of the error in this direction may be ascertained by taking into account the fact that each 5 degrees of temperature makes a difference of 0.001 on the lactometer. Milk expands by heat and contracts by cold, so that 5 degrees of temperature above 15° would show 1 degree lower on the lactometer ; and 5 below would show a degree higher. For example, if the milk at 15° shows a specific gravity of 1.032, the gravity at 20° would be 1.031, and at 10° the gravity would be 1.033. The temperature at 15° C. corresponds to 59° Fahr.—the temperature at which the milk should be taken, but as correction tables have been prepared, it is no longer necessary to heat or cool the milk to bring it to this temperature. These facts and figures prove that the accuracy of the lactometer can be tampered with very considerably, although it has served a useful purpose where the principles upon which it works have not been understood. In skim milk the specific gravity ranges between 1.032 and 1.040. All the constituents of the milk, excepting the fat, show separately a specific gravity greater than that of water ; and, taken together, the specific gravity of all the solids other than fat is pretty constant at 1.6. While it is true that the addition of water lowers the specific gravity of milk, yet it cannot be said that a low specific gravity in unadulterated milk shows a quality rich in fat relatively to the other solids, for the fat, as I have shown, cannot be increased without also increasing the other solids. It may therefore be concluded that the specific gravity, by indicating the quantity of water, whether created before or after milking, is also a measure of the fat as a uniform percentage of the total solids, but where this relation is disturbed, other instruments must be used.

The lactometer, however, although indefinite and unreliable in itself, is very useful in connection with other testing instruments. In connection with an instrument which accurately gives the percentage of fat, the lactometer can be effectually used for ascertaining the percentage of total solids. Many formulas have been introduced for effecting this end, of which the following is most commonly used :—

$$t = 1.2 \cdot f + 2.665 \frac{100s - 100}{s}, \text{ and}$$

$$f = 0.833 \cdot t - 2.22 \frac{100s - 100}{s}; \text{ so}$$

$$s = \frac{1000}{1000 - 3.75\,(t - 1.2 \cdot f)}$$

In these formulas, t represents the total dry solids, f the percentage of fat, and s the specific gravity ; when any two of these quantities are given, the third may be found. The accuracy of these formulas has frequently been tested by comparing the results with those obtained by chemical analysis, and the variations have been so trifling that they may be dismissed from practical consideration.

The specific gravity test is also unreliable when applied to cream, varying from 0.95 to 1.028—average 1.010. This must be expected when it is considered that the fat in cream varies from 15 to 70 percent.

II.—THE LACTOSCOPE.

I desire to be specially clear and emphatic in my remarks about this instrument, because it is the one we have introduced for our purposes, and for those of farmers and farmers' clubs, and a prejudice has been raised against it for two reasons, viz.:—(1) That its supposed inaccuracy would not do justice to the breeds, and (2) that the testing of cows on their intrinsic merits would check the designs of those who desire their breeds to obtain undue advantage over other breeds which have not been boomed up to the same extent. There is also a class of men who pride themselves upon belittling our work because it is out of the ordinary rut—contending that a herd book based upon individual merit is a farce. But before I pass on to the lactoscope, it is necessary to say a word about chemical analysis, with which all other methods of determining the fat are compared with respect to accuracy. Chemical analysis is regarded as the most accurate, but it is impracticable for ordinary purposes, the apparatuses required being very expensive, the process very slow, and an experienced chemist being required. With regard to cheapness and quickness combined, nobody denies that the lactoscope is the best for determining the percentage of fat, so that all I have to do is to examine the instrument with respect to accuracy. Chemical analysis itself does not always give the same results, there being different methods employed, and of the two methods usually adopted in England I have observed a difference of 0.36 percent in analyzing the same sample of milk ; but in making comparisons between the lactoscope and chemical analysis, the most accurate methods of the latter have been employed.

I wrote to Prof. Babcock, Milk Inspector for the city of Boston, and one of the most reliable milk experts in the United States, and received the following reply :—

Boston, May 21st, 1886.

W. A. MACDONALD, ESQ.:

Dear Sir,—Your communication has been received. We use Feser's lactoscope in connection with the specific gravity as a preliminary test, and in the case of fresh milk we find the figures to agree very closely with those obtained by analysis ; but with old milk, or milk that has been churned up, the results given by Feser are not as accurate.

