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REPORT OF THE MILK INSPECTOR.

BY WILLIAM K. NEWTON, M.D.

Ezra M. Hunt, M.D., Secretary State Board of Health:

SIR—I herewith hand you my sixth annual report.

During the past year the work of inspection has been carried out on the plan outlined in previous reports and nearly all sections of the State have been brought under the operations of the law.

The milk sold in the following cities and towns has been inspected: Hoboken, Jersey City, Elizabeth, Plainfield, Paterson, Burlington, Bordentown, Camden, Mount Holly, Bridgeton, Gloucester, Perth Amboy, South Amboy, Lambertville, Atlantic City, Asbury Park, Ocean Grove, Passaic, New Brunswick and Trenton.

The milk-producing sections of the State have also been visited, and the milk shipped therefrom has been thoroughly and frequently inspected.

The results of these inspections have been as follows: In Hoboken and Jersey City many cases of adulteration have been discovered; in Elizabeth, six cans of milk brought into that city by railroad were condemned, while the milk sold from wagons and produced in the adjacent country, was found to be of uniform excellence; at Plainfield, all the milk inspected was found to be good; at Paterson, out of 234 samples examined, but four were found below the standard; at Burlington, Bordentown and Camden no milk was found below the State limit; at Mount Holly, two cases of adulteration have been brought to trial; at Bridgeton and Gloucester, one sample in each place was found to be adulterated; at Asbury Park, one sample was also below the standard; at South Amboy, while the milk was uniformly of poor quality, none was found so low as to warrant prosecution; at Perth Amboy, one sample was taken for analysis; at Lambertville, one case was prosecuted; at Asbury Park and

Passaic, one sample in each place was found to be of poor quality; at New Brunswick, two men were fined for selling adulterated milk.

In the city of Newark, the local inspection has been under the charge of Mr. Henry Negles, the Milk Inspector of the Local Board of Health, who, by his care and efficiency, has done much towards insuring the excellence of the supply. At Trenton, Mr. James H. McGuire, the Health Inspector, has so watched the supply that the quality has been maintained at a high standard.

The inspections through the dairy sections also show a constant and improved quality of milk, and cases of violation of the law have been very rare; one being found in Sussex county, two in Hunterdon county, two in Burlington county, one in Gloucester county and one in Passaic county.

It will be seen by looking over this brief history of the year's work that there has been a decided improvement in the quality of the milk sold throughout the State or shipped from the dairy sections. Formerly many cans of milk were condemned in each city, whereas now it is rare that any infraction of the law occurs.

Assistants have been assigned to work as follows:

Mr. Peter L. Vandegrift has had charge of the inspection in the southern and western parts of the State, and by strict attention to duty has checked adulteration to a great extent.

Mr. Henry B. Everhart has inspected in Hudson county, and the few cases of debased milk found in Hoboken and Jersey City are evidences of his watchfulness.

Mr. James H. McGuire has done considerable special work under my direction.

The amendment to the Milk law that authorizes a trial by jury, has not worked satisfactorily in all parts of the State. In the rural and less densely populated sections it is almost impossible to obtain a jury of unprejudiced men to try a case, and in many instances a neighborly feeling often outweighs all evidence, for the defendant frequently is well known to the jury, hence to prove him guilty of the charge, even in the face of the strongest testimony, is very difficult. In cities, on the other hand, the jury trials have been well conducted and the cases fairly tried.

The evidence required by law is so surrounded by checks and safeguards that a clear case does not require a jury to weigh it, and the Inspector has no authority or right to begin a case until the testimony is conclusive.

As an instance of the miscarriage of justice through a prejudiced jury, I may mention the facts concerning a case tried in Sussex county. The complaint made before the justice of the peace charged a producer with shipping a number of cans of impure milk, and the proof that the milk was below the State standard was amply supported by the results of the chemist's analysis; this evidence was still further fortified by the written confession of the defendant. After a prolonged trial, and a still more protracted debate in the jury-room, no verdict could be arrived at. The case was retried, and, notwithstanding the conclusive evidence, the jury acquitted. An appeal was now taken to the Quarter Sessions, and after a trial lasting near an entire day, and after much deliberation by the jurors, they could not arrive at a verdict. The result of the new trial, soon to occur, can only be conjectured.

