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COMMERCIAL AND MOLECULAR DISTILLATES OF MINERAL OILS IN RELATION TO THEIR CARCINOGENICITY

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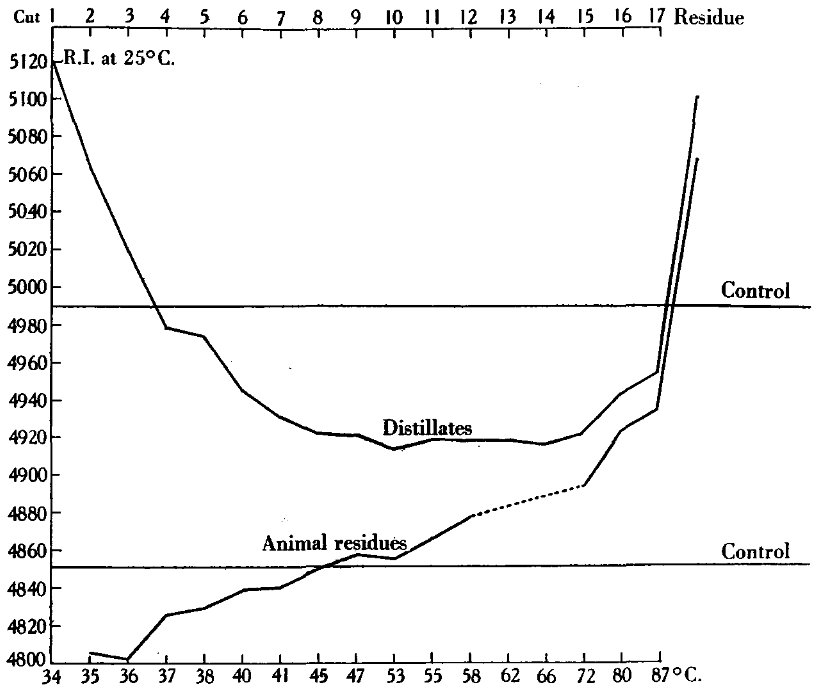
(With 2 Graphs)

IN our study of the relation of carcinogenicity to the physical characteristics of mineral oils we have dealt almost entirely with density, refractive index and viscosity.

Density and refractive index are easy to deal with as both give straight line graphs on admixture of two or more samples, but with viscosity it is, of course, quite another matter. In the ordinary commercial distillates with which we have worked, starting with cut No. 1 it is usual to find that there is a gradual increase in density, index and viscosity with rise of temperature; and a gradual decrease in density fall and index fall from No. 1 cut upwards when recovered from injected animals. Molecular distillates, we shall see, do not give such a regular set of data.

We have meanwhile only completed three preliminary molecular distillations—two with a shale spindle oil and one with a Persian spindle oil. The results were extremely interesting, for while the distillates were what may be called regular as regards viscosity they were irregular as regards density and index (*Nature*, 1937, **139**, 374). We have here what at first sight seems the paradox of a gradually increasing viscosity accompanied by a gradually decreasing density and index. The first few fractions, although of high density, have a relatively still higher index, with consequently a refractivity which in some cases is considerably higher than that of the original oil. This fact, in conjunction with that of a low viscosity, renders them exceedingly toxic for the animal on injection.

In the two trial runs with shale oil No. 55 there was not really a continuous fall in density and index from the first to the last (fifteenth) fraction, but as far as we were able to examine there was a continuous rise in viscosity. The fourth fraction had actually the highest density and index, but from here to the end of the distillation as far as taken by us there was a continuous fall in both characteristics. In the trial run with the Persian spindle oil No. 102 there was a continuous fall in density and index up to the tenth fraction, at which point reversal commenced to take place (Graph I). The viscosity, of course continued to rise during the whole course of the experiment. The residual oil in the flask after five fractions had been distilled had a density and index well below those of the original oil, although well above those of the fifth fraction, but the highly viscous tarry material remaining after the termination of the distillation had, as would be anticipated, a very high density and index. The first fraction had a high refractivity, the values gradually declining, up to the fifteenth fraction,



Graph 1. Molecular distillates of Persian spindle oil No. 102.

that of the sixth fraction having a value equal to that of the original oil. The tarry residue had a low refractivity indicating the presence of a relatively small percentage of aromatic constituents. The ratio of the density fall to the index fall showed a consistent decline from the first to the last fraction.

