

**THE DIFFUSION OF CRUDE  
PETROLEUM  
THROUGH FULLER'S  
EARTH. DISSERTATION**

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649310807

The Diffusion of Crude Petroleum Through Fuller's Earth. Dissertation by Oscar Ellis Bransky

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**OSCAR ELLIS BRANSKY**

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EARTH. DISSERTATION**



# The Diffusion of Crude Petroleum through Fuller's Earth.

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## DISSERTATION.

SUBMITTED TO THE BOARD OF UNIVERSITY STUDIES OF  
THE JOHNS HOPKINS UNIVERSITY IN CONFORMITY  
WITH THE REQUIREMENTS FOR THE DEGREE OF  
DOCTOR OF PHILOSOPHY.

By

OSCAR ELLIS BRANSKY.

UNIV. OF  
CALIFORNIA

EASTON, PA.:  
ESCHENBACH PRINTING COMPANY  
1911.

#### ACKNOWLEDGMENT.

To President Remsen, and Professors Morse, Jones, Renouf, and Acree, the author is greatly indebted for valuable instruction in the lecture room and laboratory. The author wishes, in particular, to express his gratitude to Dr. Gilpin, under whose guidance this investigation has been pursued, and to Dr. Day, of the United States Geological Survey. Thanks are also due to Prof. Swartz for important suggestions.

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## The Diffusion of Crude Petroleum through Fuller's Earth.

### INTRODUCTION.<sup>1</sup>

It is a well-established fact that the petroleum obtained from the sandstones of the Upper Devonian and Mississippian periods, generally known as the Pennsylvania oil, differs markedly from the natural oil found in the Trenton limestone, usually designated as the Ohio oil, or Trenton limestone oil. Both of these oils, in turn, are distinctly different from the petroleum occurring in the loose sands and soft shales of California. The unconsolidated tertiary clays, sands, and gravels in the southern United States, particularly in Texas, yield another variety of petroleum, characterized by properties more or less different from any of the preceding oils.

Not only do these differences exist between oils found in separate regions, but extreme variations in color and specific gravity, as well as in chemical composition, often occur between those of neighboring localities. On the other hand, close resemblances abundantly occur between petroleum of sections widely removed from each other. Some of the South American and many of the European oils, for instance, have been found to possess properties very similar to those of the oils of the southern United States; while the oil from the Corniferous limestone of Canada closely resembles the Ohio petroleum.

These variations in the oils of the United States and other countries have been carefully studied by many investigators. Such noted workers as Warren, Storer, Mabery, Pelouze, Cahours, Schorlemmer, Beilstein, Markownikoff, Engler, and Kurbatoff have devoted their lives to this subject. The question that naturally arises in connection with these variations is: Are these differences fundamental? Is the Pennsylvania petroleum as distinctly different from the Ohio oil as one chemical compound is from another? In answer to these

<sup>1</sup> This research was aided by a grant received from the C. M. Warren Committee of the American Academy of Arts and Sciences.



questions, the following extract from a paper read by Mabery<sup>1</sup> in 1903 before the American Philosophical Society is of considerable importance: "Now, after years of arduous labor, I have reached the conclusion that petroleum from whatever source is one and the same substance, capable of a simple definition—a mixture of variable proportions of a few series of hydrocarbons, the product of any particular field differing from that of any other only in the proportion of the series and the members of the series." The evidence supporting this declaration has been and is accumulating constantly, and, at the present time, this view is generally accepted.

If petroleum, then, is one and the same substance, how can the extreme variations between the American oils be explained? Were the causes operating in the formation of the Pennsylvania oil, almost barren of sulphur and nitrogenous bodies, different from those acting in the production of the sulphur-bearing oils of Ohio, or the heavy sulphur and nitrogenous oils of California?

To account for the formation of crude petroleum, two views, as is well known, the organic and inorganic, have been advanced. The Pennsylvania oil, according to these theories, may have been formed either from organic or inorganic substances, or from both. It is as yet impossible, however, to state conclusively from which of these sources the oil was derived. It is apparent, therefore, that the differences between the Pennsylvania and the Ohio, Texas, and California oils cannot be explained upon the assumption that the former was formed from organic remains, while the latter were produced from inorganic matter, or *vice versa*. If, however, crude petroleum is organic in origin, it may have been formed either from vegetable or from animal remains. The following discussion is based upon the assumption that the above-mentioned oils were derived from an organic source.

