

It thus emerges from the present investigation that the visual pigment which functions in the yellow sector of the spectrum and is responsible for the very high luminous efficiency and the very high power of colour discrimination indicated by Figs. 1 and 2 for that part of the spectrum is quite distinct from the pigments which function in the red and green sectors of the spectrum and is not a mere superposition of these two pigments functioning jointly. The identification of that pigment presents a problem which will not be discussed here. But

a useful hint is furnished by the observations which indicate that the pigment has two maxima of absorption, one between 540 m μ and 560 m μ , another between 560 m μ and 590 m μ , the latter being much the more pronounced of the two. Incidentally, it may also be remarked that the concept of three visual pigments or three fundamental sensations which forms the core of the Young-Helmholtz theory of vision is contradicted by the results of the present study and is therefore unsustainable.

DUPLEX ORIGIN OF PETROLEUM

THEORIES regarding the origin of petroleum are largely based on arguments advanced from the geological point of view. The organic chemical arguments derived from an investigation of the composition of petroleum (also natural gas, waxes, and bitumens) have been generally neglected.

According to Sir Robert Robinson there are convincing evidences to show that petroleum hydrocarbons are both biogenic and abiogenic, the latter portion being very much the older, probably by a factor of four or five times the maximum hitherto contemplated for biogenic petroleum.

The evidence for the biogenesis of petroleum is incontrovertible; but this may only apply to a part of the material. The indications of biogenesis are clear in young oils, less in evidence in those of middle age, and all but absent in the older crudes. The advocates of hundred per cent biogenetic origin assume that organic matter laid down in the sediments could be modified at quite moderate temperatures and pressures in the course of ages until it became the ancient petroleum which is described as 'crude' oil. The apology for the improbabilities that have to be accepted is the large time-scale involved, perhaps 400-500 million years. Actually it cannot be too strongly emphasized that petroleum does not present the composition picture expected of modified biogenic products and all the arguments from the constituents of ancient oils fit equally well, or better, with the conception of a primordial hydrocarbon mixture to which bioproducts have been added.

Recent investigations by improved chromatographic techniques have provided more precise knowledge of the constituents of petroleum in the lower ranges. It emerges that the straight-chain hydrocarbons always predominate over any one of the branch-chain isomers. Further, an examination of the nature of branch-chain hydrocarbons in the smaller carbon numbers (C₅-C₈) and of their quantitative relation to the corresponding *n*-alkane suggests that the branch-chain hydrocarbons could have been derived by isomerization processes. These have apparently been accompanied by *cyclodehydrogenation*, for example, *n*-hexane to 2-methylpentane and methylcyclopentane, *n*-heptane to 2- and 3-methylhexane, methylcyclohexane and then to dimethylcyclopentane.

It may also be that certain minor constituents are best regarded as the outcome of synthesis. For example, adamantane as arising from cyclopentadiene by dimerization, reduction and then pyrolysis. Moreover, the absence of oxygenated compounds and of olefines is indicative of a hydroforming type of operation. Aromatic hydrocarbons, thiophenes, and pyridines survive because of their relative high degree of resistance to hydrogenation.

According to Sir Robert Robinson it is supposed that the primordial oil was used as a source of carbon by primitive organisms. These contributed components to the oil and, later, phytoplankton and land plants did likewise.

Before coming to any definite conclusion about the origin of petroleum the above points have to be seriously taken into consideration.—
(*Nature*, 1963, 199, 113.)