It was not difficult to foresee the degree of response of the animal to the injection of these distillates. The intense reaction called forth by the high index, low viscosity early fractions, with a gradual falling off to an almost negligible quantity in the last few, low index, high viscosity fractions is illustrated in the graph. The ratio of density fall to index fall is, of course, in an opposite direction to that just mentioned as regards the distillates themselves, the "levelling" action of the animal almost invariably being in evidence in this type of experiment.

At the time of writing the painting of animals with molecular distillates of shale oil has been in progress a few weeks only. The intense toxicity of the early fractions as compared with the later ones for the hair follicles was manifested in a few days by complete epilation of the animals painted with the former,

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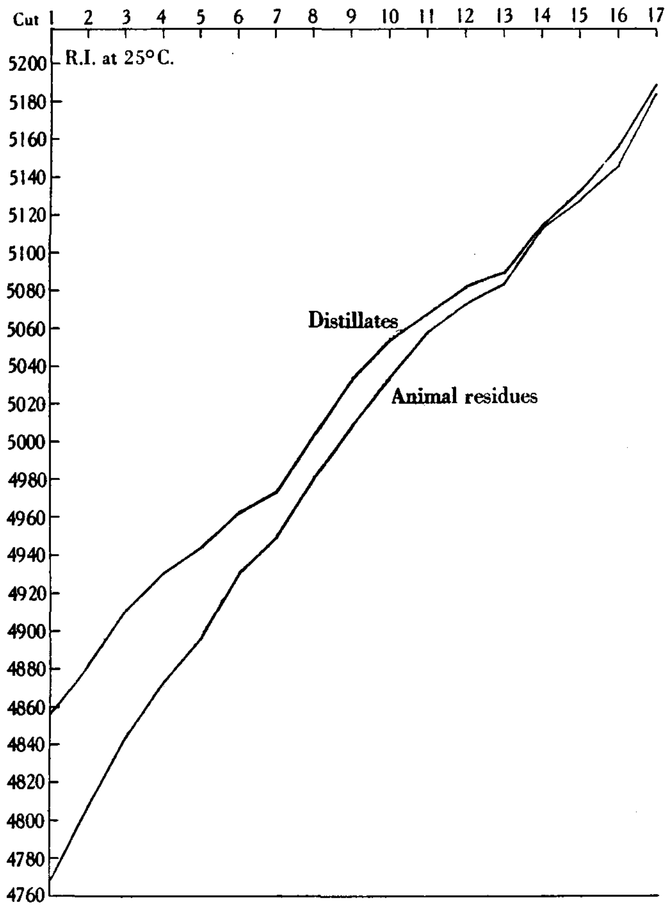
while there was no apparent effect on the animals painted with the residue. Also, although the animals are only being painted daily with a very small quantity of oil, it is evident that the early fractions are badly tolerated as many deaths have already occurred, necessitating a reduction in the paintings from



Graph 2. Commercial distillates of Peruvian lubricating oil.

five to two per week. It is not improbable that we shall ultimately have to resort to dilution experiments, as we have had to do when testing highly toxic extracts. By this means fallacious results given by debilitated animals or animals with a damaged skin are to a large extent eliminated.

It is interesting to compare the animal reaction to molecular distillates (Graph I) with the reaction to ordinary commercial distillates (Graph II), although it is unfortunate that the two oils selected were so dissimilar. In both categories of distillation there was a gradual rise in viscosity from the first to the last fraction, but the range was relatively small with the molecular distillates. It will be seen that as the temperature rises, the index of the recovered oil approaches nearer and nearer that of the injected oils in both instances. The process is really much more rapid when dealing with molecular distillates than it is with ordinary distillates, for in the former the viscosity range is small, and the divergence between the index of the injected and recovered oils is so very wide in the case of the first distillate. It remains to be seen to what extent molecular distillates are carcinogenic, and how they compare with solvent extracts of abnormally high refractivity when applied to the skin of animals.

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