

**PRELIMINARY REPORT ON
THE GEOLOGY OF THE
COMMON ROADS OF THE
UNITED STATES; PP. 259-305**

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649296644

Preliminary Report on the Geology of the Common Roads of the United States; pp. 259-305 by Nathaniel Southgate Shaler

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NATHANIEL SOUTHGATE SHALER

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DEPARTMENT OF THE INTERIOR - U. S. GEOLOGICAL SURVEY
J. W. POWELL, DIRECTOR

PRELIMINARY REPORT

ON THE

GEOLOGY OF THE COMMON ROADS OF THE UNITED STATES


BY

NATHANIEL SOUTHGATE SHALER

EXTRACT FROM THE FIFTEENTH ANNUAL REPORT OF THE SURVEY, 1855-54



WASHINGTON
GOVERNMENT PRINTING OFFICE
1895



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BY N. S. SHALER.

PREFATORY NOTE.

It is intended in the following memoir to set forth in a general way the facts which are known concerning the conditions of roadmaking in this country, so far as they are determined by its geologic and topographic features. In preparing the report the writer has availed himself of information obtained from a number of the officers of the Geological Survey, as well as from various persons who were not in that corps. He is particularly indebted to Maj. J. W. Powell, Prof. T. C. Chamberlin, Prof. C. R. Van Hise, Prof. J. E. Wolf, Mr. W. J. McGee, Mr. Frank Leverett, Mr. Bailey Willis, Mr. G. H. Eldridge, Mr. B. T. Hill, and Dr. J. W. Spencer, lately State geologist of Georgia. Some portion of the information here presented has been gathered by the Massachusetts Highway Commission, a board established by that Commonwealth, to which has been committed the task of a general inquiry concerning the roadbuilding materials which may be used by its people, as well as the business of constructing a system of State roads.

The detailed statement of this report concerning the location and value of road materials in this country could have been almost indefinitely extended by the use of census and other reports. This course has been avoided for the reason that the information thus obtained would have no value, except that of a statistical nature, and would be likely to mislead roadmasters in the choice of materials to be used in their work.

From the statements of this report it will readily be perceived that there is as yet but little trustworthy information in hand as to the relative value and particular distribution of the roadbuilding stones of the United States. It is to be expected that with the progress of the Survey such information will be rapidly gathered and put in shape for public use. Therefore the matter hereinafter presented may be regarded as a preliminary statement, rather pointing the way to inquiry than having of itself a considerable or permanent value.

INTRODUCTION.

All advance in civilization is closely connected with an extension of commercial and social communication. The most extended intercourse—that between the several great lands or continents—is necessarily by the way of the oceans or seas; that between the different divisions of the same area, though here and there it is accomplished by the navigation of lakes, canals, and rivers, is principally effected by land roads. Formerly these ways were altogether adapted to the use of horse vehicles. Of late the work of land ways has come to be divided between railroads and ordinary highways.

The effect of the use of land ways on the development of civilization is evidently great. It is easy to see that so long as men trusted to water communication for their commerce they were to a great extent limited in their dwelling places to regions immediately adjacent to the shore of the sea or to the banks of navigable streams or lakes. Even these methods of intercourse were precarious, as they were much affected by storms and in a large part of the earth by the winter ice. The result is that those peoples which have depended for their commerce upon navigation only have rarely become numerous or attained a considerable economic development.

The effort to establish commerce by land ways appears to have been one of the principal inducements which led to the domestication of the larger beasts of burden. Even before our kine served for milch cattle or for drawing the plow, they were extensively used as pack animals, for which purpose they were fairly well fitted. It seems pretty clear that horses were valued for that purpose long before the saddle became generally used for the conveyance of man. The failure to devise the stirrup until relatively modern times appears to indicate a lack of experience in equestration among the early peoples.

Although the distant land commerce of our own and other civilized countries is now principally effected by railways, and much of the local commerce is accomplished by the same means, the immediate well-being of every community is greatly influenced by the character and condition of its common roads. During the last half century the constructive energy of our people, so far as ways of communication are concerned, has been mainly directed to the extended iron ways; but we have now attained a stage in our industrial development where the attention of our people is again directed to the lesser but equally important routes. In part, at least, this recent interest in ordinary highways is due to a growing sense of the importance of the conditions which favor or hinder the local advantages of our communities. Men are learning that the most available good which the world has to give them is that which lies nearest their doors. A few years ago our agricultural communities were in a state of unrest for the reason that the cheap and fertile land of our frontiers invited the farmer to seek fresh fields and pastures new.

