

It is only in cases where there is considerable travel in opposite directions so that vehicles are continually meeting and passing each other that it is necessary to have a stoned way more than ten or twelve feet wide; for occasional passing one vehicle can always move off of the stoned portion; and if this passing is not too frequent, it will not occur very often at the same place, and the dirt side-road will not be cut up even in bad weather. Thus all the benefits of a good macadam road are enjoyed at a reasonable cost.

When the travel is such that vehicles are continually passing each other, then the stoned way should be about fifteen feet wide; and if outside of this there are hard earth or gravel shoulders three feet wide, full provision will have been made for the heaviest travel except in the immediate vicinity of large cities. This is the breadth adopted by the Massachusetts Highway Commission for their most important roads, and it has proved quite sufficient.

GUARD-RAILS.

Roads on the side of a hill or on embankments end often in steep slopes, which may be very dangerous. Not only is the county morally responsible for an accident that may happen to a traveler in such a place, but it is also liable for large damages if a traveler is injured by falling off the road. It is therefore proper to provide a suitable guard-rail at all such places for the protection of life and limb. This simple precaution is much neglected in Maryland.

WIDE TIRES.

The experiments detailed on pages 298-299 show the great advantages of wide tires on soft roads, but on well-made hard smooth roads they apparently are of no special benefit. Although they are very generally used in France, the French engineers have concluded that wide tires are no protection to their roads and since 1852 they have not been required. In this country, however, with its wretched highways, wide tires are a decided advantage both in offering a less resistance to traction, and also in helping to smooth roads, which narrow tires would seriously injure. On this account the turnpike companies only charge half-toll for wagons with wide tires; therefore, wide tires are numerous in districts of turnpikes but are rare in other sections of the state.

SIGN-BOARDS.

Sign-boards should be placed at cross-roads for the convenience of travelers. They should be substantially made; and punishment should be rigorously meted out to any one injuring them. The habit of using them as a target and wantonly destroying them is inexcusable.

PLATS AND RECORDS.

Permanent boundary marks should be placed on each side of the road wherever its direction changes, and the point midway between them should be considered as lying in the middle of the road, and should be used in the description of property boundary lines. At present the "middle of the road" is a very indefinite line, which changes position every time a fence is repaired.

All roads should be surveyed and an accurate plat and record preserved for future reference.[1]

PASSENGER RAILWAYS.

Much fault has been found with County Commissioners for granting passenger railway companies the privilege of laying tracks on county roads, it being contended that they should buy rights-of-way across country; but they are public conveniences and serve the public best by following the most settled routes, that is, the public roads.

The advantages offered by the railways are: rapid and frequent trips at small cost; and the cost could not be kept down if they had to buy expensive rights-of-way to lay their tracks. They develop the region they traverse, increase the value of the land and thus add to the taxable basis of the county. The suburban trolley system is still in its infancy and it is not unreasonable to expect a great extension of it; also an increase in its functions to take in (as it already does in some regions) an express and freight business. This would greatly increase its usefulness and would save the farmers many a long and expensive haul with horses. But it will not do away with the use of the roads for short hauls and for driving.

The passenger railway companies are organized for private gain and should therefore meet their just share of taxation, and should meet the necessary expenses of construction; on the other hand they are semi-public servants and their power of serving the public is dependent on the privileges granted them by the legislature and County Commissioners. The proper balancing of the benefits received by the companies and the services rendered by them so that they shall be treated justly and the public receive the best service at the smallest cost and with the least inconvenience, and so as to develop the system to still greater usefulness, is a very delicate matter, and one that should re-

[1] See p. 300.

ceive the closest attention of legislators. A discussion of this broad question does not belong here, but some of the minor details do.

Many of the electric roads have taken complete possession of the public highways and have greatly injured the surface of the whole road, and they often leave the road much too narrow. Sometimes they cross and recross the road increasing the danger of accidents by collision.

They should be required to keep their tracks on one side of the road if the road is not a wide one, and always to leave a level strip at least 20 feet wide on the side; for this is not more than enough to provide for a road-bed 12 or 15 feet wide and leave space for a sidewalk when this becomes necessary.

