

### Letters to the Editor.

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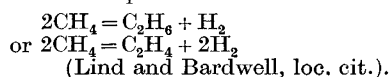
#### Helium and the Genesis of Petroleum.

VARIOUS hydrocarbons, but more especially methane, are common constituents of the natural gas effusions in many parts of the world, and another very common constituent is helium, though in relatively small quantities, which vary from simple traces to about 1 per cent or more. In the mid-United States of America, where large oilfields exist, and for which more complete information is available, it appears that the region in close proximity to the oil field is also a region of relatively high helium content in the gases (G. S. Rogers, *Professional Paper*, 121, U.S. Geological Survey, Washington, pp. 68-91; 1921).

Lind and Bardwell have investigated the effect of alpha particles upon hydrocarbons, and have found that these hydrocarbons undergo chemical change when subjected to such bombardment, the hydrocarbon molecules becoming more complicated. They have found that for methane two molecules undergo change per ion pair formed, or  $M/N$  is 2, whilst for acetylene  $M/N = 20$ , for ethylene 5.1, and for cyanogen 7.4 (*Jour. Amer. Chem. Soc.*, vol. 48, pp. 2335, 2351; 1926). The effect of alpha rays upon methane was to produce the higher saturated hydrocarbons and liquid olefines, whilst from ethylene a colourless liquid resulted, and acetylene gave rise to a white solid.

It will be assumed that helium arises from alpha particles ejected by radioactive substances. Since each alpha particle produces  $2 \times 10^5$  ions approximately, one cubic foot of alpha particles ionises  $2 \times 10^5$  cubic feet of gas. Now each alpha particle eventually becomes a helium atom, and therefore one cubic foot of helium is, in its process of formation, capable of ionising this amount of gas. Taking Lind and Bardwell's result that for methane  $M/N$  is 2, each cubic foot of helium may alter  $4 \times 10^5$  cubic feet of methane (weighing 8 tons) into higher and more complicated hydrocarbons.

The action follows the equations



Considering liquid hydrocarbons more specifically, it has been calculated from the results already mentioned, that 1.2 milligrams of these resulted from the formation of 0.000015 c.c. of effective helium, or nearly two tons of liquid per cubic foot of helium.

The average helium content of 142 Canadian sources of natural gas is about 0.25 per cent (R. J. Elworthy, Canadian Dept. of Mines, 1926), and from 325 United States sources it is about 0.5 per cent (Rogers, loc. cit.). Since many of these gas wells produce enormous volumes of gas, it is to be expected that radioactive disintegration as measured by the helium produced during long periods of geological time may have played an important part in the formation of petroleum. It is true that, owing to the paucity of experimental results, the figures arrived at may be to some extent a matter of opinion, and it is also a long way from 1.2 milligrams to millions of tons, yet it would seem (if the results of Messrs. Lind and Bardwell are to be relied upon) that in the Petrolia gas field, where the original helium has been estimated at  $10^9$  cubic feet (cf. Rogers' Report, p. 62), millions of tons—indeed, according to

the above calculation, two thousand millions of tons—of liquid hydrocarbon may have resulted in this area.

In view of these figures the question of the origin of petroleum naturally arises. The percentage of helium content in the prolifically oil-bearing tertiary series is generally small, but Lind states (*Nat. Acad. Sci.*, vol. 11, p. 772; 1925) that recent then unpublished estimates show that helium is confined to no particular age of strata but depends rather on the retentiveness of the sands. It might also be mentioned here that the helium in the atmosphere, assuming it to be entirely of subterranean origin, corresponds, under proper conditions of production, to  $4 \times 10^{15}$  tons of liquid hydrocarbons.

The presence of dense compounds in petroleum and of bitumen in meteorites, the high solubility of radon in petroleum, and the wide distribution of the radioactive elements, together with the formation of both paraffins and olefines in the experiments quoted, seem to make these questions worthy of further investigation.

If the reactions quoted above are in progress, it might be expected that hydrogen would be a common constituent of natural gas in some other form than as simply appearing in the hydrocarbons.

C. COLERIDGE FARR.  
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#### Active Nitrogen.

THE function of impurities which seem necessary to the formation of the afterglow in active nitrogen has been interpreted as being in the poisoning of the surface to the combination of nitrogen atoms. Experiments were commenced to study the rôle of the impurity oxygen. It was felt that the possibility could not be entirely excluded that oxygen was necessary in some physical action to induce the afterglow in the gas phase. Accordingly pure glowless nitrogen was introduced into a litre bulb, into the centre of which pure oxygen could be admitted more or less uniformly in all directions. In impure nitrogen the active species which eventually give rise to the glow are created in the discharge and remain for some time after cessation of the latter. If the same occurs in pure nitrogen, and if merely the presence of ordinary oxygen is required for the afterglow formation, then the afterglow may be expected to appear if oxygen is introduced into glowless nitrogen immediately after discontinuing the discharge (electrodeless). Pure nitrogen was prepared by two methods: (1) from bromine water and ammonia (Kenty and Turner, *NATURE*, 120, 332; 1927; also, Waran, *Phil. Mag.*, 42, 246; 1921); (2) from sodium trinitride ( $\text{NaN}_3$ ).

For some time it was impossible to produce absolutely glowless nitrogen (although the afterglow was very weak and of very short duration), even though the utmost precaution had been taken to ensure the complete absence of oxygen and other impurities. Only after continued baking out of the bulb at high temperature and under high vacuum was glowless nitrogen obtained. Upon the introduction of pure oxygen (1 per cent) in the manner described above, *no glow was produced*. This was repeated several times with nitrogen from both sources with the same results. Furthermore, after the oxygen had been admitted and the mixture now subjected to the discharge, little or no glow was discernible. This seemed very strange indeed. I publish these results in view of the recent work of Herzberg (*Z. für Physik*, 46, 878; 1928), whose