The change in public opinion concerning the purposes and methods of enforcing the provisions of the milk law is remarkable. In portions of the State, where the opposition was heretofore the strongest, the benign and salutary effects of the statute have been so apparent that the most hearty indorsement is now given to the work of the Inspector. Only those people who have felt the rigor of the law in the role of defendant, those who do not yet understand the objects of sanitary measures and those who are never satisfied with any law, remain to be classed amongst the opponents of this now very popular enactment.

MILK ANALYSES.

In the following tables I have given the results of analyses made during the year. The first table will show the results of analyses of pure milk, the second gives the results obtained from milk of doubtful purity, while the third outlines all cases that fell below the legal standard:

TABLE I.

ANALYSES OF MILK KNOWN TO BE PURE.

No.	County.	Total Solids.	Fat.	Solids-not-fat.	Specific Gravity.
1	Gloucester	14 23	4.48	9.75	1.0319
2	Burlington	14.63	4.51	10.12	1.0330
3	Atlantic	12.80	3.00	9.80	1.0319
4	Cumberland	19.50	10.11	9.39	1.0292
5	"	14.85	4.88	9.97	1.0324
6	Burlington	12.84	3.06	9.78	1 0324
7	Middlesex	15.76	6.36	9.40	1.0292
8	Passaic	13.12	3.70	9.42	1.0304
9	"	13.57	4.69	8.88	1.0307
10	"	13.77	4.87	8.90	1.0316
11	"	14.13	4.23	9.90	1.0320
12	Burlington	15.21	6 00	9.21	1.0292
13	Cumberland	15.59	5.54	10.05	1.0330
14	Burlington	18.43	8.88	9.55	1 0313

Nos. 4, 5 and 13 were taken from the cans of a vendor in Bridgeton. Each sample represents the mixed milk of more than one cow, and was as it is sold to customers.

No. 8 was from a cow in Passaic county, claimed by the owner to be "the poorest milker in the county;" this claim being made by the producer when notified to stop selling impure milk. The character of the milk on sale at the time may be seen by reference to No. 9, Table III.; the difference between the two samples is notable.

No. 12 is a fair sample, taken from the can of a vendor at Mt. Holly.

No. 14 gives the results recently obtained by an analysis made by Mr. Shippen Wallace. The figures are remarkable and lead one to suppose that the milk was from an Alderney cow, but the following history will give the true facts in the case: "The cow was of common stock, six years old, had her fourth calf last August, and is fed on bran and meal besides ordinary pasture." The remainder of the samples given in this table were from vendors' wagons or from ordinary cows.

TABLE II.

SAMPLES ABOVE THE STANDARD, OF DOUBTFUL PURITY, BUT MANY OF THEM KNOWN TO HAVE BEEN EITHER WATERED OR PARTIALLY SKIMMED.

No.	Total Solids.	Fat.	Solids-not-fat.
1	12.60	3.94	8.66
2	12.64	3.96	8.68
3	12.16	3.70	8.46
4	12.08	3.96	8.12
5	12.51	4.11	8.40
6	12.66	4.28	8.38
7	12.90	4.48	8.42
8	12.10	3.83	8.27
9	12.85	3.73	9.11
10	12.23	2.67	9.56
11	12.84	3.06	9.78
12	12.30	3.36	8.94
13	12.53	3 31	9.22
14	12.67	3.67	9.00
15	12.21	4.60	7.61
16	12.21	3 66	8.55
17	12.51	4.32	8.19
18	12.22	4.00	8.22

The specific gravity of all these samples was below 1.029, a figure below which pure milk never registers. The solids-not-fat in nearly all instances is too low. In a few cases proof was offered that the milk had been watered or partially skimmed, but as the standard set up by law is so low, no complaint would hold in court.

TABLE III.

ANALYSES OF CONDEMNED MILK.