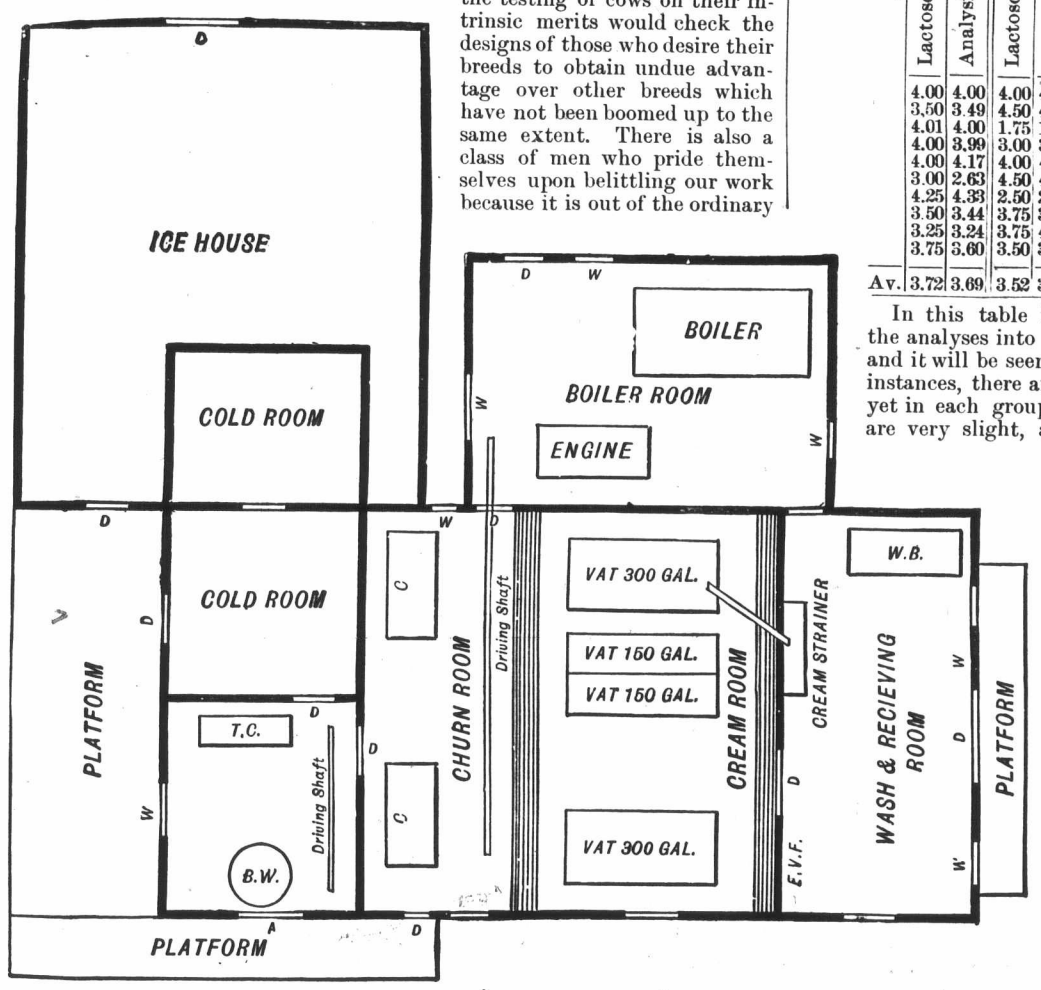
JAS. P. BABCOCK.

In the annual report of the New York State Dairy Commissioner, recently issued, careful comparisons have been made, the fat of thirty-one samples of milk having been determined by the lactoscope and by chemical analysis, with the following results :—

Lactoscope.	Analysis.	Lactoscope.	Analysis.	Lactoscope.	Analysis.	Totals. Lactoscope.	Totals. Analysis.
4.00	4.00	4.00	4.34	3.50	3.33	3.72	3.69
3.50	3.49	4.50	4 40	3.55	3.43	3.52	3.60
4.01	4.00	1.75	1.82	3.50	3.42	2.73	2.69
4.00	3.99	3.00	3.16	2 25	2 37		
4.00	4.17	4.00	4.18	3.50	3.54		
3.00	2.63	4.50	4.60	2.50	2.52		
4.25	4.33	2.50	2.52	2.50	2.53		
3.50	3.44	3.75	3.56	2 75	2.78		
3.25	3.24	3.75	4.04	1.25	1.10		
3.75	3.60	3.50	3.42	2.00	1.90		
Av. 3.72	3.69	3.52	3.60	2.73	2.69	3.323	3.326

In this table I have divided thirty of the analyses into three groups of ten each, and it will be seen that although, in a few instances, there are noteworthy variations, yet in each group the average variations are very slight, and in the grand totals, seen in the last columns, the lactoscope and the chemical analyses are practically identical, the former showing an average fat percentage of 3.323, and the latter 3.326 — a difference therefore of only 0.03 percent, which is very insignificant for any purpose whatever. Any variation of even ten times this amount would still make the lactoscope a very useful instrument for ordinary purposes.

I have also several hundred comparisons from French and German sources, of which the following tables may be taken as representative :



GROUND PLAN OF BUILDING.

	Examined by Eugling & Von Klenze. Analysis.	Examined by Eugling & Von Klenze. Lactoscope.	Examined by P. Vieth. Analysis.	Examined by P. Vieth. Lactoscope.
	3.94	4.25	3.36	3.25
	4.05	4.20	3.31	3.30
	4.65	4.40	2.76	2.80
	3.73	4.60	3.38	3.28
	3.93	4 55	3.33	3.25
	4.05	4.10	3 36	3.35
	3.71	3.60	3.27	3.40
	4.02	3.90	3.32	3.40
	4.09	4.10	3.38	3.40
	4.03	3.90		
Averages	4.02	4.16	3.274	3 270

Here again the averages correspond very closely, there being only a variation of 0.14 percent in the one examination, and 0.04 in the other. In normal milk, a material variation is not likely to occur, and if an average of eight or ten analyses with the lactoscope be taken, there is no risk of a variation worth calculating upon, providing the