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The frontier, so far as it is a land of promise, has now practically disappeared. The Eastern farmer of to-day knows full well that if he betakes himself to the West he must buy such good and easily cultivated land as is to be obtained from thrifty private hands and not from a generous Government seeking to divide a great heritage among its people.

All land transportation routes are, as regards their location, construction, and maintenance, profoundly affected by geological conditions, by the state of the earth over or through which they are made, by the character of the soil or the underlying rock, by the way in which the materials are affected by frost and rain and the pressure of wheels and of the feet of animals, and by the contours which the geological history of the region has impressed upon it. Only by knowing and considering these earth conditions is it possible to build and keep roads of good character at moderate expense. It therefore seems worth while to make some inquiry into the geological conditions of highways and to gather and set forth the knowledge which the earth science has to impart concerning them.

It will be well to approach the subject of highway geology with certain general statements concerning the conditions of the earth's surface which have a bearing on the construction of roads. In the earlier states of civilization all land transportation was effected by burdens put upon the backs of living beings. In the simplest state of commerce the small amount of carriage was effected mainly by packs on the shoulders of men. This appears to have been the way in which the aboriginal traders of this country conveyed their small wares over the land. In the next stage of development, where men have subjugated horses or cattle, the pack animal takes the place of the porter, each beast being able to carry several times as much as a man. Except for certain principal routes this state of internal communication continued in Europe well into the seventeenth century. It was maintained in some parts of this country, in the region east of the Alleghanies, until after the civil war, and it is still in extensive use in the Cordilleras of North and South America.

The wheel, though an ancient instrument, in use in Egypt and neighboring countries more than four thousand years ago, served first for chariots of war and state, and only gradually became an important instrument of commerce in the hands of the Romans. Until that eminently economic people developed the use of the wagon, the sled and the detached roller placed beneath the burden were the only instruments for conveying heavy weights over the land. The road, as distinguished from the unimproved pathway, is thus a relatively modern invention. Like nearly all the other advances in civilization, it brought men into a closer dependence upon the conditions of the earth. As long as burdens went upon the backs of men or beasts the condition of the trail over which the pack-bearers made their way could vary greatly

without materially affecting the usefulness of the route; but the use of the wheel imposes a far greater uniformity in the character of the way which is to be traveled. A trail could be laid across country without stirring the original surface and without much attention to grades, and it demanded little repair save that which use gave it. The road, on the other hand, requires labor and skill to make it reasonably traversable, and to bring it into the best condition demands architectural ability of a highly developed kind. The conditions of a good wagonway are such that it may be described as a hard open-air floor extended across a country. Its surface should be as nearly as possible level, and be composed of materials which will give the quality of surface required for the foothold of horses or oxen and at the same time yield as little as may be to the tread of the wheel. Perfectly to attain these conditions within the limits of geologic materials is impossible, yet with skill and the exact application of the means which the country affords it is generally possible to approach very nearly to the ideals of the arts.

OUTLINE OF HISTORY OF AMERICAN ROADS.

Before the settlement by Europeans the indigenous peoples of this country appear to have made little use of the native animals for carrying burdens. So far as known, the only Indians who used pack animals at all were the tribes on the west coast of South America, who had domesticated the llama, a creature which is able to carry a hundredweight for a distance of about 12 miles a day. The extensive and well-constructed roads, the remains of which still exist in Yucatan and the neighboring parts of Central America, may indicate that the prehistoric people of that district had some beast of burden at their command. It is the opinion of archaeologists, however, that they were built to serve the purpose of footmen.

Except in western South America and in the region south of the Rio Grande, there were at the time of the first European settlements no roads in this country which were fitted for the use of pack animals. For a time the only way of making journeys was afoot or in boats. Although, as many expeditions show, strong men, with no more provisions than they can carry on their backs, may be able to traverse wildernesses such as originally occupied this continent, nothing deserving the name of commerce can now be effected in that way. Thus it came about that the first extended trade in this country was accomplished by means of boats, which traversed the waterways afforded by the rivers and lakes, a "carry" or portage being made from the headwaters of one stream to those of another. Owing to the fact that the only navigable ways leading into the interior of the continent were at first in the hands of the French, that people had for a time a notable advantage over the British colonies in entering the country and in trading with the aborigines.