the oil in unconformable formations above the Monterey. Oil formed from decomposition of organic remains in the Monterey, as supposed by Arnold, would either have remained in that formation if the Monterey shales were impervious enough to prevent its escape into the atmosphere, or, if they were not, would have exhausted out into the atmosphere long before the Fernando and Quaternary strata were deposited unconformably over it. There is only one possible explanation, namely:—solfataric volcanic emanations of hydrocarbons coming up from below the crystalline gneisses along the fault-lines and in the zones of disturbances at repeated periods of dynamic movements of the Coast-Range, and some of these movements must have been very recent to explain the oil in the gravels of the Quaternary. Even in the Monterey shales, as in all the so-called bituminous shales, it is plain that the petroleum is a secondary product of impregnation subsequent to the forming of the shales, as evidenced by the fact that these shales are bituminous only along the zones of disturbances and in local and irregular pools; in these, it is not in any way spread over uniformly in one or more beds but it is distributed in the shape of branching streaks, veins, patches and in the joints and cracks; in fact the portions impregnated with bitumen often look like a regular breccia, indicating plainly the injected nature of the bitumen ([37]).

In one of my former papers ([38]) on this subject before this Institute I have emphasized by other examples this well established geological fact with regard to the occurrence of petroleums illustrated grandly by the California example just cited above, namely:—that the petroleum deposits belong to no special horizon of the geological scale, and that they are found in any and all of them, including the crystalline rocks, and as we have seen, also in volcanic emanations, in volcanic and igneous rocks, in metalliferous veins and in meteorites. When to this consideration we add the further one that these petroleum deposits are found in great abundance in certain districts in the porous reservoir-rocks of thousands of feet of the geological scale but only when these are aligned in narrow long belts along certain structural lines, while neighboring districts outside of these lines but with the same

37 Bulletin Geol. Surv., No. 317, pp. 39–41.
38. Journ. Can. Min. Inst., Vol. VI, pp. 109–113.