ture too high will decompose the hydrocarbons into the elements hydrogen and carbon, in which case no oil would be obtainable. It should be stated that with the use of super-heated steam in the shale mass, the last hydrocarbons and the larger yield of ammonia will be secured at the lower temperatures than by *dry distillation.* In fact, they shall find it *impossible* to secure the full possible yield of ammonia without the super-heated steam.

Heat distribution is greatly aided by super-heated steam throughout the shale mass, thereby reducing the chances of overheating or spot heating and the objectionable results which would follow.

Even the best crude shale oil will contain a large percentage of *unsaturated hydrocarbons* called *olefins.* Removal of the *diolefins* that are the chief trouble makers in gasoline produced by cracking.

Diolefins are responsible for the foul odors, change in color, and for the formation of the heavy resinous oil that commonly formed in gasoline.

The chemical properties of the olefins and diolefins are so similar that the problem of separating them is a difficult one. However, that can and will be resolved in the near future.

The problem is not to secure from shales a "gasoline" or motor spirit composed of hydrocarbons, but to secure a motor spirit or motor fuel which will do the work or produce the greatest energy regardless of its composition. Experiments have proved that the explosive energy of an olefin motor spirit is delivered more slowly, but through a longer period of time, than is that of a paraffin gasoline. It has also been proved that the total energy delivered weight for weight is from 12% to 17% greater for the olefin motor spirit than for the paraffin gasoline, therefore the mileage obtained from the olefin gasoline would be much greater. The olefin gasoline will vaporize at a lower temperature than does ordinary gasoline of the same gravity, and is, therefore, a better winter fuel. The gist of these facts is that shale oil gasoline has 12% to 17% more energy, and will deliver it in a steadier or less jerky fashion, causing less vibration and therefore, less strain upon the motor or the machinery driven by it. Carburation over the years have solved the minor problem of carbon deposits in cylinder heads.

Paraffin wax of high grade and readily marketable will be produced from the shale crude in commercial amounts and very profitably.

Lubricating oils produced from Colorado shales, rich in olefins will hold their body (or viscosity) better under high frictional heat than do the paraffin rich lubricating oils of the same density, and are therefore from this standpoint the more desirable lubricants. It is evident, then, that the next problem of the refiner will be to work out a refining process that will save all olefins and pass on to the consumer the benefits of their superior qualities, whether in the engine or on the bearings.

In the event the refinery of the future is modified to produce gases, similar to the propane gas used, to run certain combustion engines today, one can expect the automobile manufacturer to exchange carburators of their engines, eliminating carbon in the cylinder heads, longer lasting, cleaner, crank case oil, considerably added thrust energy, longer lasting longevity to the engine, reduction of motor repair bills, better mileage per dollar spent for motor spirits, (but far more important will be the partial elimination of the pollutants which are escaping from the present day engines into the atmosphere, (unfit to breath by human beings), and then being written up in newspapers etc: and called smog.)

Not to be overlooked is the potash potential from the spent shales; the high temperatures from the Belser super-heated steam method into the mass shales will render a part of possibly all of the potash water soluable (K_2O) content of about (0.9%) or about 18 pounds per ton of spent shale. The range of water soluable potash mentioned will be from 0.25% to 2.02%. There are no relationships between the oil content and the potash content. It will be very easily extracted under the Belser patents, (the steam heat dissolving the potash in its entirety.) For example, a super-heater heating 1000 tons of shale per day would have 600 to 700 tons of spent shale in situ which would yield, approximately 10,800 to 11,000 pounds of potash. This is a by-product worthy of consideration.

Also to be considered is the fact that all true oil shales, as well as oils from lignitic shales contain phenolic compounds, and may be regarded as a source of carbolic acid. I doubt as to the quality being sufficient to warrant an expensive installation to save them as they occur more plentiful as a by-product of coking.