

3. (1) and (2) together imply that the aggregate of the local intensity of magnetization per unit volume of a diamagnetic substance is comparable with the saturation intensity of magnetization of a ferro-magnetic substance.

4. The above results lead to a correct estimate of the energy (potential) associated with the crystalline structure, in virtue of the molecular grouping, as tested by the magnitude of the latent heat.

5. Lastly, unless the forces binding the diamagnetic molecules together were of the order of magnitude stated, we should not be able to detect a departure of the experimental value of the specific heat near the fusion point from the value calculated on Debye's¹² theory [of specific heat]. Every substance investigated by Nernst and Lindemann discloses such a departure.

The above evidence is sufficient to establish the existence of an intense local molecular field of the order 10^7 gauss, if interpreted magnetically, in those diamagnetic crystalline substances (about 40 of which have been investigated) which show a measurable change of χ [specific magnetic susceptibility] on crystallization.

10. Finally, Professor Ernest Merritt, in an address to the American Physical Society in 1915, showed, through the fluorescence bands of uranium salts, interesting evidence of the existence of atomic magnetic fields of the order 10^8 gauss.

Hence, from all the foregoing, which could be greatly elaborated, it seems that there is much and varied evidence in favor of the assumption that atoms have very powerful magnetic fields, due, presumably, to orbital revolutions of electrons.

Of course no one claims that more than a mere beginning has been made in the solution of the problem of the atom, but there is abundant evidence from many sources that this beginning is real.

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KENTUCKY AS AN OIL STATE

At the present writing (June, 1917) Kentucky stands in the limelight as a prospective oil state. Due to the fact that the Irvine Dis-

¹² *Ann. der Phys.*, 39, 789, 1912.

trict of Estill County has been extended over a large area together with the greatly renewed activity in the older Kentucky fields, operators are now turning their attention to the state as a whole. This is particularly true of oil men from the Mid-continent Field. So it appears that the latter part of this year and the early months of 1918 will forever settle the question as to the state's potential rank in the production of petroleum and natural gas. Test wells are to be drilled in nearly every county in the state and the most modern applications of petroleum geology are being freely used. Up to the present time most of the "wild cat" work has progressed only to the mapping or leasing state, but the high standing of the companies interested is a good indicator of the developments that undoubtedly will follow.

There are four important geological factors that are always met in the search for new oil fields. When all of them are found to work in harmony great fields, like those of Oklahoma, Kansas and Texas or those of Pennsylvania, Ohio and West Virginia, are the result. Geological "structure," such as anticlines, domes, etc., constitute only one of these factors. A large number of structures do not produce oil or gas. They may or may not produce salt water. Furthermore, they may lie in what would be considered favorable regions. In such cases the detail which may have been expended in mapping them is of no avail. Such conditions result from failure of one or more of the three other factors, namely either (1) there is no open "sand" or other porous medium under the structure to serve as a retainer for oil and gas; or (2) there has never been present any salt water or other water in the sand to serve as a concentrating factor; that is, no gathering of oil and gas from a disseminated state to a commercial body; or (3) there is an absence of petroliferous shale or other fossil-bearing rocks that produce oil in a disseminated form.

Now the future of Kentucky as an oil state depends on the four factors above mentioned: (1) structure, (2) sand, (3) water, (4) original oil. There can be no question about the state

having three of the above points in its favor, namely, (1) structure, (2) water, (3) original oil. There are numerous favorable structural conditions in various counties of the state. The rocks contain plenty of water and there are some good beds of oil-bearing shale. The Devonian Black Shale is particularly a splendid carrier of original oil. The fourth factor is, however, as yet to be proved of sufficient importance to place Kentucky in high rank as an oil state; namely, "sand." In great oil fields there are large bodies of sand or retaining reservoirs in close proximity to beds of oil-bearing shale. There are frequently several such "sands" in the geological column in close relationships to oil-shale beds.

In Kentucky the "sands" or "porous beds" near the Devonian Oil Shale are carrying most of the oil so far discovered. In Wayne County these sands lie in the Waverly series above the Black Shale, but in other districts the oil is held below the shale in porous beds of limestone. This is true of the oil fields at Irvine, Cannel City, Campton, Menefee County and other districts of eastern Kentucky. In the coal basins of eastern Kentucky and western Kentucky there are a large number of beds of porous quartz sandstone; they lie in the Chester and Pennsylvania series, but in connection with these sandstone beds, oil shales must be proved to exist in order that any particular structure may be found productive. If, for instance, a bed of oil shale like the Devonian Black Shale could be found just above or below the Big Clifty Sandstone at the base of the Chester, then an anticline containing these beds at sufficient depth would most certainly make a big oil and gas field like those of Oklahoma; but it so happens that in a great many cases in Kentucky the oil shales do not lie near dependable porous reservoir rocks or else the porous sandstones in the higher portion of the geological column, such as those above enumerated, do not have near them any great amount of typical oil shale.

In conclusion the writer desires to state it as his opinion that Kentucky is not to rank high as an oil state in comparison with many other areas in the United States where the

four factors work in harmony and there are numerous porous sands near beds of oil shale; however, the writer wishes to emphasize the probability that a number of structures in Kentucky will find the four factors working together and will furnish new oil pools that will be highly valuable to those who are fortunate enough to discover them.

Careful studies by geologists working in the state will serve to gather a great deal of important information in addition to merely mapping suitable structural conditions in any particular locality.

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OVERWINTERING OF THE APPLE-SCAB FUNGUS

THOUGH it is generally known that the scab disease of the apple, caused by the fungus *Venturia inequalis*, sometimes attacks the young twigs of susceptible varieties of the apple, yet not much has been published on this phase of the disease in North America.

Morse and Darrows¹ show that the conidia of this fungus survived the winter on apple twigs and germinated readily in the spring. They found no evidence, however, that the mycelium exists during the winter as a living stroma and produces conidia in the spring.

A review of the literature of this subject is given by Morse and Darrows. Wallace² also reviews the literature of the persistence of the stroma on the twigs and the hibernation of conidia and is convinced that twig infection is not of common occurrence and that conidia can not withstand winter temperatures.

The writer's attention was first called to scab disease on the young shoots of the apple in the fall of 1915, when a number of badly diseased twigs of a McIntosh apple tree were sent to the college for determination. They were forwarded by Dr. E. W. Henderson, of Mansonville, in this province. The twigs were defoliated for several inches from the tips, and the leaves that remained below showed a very severe attack of scab. The twigs were severely

¹ *Phytopath.*, 3: 265, October, 1913.

² *Bull. Cornell*, 335, 193.