AN OPTICAL INVESTIGATION OF SOME INDIAN OILS.

III. Intensity of the Scattered Light.

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1. Introduction.

In an earlier paper in this Journal (Jogarao, 1936) the results of a study of the depolarisation of the transversely scattered light in a number of oils have been reported. In the present paper the same oils have been studied in respect of the intensity of the scattered light. Such an investigation, besides furnishing us valuable information regarding the optical characters of the oils, is expected to decide whether the scattered beam observed in these oils has a genuine molecular origin or is due to any other kind of phenomenon. The two most important factors that make the scattered light appear more intense than what it really ought to be are fluorescent impurities and dust particles in the scattering liquid. These two disturbing factors are eliminated in the following manner.

2. Eliminating Dust Particles and Fluorescence.

It has already been mentioned that these oils could not be distilled even in vacuum without decomposition. As such, a systematic process of refining described in the first paper of this series has been applied to each one of the oils studied. As has been done in the paper already referred to, effects due to fluorescence are avoided by interposing a deep red glass in the path of the incident beam before obtaining the estimates of the intensity of the scattered beam. Dust could not be removed by the above process but considerable success in this direction was attained by continuously centrifuging the oil so purified for a number of hours in an Ecko centrifuge (3600 R.P.M.). A series of observations given below in the case of olive oil clearly show the effect of continued centrifuging. The intensity of the scattered light gradually decreased until it attained an almost steady value after about seven hours of centrifuging.
In this manner all the oils studied have been rendered practically dust-free and fit for optical investigation. The depolarisation factors for the oils have been re-measured in the present investigation and the values obtained now are not very different from the values obtained before. It may be noted here that in the former investigation, the track of the scattered light in gingelly oil was found to be reddish. The gingelly oil has been centrifuged in the manner described above in the present investigation and the scattered light in this sample is found to exhibit a rich blue colour. It has also been noticed in the earlier paper that the scattered beam in gingelly oil is different from the other oils in that it showed a value of 0.7 for \( \rho_h \) and as the track was reddish much significance was not attached to this result. In the present investigation, the track is found to exhibit a value of 1 for \( \rho_h \) in conformity with the other oils.

3. Experimental Arrangements.

The intensity of the scattered light (Ether = 1; Benzene = 3.2) has been measured by means of the rotating sector photometer, constructed in this laboratory. Benzene has been taken as the standard. Pure redistilled benzene and the purified and dust-free oil are contained in two cubical glass cells. The glass cells are covered with black paper on the outside excepting windows for the passage of incident light and the observation of the scattered light. The openings are kept so that the scattered beams emerge out of the two cells side by side. Light from a carbon arc is focussed by means of a Zeiss biotar lens fixed in the side of the dark cabin, into the cells. The path of the beam through the cells has been adjusted to be narrow and parallel.

The sector photometer has been made as follows. A brass circular disc 1/16" thick and 6 1/2" diameter, having a sector of 60° opened in it has been mounted coaxially along with another similar brass disc of radius 5 1/2" but having a suitable opening. The two are attached to a pulley with ball bearings, so that the whole can be rotated in a vertical plane at a very high speed by means of an electric motor.

The glass cells are mounted behind the sector at the same height. The intensities are compared in the usual manner.

At first the oils showed much greater intensity than benzene even when a deep red glass has been interposed into the path of the incident beam but
the intensity soon became much less on purification by centrifuging. The results are given in the following table.

**Intensity of Transversely Scattered Light in Oils.**

<table>
<thead>
<tr>
<th>Oil</th>
<th>Intensity of the scattered light (Ether=1) with a deep red glass interposed</th>
<th>Depolarisation $\rho \times 100$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Revised values</td>
</tr>
<tr>
<td>Castor oil</td>
<td>1.92</td>
<td>40.1</td>
</tr>
<tr>
<td>Olive oil</td>
<td>1.80</td>
<td>27.0</td>
</tr>
<tr>
<td>Cocoanut oil</td>
<td>2.40</td>
<td>39.2</td>
</tr>
<tr>
<td>Groundnut oil</td>
<td>2.24</td>
<td>34.0</td>
</tr>
<tr>
<td>Gingelly oil</td>
<td>2.52</td>
<td>11.7</td>
</tr>
</tbody>
</table>

The depolarisation values obtained with the oils after intense centrifuging are given here for comparison along with the values obtained previously.

4. **Comparison with Theory.**

The following formula* gives us a method of calculating the relative intensities of the transversely scattered light.

$$\frac{I}{I_0} = \frac{\pi^2}{2 \alpha^2} \cdot \frac{RT \beta}{N \lambda^4} \cdot (\mu^2 - 1)^2 \frac{6 + 6\rho}{6 - 7\rho}.$$

The various letters have the usual significance. If $I_1$ and $I_2$ represent the intensities of light scattered by two liquids for identical values of $I_0$, $\lambda$ and $T$, we have

$$\frac{I_1}{I_2} = \frac{(\mu_1^2 - 1)^2}{(\mu_2^2 - 1)^2} \cdot \frac{\beta_1}{\beta_2} \cdot \frac{6 + 6\rho_1}{6 + 6\rho_2} \cdot \frac{6 - 7\rho_2}{6 - 7\rho_1}.$$

Compressibility values are available only for castor and olive oils. So the relative values of the intensity of the scattered light (Ether = 1; Benzene = 3.2) in the case of these two oils is calculated and given in the following table, along with the values obtained experimentally.

Data regarding the compressibilities of the other oils are not available and as such a comparison with theory in those cases is not possible. A systematic study of the compressibilities of oils, however, is in progress in this laboratory and use will be made of the values as soon as they are available. It may be concluded that there is satisfactory agreement between the calculated and observed values of the intensity of the transversely scattered light in the case of castor and olive oils. This result establishes the fact, that, provided care has been taken to eliminate fluorescence by interposing a deep red glass and dust by powerful and continued centrifuging, the oils exhibit a scattered beam having a genuine molecular origin and hence subject to the usual laws of molecular scattering in dense media.

5. Summary.

The intensity of the transversely scattered light (Ether = 1; Benzene = 3.2) in the case of five dust-free oils is measured by means of the rotating sector photometer. Using values of compressibility, refractive index and depolarisation available for olive and castor oils, the intensity of the scattered light is calculated. The calculated values agree with the experimental values. It is concluded that the light scattered by the oils is molecular in origin.

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REFERENCE.