which supports it at the closed end, the open end being plugged by the disc. The shaft is driven at about 250 r.p.m. The horizontal brushes, which move freely on the cross arms, press against the cylinder wall with only centrifugal force. The fumed lint is placed in the cylinder which, with the brushes in place, is slipped through the supporting opening and over the disc plug. The motor is started and run until lint dust ceases to fall. The outside of the cylinder is brushed or blown free of lint. A sheet of paper is placed below the cylinder, the latter is removed and dumped onto the paper, and the brushes freed of all foreign material, which is collected on the paper and all transferred to a container for weighing.

Machine brushing requires from 1 to 2 minutes against about 15 minutes for hand brushing.

**Thermal Properties of Fats and Oils**

**IV. Some Observations on the Polymorphism and X-Ray Diffraction Characteristics of Tristearin and a Highly Hydrogenated Cottonseed Oil**

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As a preliminary step in the calorimetric examination of certain highly saturated fats, it was necessary to investigate the polymorphic behavior of these materials under the conditions that obtain in the calorimeter. Saturated glycerides are known to be capable of existence in a multiplicity of polymorphic forms, and these presumably differ in their heat capacities and other thermal characteristics. For identification of the different polymorphic forms, melting point determinations were supplemented by x-ray diffraction measurements. The results point to the existence of hitherto unreported crystal structures in the lower-melting forms, and are otherwise of more than incidental interest; consequently, they are here made the subject of a separate communication. In the present literature there is virtually nothing dealing with the subject of triglyceride crystal structure beyond the publications of Malkin and coworkers (2,3,6,7).

**Preparation and Composition of the Samples**

The samples examined consisted of cottonseed oil, hydrogenated in the laboratory almost to completeness with a nickel catalyst, and a highly purified sample of tristearin. The estimated fatty acid composition of the cottonseed oil, before hydrogenation, was recorded in a previous communication (8). According to the data of Hilditch and Maddison (5), cottonseed oil of this composition, when highly hydrogenated, should consist principally of \( \beta \)-palmitodistearin and tristearin, in the ratio of about 3 parts of the former to 1 of the latter. The hydrogenated oil had an iodine value of 0.85; hence it probably contained about 3 per cent of oleoic saturated glycerides. Its content of free fatty acids was 0.30 per cent.

Samples of tristearin were prepared by reacting stearoyl chloride in 10 per cent excess with glycerol and quinoline in chloroform solution, according to the method of Averill, Roche, and King (1), and repeatedly crystallizing the product from ether containing a small amount of alcohol. Stearine acid for preparation of the acid chloride was derived from a commer-

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**TABLE I**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Melting Points of Different Polymorphic Forms of Tristearin, ( \beta )-Palmitodistearin, and Highly Hydrogenated Cottonseed Oil (I.V. = 0.85)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>II</td>
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</tbody>
</table>
| Tristearin (Clarkson and Malkin) | 71.5 | 65.0 | 54.5 | ....
| Tristearin (present investigation) | 71.0 | 64.5 | 54.5 | ....
| Tristearin (present investigation) | 71.8 | 64.5 | 54.5 | ....
| \( \beta \)-Palmitodistearin (Malkin and Meara) | 69 | 64 | 55 | 50 |
| Hydrogenated cottonseed oil (present investigation) | 62.3 | 61.0 | 58.5 | 50.5 |

1 Following the scheme adopted by Daubert and Clarke (4) the different polymorphic forms are designated as I, II, etc., simply according to their melting points and without regard for the geometry of the crystal structure involved. Forms I, II, and III of tristearin correspond respectively to the \( \beta \), \( \beta' \), and “vitreous” forms of Malkin and coworkers. The above tabulated forms of \( \beta \)-palmitodistearin are designated by Malkin and Meara as \( \beta \), \( \beta' \), \( \alpha \), and “vitreous” in decreasing order of melting point.

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1 One of the laboratories of the Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, U.S. Department of Agriculture.

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By application of the technique described by Clarkson and Malkin (3), wherein solidified samples in capillary tubes are plunged into constant-temperature water baths of different temperatures, it was possible to distinguish four different crystalline modifications in the hydrogenated oil. The melting points of the oils containing these modifications are listed in Table 1, together with the melting points reported by Clarkson and Malkin for tristearin, those found in the pres-
Fig. 1 X-ray diffraction photographs. Tristearin: (A) Form I; (B) Form II; (C) Form III; (D) Composite of the three forms. Hydrogenated cottonseed oil: (E) Form I; (F) Form IV. Film distance for (D), 10 cm.; for all others, 5 cm.