It has been suggested that the differences between these oils may be accounted for by assigning a vegetable origin to the Pennsylvania oil, and an animal origin to the others.

<sup>1</sup> P. Am. Phil. Soc., 1903.

Mabery<sup>1</sup> states that "It would seem that the small proportion of these bodies<sup>2</sup> in the Pennsylvania oil, as compared with the larger proportions in the limestone oils and California oils should be strong evidence in favor of a different origin, that the Pennsylvania oil came from organic vegetable remains, which should permit of the small amounts of sulphur and nitrogen compounds from this class of oils." Newberry, Peckham, Orton, and other geologists also favor the view that the Pennsylvania oil is of vegetable origin, and is derived from the organic matter of the bituminous shales of the Devonian period.

The facts which have led to the association of this oil with a vegetable source are, first, that the oil is of a different character from the limestone oils of Ohio, and those of Texas and California; second, that the Pennsylvania petroleum is found in strata that bear but few fossils; third, the belief that the Chemung and immediately overlying formations are barren of animal organic remains; fourth, the existence of large quantities of microscopic fossils, whose origin many believe to be vegetable, in the black shales of the Lower and Middle Devonian periods, to which formations many investigators are inclined to refer the origin of the Pennsylvania oil.

It is generally recognized that the Pennsylvania oil differs markedly from the Ohio, Texas, and California oils. Investigation has shown that the former contains a much larger proportion of the paraffin hydrocarbons, and a much smaller percentage of benzene and unsaturated hydrocarbons and sulphur and nitrogenous bodies, than the latter oils. It is further generally admitted that the Pennsylvania oil was not formed *in situ*. These two facts have aided strongly in assigning a vegetable origin to this oil. To what strata, then, should the source of the oil be referred? The great coal formations of Pennsylvania, lying above the Chemung, seem, at a first glance, to offer a solution of this problem. It is a notable fact, however, that these formations have not, up to the present time, been connected, either chemically or geologically, with the Pennsylvania oil. The possibility exists, however,

<sup>1</sup> P. Am. Phil. Soc., 1903.

<sup>2</sup> Reference is made to the sulphur, nitrogen, and oxygen compounds in petroleum.

that it was formed from vegetable remains in the Carboniferous formations above, and that then, by downward diffusion, it reached its present position in the Chemung. This view rests upon the physical fact that a liquid diffuses by the force of capillarity in all directions, downward as well as upward. Little attention has been given to this possibility, but it seems to deserve a very careful study. Owing, however, to the universal association of water under hydrostatic pressure with natural oil and gas, the migration of the latter is generally upward. This fact is attested by the accumulation of oil in anticlinal folds when water is present, and by the existence of the remarkable gushing oil wells. That the Pennsylvania oil, if not formed *in situ*, ascended to its present location seems, therefore, more probable.

In what strata below the Chemung, then, was the oil originally produced? It has been previously mentioned that a number of investigators refer the source of the oil to the black shales of the Lower and Middle Devonian periods. The organic matter of these shales is composed largely of microscopic sporangites, which suggest the existence, according to Orton, of masses of floating vegetation, or Sargasso seas. According to this view, the origin of the Pennsylvania oil is vegetable in character, and its primitive abode was in the shales of the Devonian age lying below the Chemung sandstone, to which it ascended under the influence of natural agencies. Another origin, animal in character, may be assigned to this oil. This view is that the oil was formed in the fossil-bearing strata of the Chemung age, and that it diffused to the sandstone reservoirs in which it is now found, and that during such a diffusion its original character was changed. Prof. C. K. Swartz, of the Johns Hopkins University, who has made a critical study of the Chemung strata in Maryland, informs us that fossil remains exist in considerable abundance in the strata of this age in Maryland and adjoining areas. In Pennsylvania, the corresponding strata have been found to bear many fossils. It is possible that the oil formed in these strata, and then diffused to the strata in which it now exists and which are barren of fossil remains.