"The properties of the extremely thin film of oil that remains on tin plate after the commercial cleaning process are very important. Significant points are the adequacy of protection against blue and yellow staining, maintenance of new-bright surfaces during periods of shipment and storage, and the ease of soldering and lacquering in subsequent can-making operations. These matters are quite intimately related to the oil used in tinning, and any change at the tin pot entails careful investigation throughout all following steps, including the performance of the can in service. In the case of palm oil the fine points are known, with others the risk is on the producer until the new practice is as well established as the old. . . . A hydrogenated oil with free fatty acid value of approximately 0.5-1.0, iodine value 20-25, flash point above 500° F. new and 525° after use, fire point approximately 600° F., Saybolt viscosity 85 at 210° F. after heating for one week at 460° F., has given a good account of itself in the tinning operation. The 'Setting' characteristics of hydrogenated oil are different from those of palm oil; oil drag on the plates is increased; slower speed is sometimes necessary, resulting in reduced output; provision must be made against the freezing of hydrogenated oil in circulating systems and cooling boxes. These operating problems are cited as typical in a change from established procedure."

Manufacturer B. "The present practice of using palm oil in the tin pot apparently arose from a combination of necessity and convenience. The Wales tin-plate industry needed an oil to blanket its tin pots, and the British Empire had at its disposal a raw material that fitted this need.

"Tin-pot operations called for a relatively cheap material of high thermal resistance to prevent oxidation and evaporation; to furnish a medium in which the molten tin could flow; and one of such nature that the excess could be conveniently removed from the surface of the freshly tinned sheet.

"Palm oil met these conditions and has, by custom, enjoyed continued use.

"It is quite probable that the quality of the oils in use today is far superior to that used in the early days of the industry. The advent of the plantation systems, which put order into production and which utilizes latest scientific knowledge, has brought this about. However, it is still palm oil.

"Despite the large number of data available concerning the physical constants and chemical constitution of palm oil there has never been a satisfactory correlation made between these values and the performance of palm oil used for hot dip tinning. This is confirmed by the scant information in the literature. Aside from the fact that palm oil satisfied the conditions cited above, the functions of the various properties are a matter of conjecture.

"The only properties, therefore, that can be definitely said to be essential to the proper functioning of oil in the tin pot are: (1) High flash and fire point; (2) high resistance to thermal decomposition; (3) relatively low viscosity at high temperatures; and (4) easy control of amounts remaining on the freshly tinned sheet.

"Another consideration is that the oil and the products of its decomposition should be as non-corrosive as possible.

"The mere fact that an oil works well in a tin pot is not a criterion of its use as a replacement for palm oil. Any radical change in the type of oil may alter any one of the numerous operations of the tin plate fabricator. In this connection we must consider such operations as shearing, stamping, lithographing, lacquering, the application of sensitive and seam-coating compounds, labeling and even the service life of the filled container.

"While it is recognized that palm oil has not fulfilled all of the requirements of the various phases of fabrication, the attending shortcomings have not militated against its use over a long period of time."

Manufacturer C. "To be serviceable for use in the operation of hot dip tinning, an oil must consistently produce a high grade of tin plate that has stability characteristics when tested with a variety of wet packs by the canners. Such tests necessarily require several years for their evaluation and are meaningless unless the tin plate is from an operating machine that is running under equilibrium conditions. The process of tinning is continuous, twenty-four hours per day and seven days per week. Even so, it may require from two to three weeks before complete equilibrium is assured in all cases.

"Among the essential properties of a satisfactory oil may be mentioned a flash and fire point well above the operating temperature, suitable wetting properties relative to steel and tin, and resistance to pyrolytic decomposition in the presence of metals and flux. The properties of the oil cannot be considered secondary and it is a fortunate circumstance in this case that they are found, possibly uniquely, in a low priced commodity."

Consumer A. "There are many sources of palm oil such as Lagos, Benin, Victoria, Cameron, Red Sierra Leone, Niger, Sumatra, and Congo. The better qualities contain the lower amounts of free fatty acids. For example: Lagos is one of the best and contains about 11 per cent of free fatty acid (palmitic acid). Many sources contain 18 to 38 per cent of free acid. When palm oil goes into use in the tin stack its acidity runs up rather rapidly to about 50 per cent.

"Where hydrogenated cottonseed oil is used as a substitute for palm oil the acidity of this oil increases but little and will not exceed 5 per cent.

"Palm oil fumes at 470° F. whereas hydrogenated cottonseed does not fume even when approaching 600° F., the approximate temperature of the bath.

"Hydrogenated fish oil might prove satisfactory as it has a high smoke point.

"We use a Sumatran oil with about 6 per cent fatty acid. In operation the oil gets heavy and every 8 hours old oil must be partially replaced by new oil. Hydrogenated cottonseed oil has been used and although it does not give quite as good a finish to the tin plate is certainly usable. The higher cost of hydrogenated cottonseed oil has been a deterrent to its use, but on account of its stability it goes almost three times as far as palm oil, offsetting its first high cost.

"By using palm oil or cottonseed oil with tin pot (always lead-free) and sieving the oily bran from slivers of tin, the product makes an excellent hog feed, and commands a fair price. Cottonseed oil bran would probably be better than palm oil bran because the free fatty acid is much lower."

Research Foundation A. "There is really no satisfactory way to judge a new oil except by actual operation with a tin bath. Some preliminary ideas can be obtained by using a small tin pot, such as a clay graphite crucible containing molten tin, heating being performed in an electric furnace of laboratory size. The temperature of the tin bath is controlled best by means of a thermocouple, such as alumel-chromel, encased in a closed tube of fused silica which is immersed in the molten tin. . . .

"The principal properties to be fulfilled by a tinning oil are as follows: (1) Ability to take up oxide on the tin bath; (2) ability to absorb any flux residues; (3) promoting the spread of tin on the base metal; (4) no difficulty in removal of residual oil; (5) no harmful effect, such as corrosion, on the tin coating if some oil remains; (6) reasonably long life; (7) low fire risk; and (8) no bad effect on subsequent lacquering, etc.

"Palm oil is considered good for items 1, 2, 3, and 5; fair for 4; bad for 6 and 7. It is also considered satisfactory for item 8, although there is definitely room for improvement.

"It is rather difficult, on the basis of present knowledge, to correlate the above properties of palm oil with its physical and chemical properties. However, it appears that a tinning oil must have some degree of chemical action, such as would be contributed by acid content. It is somewhat doubtful whether unsaturation in itself is of any benefit. In fact, it may be