In wide and important roads the tracks should be in the middle with at least 20 feet on each side to the gutters, and from five to ten feet beyond that for sidewalks; say a distance of 30 feet on each side between the outer rail and the fence. In the opening of new roads the roadway (between fences) should be made broad enough to provide room for a railway if it should be needed.

Railway companies should not be required to keep the road in order; it is apart from their line of business and they have not the skilled assistance necessary for the proper care of roads; it is not advisable as a method of taxation, not nearly as good a method, for instance, as the park-tax levied on the street railways of Baltimore. If, however, they directly or indirectly damage the roadways, the damage should be repaired by the proper persons in charge of the road, at the expense of the companies.

TURNPIKES.

In the early development of our country when civilization was pushing its way to the west, the necessity for roads leading great distances made itself felt. Before the Revolution the colonial governments were too weak, and after it the federal government was too much occupied with other matters to give its attention to the building of these roads. The National Road seems to be the only one which was built by governmental funds. A little later toll-roads were undertaken by Baltimore county, but were soon turned over to private corporations.[1] As the country became more thickly settled the necessity for more roads resulted in the building of many public highways which were free to all, as it was quite evident that the inconvenience of paying toll on all roads would be an unbearable annoyance. In the last century there were many toll-roads in England. Adam Smith,[2] writing of the means of maintaining the roads, advocated the collection of tolls, on the ground that it was only fair that persons using the roads should pay for them. And this seems perfectly reasonable, but it has not proved good policy and the tendency of modern times is towards the abolishment of toll on roads and bridges. The toll-roads in England, where they were more numerous than in any other country, were abolished by law in 1878. In Saxony they were abolished in 1884, partly on account of the satisfactory state of the treasury, partly on account of the great expense of collecting the tolls, partly on account of the annoyance to travelers. In a few states of the Union there are no toll roads. In some the charters of toll roads expire after a number of years and the roads become public property; in others the roads may be purchased by the county either by agreement or at an appraised valuation; in still others, as in Maryland, no special laws have been passed looking to the abolishment of toll-roads, but the general principles of eminent domain would probably meet all requirements.

In New Jersey where so many excellent public roads are now being built, the toll-roads are losing much of their revenue, and the people who are required to use them feel that they are being treated unjustly in having to pay toll, whereas many of their more fortunate fellow-citizens are enjoying all the privileges of free roads well-built by state aid. A law has therefore been passed allowing a certain amount of the money appropriated by the state for the improvement of highways to be used for the acquirement of the toll-roads, on the same general terms of distribution of expense as in building roads under the state-aid law.

In a report to the Maryland legislature on turnpike roads in 1818

[1] For the history of turnpikes in Maryland, see p. 162, et seq.

[2] Wealth of Nations.

by Governor Charles Goldsborough,[1] the opinion is expressed that the charging of tolls interferes with commerce to the disadvantage of the state. He writes: "But where the policy of the State invites a great commerce to enter its territories and settle there, this system [of toll-roads], it must be immediately perceived, will not attain the end."

A communication from the president of the Cumberland Road, included, among others, in the report contains these words: "There can be no doubt, if this road were made free from tolls, or the tolls so reduced as to be only sufficient to keep it in repair, that the community would be greatly benefited by it; those who use it would be directly benefited, and the state at large indirectly, by receiving the immense products of the west, that would be induced to seek a market in it. To accomplish this, legislative interposition would be necessary, and probably it could only be accomplished by the state becoming its proprietor."[2]

It must not, however, be inferred that toll-roads are a hindrance to commerce. On the contrary, not only have they in the past been a great encouragement to industries and a real saving to the people, but this may be said of them still. The average cost of hauling one ton a mile on the ordinary roads in Maryland is 26 cents. The cost on the turnpikes is certainly one-third less, notwithstanding the tolls paid for this distance are about 3 cents.[3] During the winter weather the toll-roads are the only roads which can be profitably used and, therefore, their saving is much greater than appears in the above statement. Nevertheless, they are more expensive than would be the cost of first-class public roads properly administered, for the people pay about $280 a year per mile in tolls, and much better roads could be kept up and the interest on their present market value met for less than two-thirds of this sum.

