The obtaining of oil is a chemical process, and chemical reactions depend upon physical conditions. The physical conditions are imposed by the apparatus we use and the way to which we handle the apparatus. If our apparatus or our handling of it imposes physical conditions out of harmony with the results desired, it is useless to look for success.

The secret lines in knowing what reactions must take place to produce the desired results, and in shaping the apparatus and operating it to secure those reactions.

Considering the shale deposits as a whole, the following points appear to stand out.

(A) *The shales contain no hydrocarbons liquid at atmospheric temperatures.*

(B) There are no direct relationships between the oil yield and the presence of these hydrocarbons. Shales apparently free from the hydrocarbon particles may give a high yield of oil, while others in which such particles are numerous may give a low yield.

(C) Solid hydrocarbon in minute particles and in widely differing quantities occur in specimens the writer has examined.

(D) The specimens examined contain partially bituminization vegetable matter (and possibly some animal matter), and the quantity of this and the hydrocarbons together determines the possible oil yield.

In my considered opinion the shales are related to lignite or coal on the one hand and the true hydrocarbons on the other. The closeness of the relationship to each depends upon the nature and degree of the alteration of the vegetable matter of the shale. While the facts I have just stated throws some light on the origin of the shale, there is only one problem to be worked out, before the whole story of the oil shales can be written. I shall cover that problem shortly.

Comparison of Scotch and Colorado Shales

Analyses of the Scotch and the Colorado shales vary from place to place and from stratum to stratum, both in their organic and inorganic contents.

The average yield of Scotch shales is reported at about 18 to 20 imperial gallons of 22 to 24 U.S. gallons, per ton. There are billions of tons of shale in the Colorado deposits which will yield double this amount of oil and vast quanities that will yield from 50 to 60 gallons per ton. In addition to these are immerse tonnages which will equal the Scotch in oil content.

The ammonia yield of the Scotch shales is probably double that of the Colorado shales, but there can be no reasonable doubt that the ammonia will prove a valuable product and will add considerably to the profits.

The writer is aware of the shales of Scotland, England, South America, Canada, California, Colorado, Wyoming, Utah and other states. These shales differ in details, but the fundamental problems of treatment are the same—*the problems of hydrocarbon chemistry.* The history of the shale oil industry is a story of scientific research by *chemists and engineers of the highest rank.* It is a story of evolution—the survival of the fittest in apparatus and in manipulation.

The road is strewn with discarded apparatus—the best in its day. It is marked by abandoned theories and processes, each having played its part in reaching the goal.

Instead of profiting by the half century or seventy-five years of experiment and experience of Europeans and learned Americans including *Mr. Carl Belser, the name well known to the Department of Interior and United States Bureau of Mines in Colorado,* most of our experimenters have ignored all progress made at the expense of ceaseless toil and millions of dollars, and have chosen to be "pioneers," secretly cherishing the thought that chance, inspiration, revelation, or their own superior mentality will enable them to present to the world a process beside which the poor old Scotch process will recall the days of the stage coach.

If the major oil companies of the United States wish to improve on the past methods of extracting the oil from the Colorado and Wyoming and Utah shales, they must start with a feasible method of extracting the hydrocarbons from the shales and modify their methods of refining the extracted oil. The Colorado shales far exceed the European and Canadian shales in oil content and consequently, the tendency to coke and clog will be greater. This is no longer an insuperable difficulty. Colorado shales contain a smaller percentage of nitrogen available for ammonia. This fact will make certain modifications of extracting