

geological periods of time may be very considerable, independent of depth. Actual radium or thorium determinations in oil sands are not available but are quite desirable. There can be no doubt of some degree of association of radioactive material with hydrocarbons. Bohn⁷ has reported about 2×10^{-10} curies of radon per litre in two samples of California crude oil, and Spence⁸ has pointed out an apparently significant association of uraninite with a solid hydrocarbon, thucolyte, and also with liquid oil, so that the process of condensation may be still proceeding, or as he says: "the mineral has not yet reached stable form".

In conclusion, hydrocarbons, either gaseous, liquid, or solid, must be modified in the earth's crust, just as in the laboratory, whenever they are exposed to alpha rays. The general character of the reaction is one of condensation to higher members, with elimination of hydrogen (and methane). The absence of hydrogen in the gases associated with petroleum is not proof of the absence of such action of alpha rays, because hydrogen might well be removed catalytically by combining with unsaturates which may have originated as such or have been produced from saturates by the elimination of excess of methane. Unfortunately, we have at present no absolute criterion as to the relative importance of the radioactive effect.

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¹ *Science*, 73, Jan. 19, 1931.

² *J. Am. Chem. Soc.*, 48, 2344; 1926.

³ *Proc. Camb. Phil. Soc.*, 23, 516; 1927.

⁴ "Chemical Effects of Alpha Particles and Electrons", 2nd edit., 1928, p. 150.

⁵ *J. Am. Chem. Soc.*, 48, 1564.

⁶ *Proc. Roy. Soc. A*, 124, 16; 1930.

⁷ *J. Franklin Inst.*, 210, 461; 1930.

⁸ *Amer. Mineralogist*, 15, 499; 1930.

It is well that Dr. S. C. Lind directs attention to certain points in his theories which it was not possible within a limited space to deal with in my recent notice of his work, if only to promote a wider interest in the potentiality of radioactive stress in determining the trend of development and composition of petroleum. The hydrogen question is certainly a difficult one to dispose of, especially in view of the comparative rarity of this gas in a free state in natural gas, a point I have been at pains to verify from diverse published records, but Dr. Lind's suggestions are helpful, if not actually convincing. One would like to know, however, what sort of catalysts he has in mind which might be presumed to exist in the oil environment and to be capable of promoting reaction whereby the hydrogen is eliminated. Are they organic or inorganic? If the former, can we invoke bacterial aid, in which case the agent is doubtfully catalytic? If the latter, would not careful analysis of the source-rock reveal some competent mineral substance?

Perhaps petroleum technologists have not, on the whole, accorded alpha radiations that place in their theories of oil genesis which their importance in other realms of science would seem to indicate. Comparatively little attempt has been made to explain the strong radioactivity of certain crude petroleum samples tested when 'fresh' from the oil wells, or in another direction to follow up the results of the work of Himstedt and Kraus on the absorptive capacity of petroleum and petroleum products, for example, kerosene, for radium and thorium emanations.

These points have not only a chemical, but also a geological significance, especially in view of the lack of data, as Dr. Lind remarks, on radium and thorium determinations in actual oil sands. Here we are on

practically virgin research territory. It would be highly instructive to carry out such determinations on those sands or other reservoir rock from which strongly radioactive petroleum had been derived; and from the petrographic point of view, apart from other factors involved, the existence of, perhaps, an unusually prominent radioactive mineral content, for example, zircon, might suddenly prove of more than passing interest. On the other hand, whatever be the function of the alpha radiation in the complex process of petroleum genesis, its novelty will wear rapidly with many if it is to be made the instrument of exhumation of the inorganic theory of origin of petroleum, which a decade of geological opinion at least has served to bury.

THE WRITER OF THE NOTES.

Prehistoric Man in Kenya.

READERS of NATURE will have seen in Sir Arthur Keith's new book entitled "New Discoveries relating to the Antiquity of Man" a chapter dealing with my discoveries in East Africa, and may have been surprised to find in it certain statements which cannot be reconciled with the accounts of these discoveries as given by myself in lectures to various scientific societies since my return to England in December 1929.

Unfortunately, a few misunderstandings have crept into Sir Arthur's account. For this I take the blame; for although, when working on my human material at the Royal College of Surgeons, I have on frequent occasions discussed anatomical details with Sir Arthur, I have never—though I had not realised the fact until now—explained to him in detail the geological and archaeological evidence obtained during the 1928–29 season, which very materially altered some of the provisional conclusions at which I had arrived in the previous season.

In my forthcoming book "The Stone-age Cultures of Kenya", and in two other reports now in preparation, the details of the discoveries up to the present time will be set out clearly. Meanwhile I should like to rectify certain points. At Bromhead's site (which Sir Arthur refers to as Elmenteita I. on p. 181) we found human remains associated with a lithic industry, which I called Elmenteitan, and with pottery. There was also found at the site—but not really *in situ*—a stone mortar which in 1927 misled me into suggesting a relationship between this culture and that at the Nakuru site. Later, however, I found clear evidence that the said stone bowl was derived from elsewhere, and thought I had made this fact quite clear. Unfortunately, Sir Arthur somehow overlooked this fact.

Bromhead's site belongs to our Makalian post-pluvial wet phase which I *provisionally* correlate with the Bühl Stadium. But although pottery certainly occurs at this period—and also earlier—I have no suggestions of agriculture or of village sites until the next wet phase, the Nakuran, which I date as c. 850 B.C.

Again, it is evident from Sir Arthur's account of Gamble's Cave, p. 164 ff., that my field reports have been misunderstood. The deposits marked *silts* in his diagram are in fact *aeolian sands*. It is true that, for a few months in 1927, I regarded them as *silts* owing to their fine stratification, but the fact that they were of aeolian origin was recognised in 1927 and the interpretation of the cave section altered accordingly before the 1928–29 season began.

Also, the culture sequence given for Gamble's Cave II. is not quite accurate. The sequence in Gamble's Cave II. was as follows: The uppermost prehistoric occupation level contained an Elmenteitan industry