[1] Executive Communication to the General Assembly of Maryland at December session, 1818, on the Subject of Turnpike Roads, p. 17. Annapolis, 1819.

[2] Executive Communication to the General Assembly of Maryland at December session, 1818, on the Subject of Turnpike Roads, p. 24. Annapolis, 1819.

[3] This would be somewhat increased if the empty wagon returns over the toll road, but farmers usually prefer to return over the poorer country roads in order to avoid the toll.

It may be laid down as a general principle that all conveniences which are of general utility should be made free to all, if this freedom would not lead to abuse or to increased expense. This plan is followed in regard to many public rights, such as the general use of the streets and parks of a city with their lighting and policing, and many other similar advantages. Whereas other privileges, which if free, might give rise to extravagance from careless and excessive consumption, such as the use of gas and water in residences, should always be paid for pro rata by the beneficiary. It is very clear that the public roads belong to the first class mentioned, and it will be shown that the public ownership of the toll roads and the abolishment of tolls would even be a saving to the people. The advantages of having all the roads free without any special tolls would be not only a great public convenience, but would also lead to increased commerce, as was clearly recognized as far back as 1818 in the report of the Governor of Maryland already quoted.

The objection to the payment of tolls is not altogether on account of the sum paid, although this is not insignificant, but is largely due to the annoyance attendant upon the collection of the toll. Moreover, there is continual disagreement between the turnpike authorities and the people using the road on the subject of repairs and something is to be said on both sides of the question. The people are naturally dissatisfied with paying toll over roads not kept in good order, and on the other hand the turnpike authorities frequently receive such small returns on the capital invested in the road that they are loath to spend more than is absolutely necessary. The Reisterstown road, which is probably one of the best turnpikes leading out of Baltimore, is an example of a road yielding small returns. It cost about $600,000 to build its total length of 63 miles, though at present toll is collected on but 48 miles. The returns have been so small that some years ago the par value of each share of the capital stock was reduced from $20 to $6, that is, to less than one-third of the original cost. The market value to-day of this stock is about $1.50. It is paying dividends of about 3 per cent annually, that is, less than 1 per cent on the original cost of the road. The other toll-roads about Baltimore pay small dividends or none at all, whereas those in the western part of the state yield fair or good returns on the investment.

There are at present fifty-one turnpike companies in the state collecting toll on 497 miles of roads. The total sum paid annually in tolls by the people is not less than $140,000, or about $280 a mile. This sum goes into repairs, administration, collection of tolls, and dividends.[1]

It would be greatly to the advantage of the people of the state if the turnpikes were bought out at a reasonable price and made county or state roads, for the cost of maintenance and administration would not be much larger than it is at present, and the very serious expense of collecting the toll, which of course must be paid by the people using the road, would be saved. The amount now used for paying dividends would more than meet the interest on bonds issued to buy the roads, since the state could readily borrow money at 3 per cent. The roads could undoubtedly be bought by the state at a reasonable price based on the market value of the stock or on the earning capacity of the roads. An average of $1,000 per mile seems to be enough for this purchase; some are worth more, others less. If another $1,000 per mile is added to put the roads in first-rate condition the total cost to the state would be little less than $1,000,000. If 3 per cent bonds were issued for this sum, $50,000 maturing each year, and if $125 a mile is allowed annually for maintenance, the cost would be $142,125 the first year, gradually diminishing to $113,625 at the end of 20 years. The first year's expense would be about the present cost to the people, and at the end of thirty years, the people would own the roads and their maintenance thereafter need not cost more than $62,125 a year, that is, a saving of $78,000 a year. This would be a very advantageous use of the state funds.

[1] An attempt was made to make a full investigation of the toll roads of the state after the manner of the investigation of 1818 (see pp. 172-174), and a list of questions given on page 42 was sent to all the turnpike companies with the assurance that no information contained in the answers would be made public except as a summary of all the roads. Only a few answers, and those in general from the smaller companies, were returned. It has therefore been necessary to collect the information here given from other sources.

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