Per cent.	$d\ \frac{19°}{4°}$.	$d\ \frac{20°}{4°}$.	$d\ \frac{21°}{4°}$.	$d\ \frac{22°}{4°}$.	Differences for 1 per cent.	Differences for 1°.
90	0.81883	0.81794	0.81706	0.81616	267	88
91	0.81616	0.81527	0.81440	0.81350	270	88
92	0.81345	0.81257	0.81170	0.81081	274	88
93	0.81071	0.80982	0.80895	0.80807	278	88
94	0.80792	0.80704	0.80617	0.80529	282	87
95	0.80509	0.80421	0.80335	0.80249	287	87
96	0.80221	0.80134	0.80049	0.79962	293	86
97	0.79928	0.79841	0.79756	0.79670	297	86
98	0.79631	0.79544	0.79458	0.79373	302	86
99	0.79328	0.79241	0.79156	0.79072	309	85
100	0.79018	0.78932	0.78847	0.78763		85

possible. But from 5 per cent. to 15 per cent., interpolation for expansion is uncertain at the higher temperatures, in some cases by as much as 0.0010. The same is true, in a less degree, near 40 per cent. For mixtures of these percentages, where special accuracy is required, observations may be made below 18°.

[CONTRIBUTION FROM THE DEPARTMENT OF FOOD AND DRUG INSPECTION OF THE MASSACHUSETTS STATE BOARD OF HEALTH.]

A COMPARATIVE REFRACTOMETER SCALE FOR USE WITH FATS AND OILS.

BY ALBERT E. LEACH AND HERMANN C. LYTHGOE.

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THE indices of refraction of substances vary with the temperature, the refraction becoming less as the temperature is raised. It has been shown by the work of Olds, Long, Proctor, and Tolman that this variation is a constant for certain oils and fats (notably the edible oil and fats) and its value is 0.000365 for each degree centigrade. This relation has been substantiated by the writers.

Recently the Zeiss butyro-refractometer has come into use to a large extent for the examination of oils and fats, partly on account of its cheapness in comparison with other instruments for the same purpose, but principally on account of its ease of manipu-

lation, and from the fact that its scale is within the range of the refractions of the fixed oils and fats.

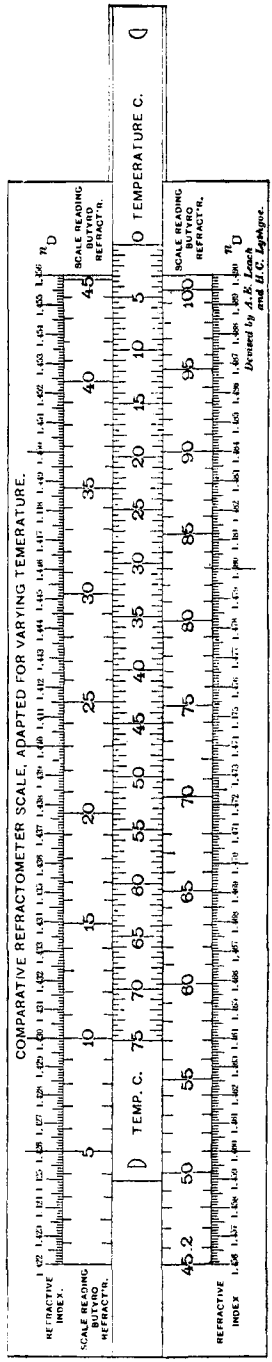
This instrument has an arbitrary scale from 0 to 100, covering the indices of refraction from 1.4220 to 1.4895, which scale is not uniform with the values of n_D. Thus the differences from 0 to 10 in indices of refraction is 0.0080 and from 90 to 100 is 0 0055 ; consequently the variation with the temperature of oils on the arbitrary scale of the instrument is not constant except for slight changes of temperature, and this variation changes with different parts of the scale.

Thus the variation for 1° C. on the refractometer is 0.46 for readings between 0 to 10, and 0.66 for readings between 90 and 100.

The best methods of obtaining scale readings at different temperatures is to first transform them into values of n_D, apply the correction, getting the values of n_D at the required temperatures, then transform into scale readings.

In order to do away with this extended calculation the writers have devised the slide-rule illustrated. The values of n_D are constant, and the values of the butyro scale have been laid off against the index of refraction scale, according to the table of Pulfrich, published by Zeiss and Jena. The sliding temperature scale (from 0 to 75° C.) has a value of 0.027375 on the index of refraction scale, making each degree centigrade equal to 0.000365 on the scale of indices of refraction.

By the use of this slide-rule, readings may be obtained on the scale of the butyro-refractometer at different temperatures,



without first transforming them into indices of refraction, readings in indices of refraction may be obtained at different temperatures without calculation, and readings on either refractometer scale may be readily transformed into readings on the other.

In using this rule the slide is moved until the initial temperature and refraction coincide, then opposite the required temperature is found the corresponding refraction. If this temperature falls outside of the refraction scale it will be necessary to shift the slide, for example:

At 35.5° C. an oil reads 40.1 on the butyro-refractometer. Required, its refraction at 20°. Place the slide so that 35.5 on the slide coincides with 40.1 on the butyro scale, then it will be seen that the right end of the refractometer scale (45.2) exactly coincides with 25° on the slide. Move the slide until 25 coincides with 45.2 on the lower scale, then opposite 20 on the slide read 47.7.

[CONTRIBUTION FROM THE DEPARTMENT OF FOOD AND DRUG INSPECTION OF THE MASSACHUSETTS STATE BOARD OF HEALTH.]

THE DETECTION OF WATERED MILK.

BY ALBERT E. LEACH AND HERMANN C. LYTHGOE.

Received July 27, 1904.

ONE of the most difficult problems with which the analyst is confronted is that of distinguishing between what might be termed honest low-standard milk, or milk below the standard coming from the cow as such, and milk that is fraudulently watered. Judgment on this point has heretofore been based largely on the relative proportion of fat to solids not fat, taken in connection with an abnormally low percentage of total solids. Additional information on this question is furnished by the density of the milk serum when the milk has been curdled under fixed conditions, though this in itself is by no means conclusive.

The addition of water to milk perceptibly affects the degree of refraction of the serum to such an extent that this latter constant promises to be a most helpful one in determining whether or not the milk has been watered. For this purpose the immersion refractometer of Zeiss is most useful, although the Abbé refractometer may be employed.