No.	Total Solids.	Fat.	Solids-not-fat.	Disposition of Case.
1	11.73	2.43	9.30	From the State Camp at Sea Girt. See note below.
2	11.20	2.40	8.80	
3	11.12	2.16	8.96	
4	11.42	2.44	8.98	
5	9.84	2 43	7.41	Plea of guilty. Fined $50.
6	10.51	1.30	9.21	Skimmed, shipment stopped.
7	11 49	3.18	8.31	Partly watered.
8	10.70	2.70	8.00	Defendant not found.
9	11.91	3.30	8.61	See No. 8, Table I.
10	9.70	2.42	7.28	Plea of guilty. Fined $50.
11	10.52	2.97	7.55	" " "
12	10.72	3.17	7.55	" " "
13	10.50	2.35	8.15	Destroyed.
14	11.84	2.94	8.90	"
15	11.72	3.64	8.08	"
16	9.48	2.84	7.00	Plea of guilty. Fined $50.
17	9.87	2.87	7.00	" " "
18	10 54	3.18	7.36	" " "
19	10.81	2.95	7.86	" " "
20	11.64	2.92	8.72	" " "
21	8.26	2.01	6.25	" " "
22	9.20	2.70	6.49	Plea of guilty and paid $61 for the two cases.
23	10 35	3.38	6.96	
24	9.26	2.06	7.20	Plea of guilty. Fined $50.
25	10.34	2.89	7.45	Two samples from same man. Fined $50.
26	10 54	2.75	7.79	
27	10.44	2.96	7.48	Plea of guilty. Fined $50.
28	11.16	2.98	8.18	" " "
29	11.92	3.56	8.36	Case pending.
30	11.30	3.22	8 08	" "
31	10.90	2 66	8.24	Fined $25.
32	10.13	2.55	7.58	Plea of guilty. Fined $50.
33	11.32	3.33	7.99	No complaint made.
34	10.07	2.45	7.62	Plea of guilty. Fined $50.
35	11 52	3.59	7.93	No case made out.
36	11.79	2.76	9.03	" " "
37	11.02	3.26	7.76	" " "
38	10.58	3.30	7.28	Plea of guilty. Fined $50.
39	11.85	3.14	8.71	Case not tried.
40	10.11	2 77	7.34	Plea of guilty. Fined $50.
41	10 74	4.31	6.43	" " "
42	11.09	3.46	7.63	" " "
43	10.12	.....	.....	Case pending.

SUMMARY OF CASES IN TABLE III.

Cases tried and penalty inflicted in each case	24
Cases now pending	3
No case, or complaint not made out	6
Milk destroyed, no prosecution	5
Defendant not found	1
Sea Girt cases, in charge of Quartermaster-General	4
Total	43

Of the twenty-four cases paying penalties, twenty paid a penalty of $50 each; one paid a penalty of $61 for two cases; and one, through error, was only fined $25. Four cases were made out on the same day against the same man, but the penalty was only inflicted for one offense. The total amount of penalties collected by justices of the peace, and which should now be in the hands of the State Treasurer, was $1,086. When a penalty is inflicted, I immediately notify the Comptroller of the Treasury, and then my responsibility ceases, for the law does not permit me to have any charge over the money collected. The money thus paid to the State will go very far towards paying the running expenses of this department.

As was stated above, in six cases no action was taken. This may be explained by the fact that in many instances it is impossible to comply with all the requirements of the law. The law insists that the sample of milk must be taken and sealed in the presence of a witness and then sent to one of the members of the Council of Public Analysts. As a witness to the sealing cannot always be obtained willing to testify, many cases are lost to the State, and no case can be made out without this witness. In a few instances, the absence of the analyst from town has made it impossible to have the work of analysis done in time. In four cases the milk was destroyed and no further prosecution undertaken, because the owner lived at a great distance, or out of the State

The four samples, Nos. 1, 2, 3 and 4, taken on different days at Sea Girt, represent the quality of milk furnished to the State Camp by the contractor. The inspection was made at the request of Quartermaster-General Perrine. None of the milk was pure, or up to the State standard, it being skimmed and a mixture of whole and skimmed milk. The results of my inspection were reported to General Perrine, it being understood that the contractor would not be paid, because of his breach of contract, hence no prosecution was

begun by me. At the time of writing, I have had no advice from the Quartermaster's Department as to whether any action has been taken to punish the contractor.

EXTENT OF ADULTERATION SHOWN BY THE TABLE.

The amount of adulteration, by adding water to the milk, as shown by Table III., varies from thirty-three per cent., in a few cases, to from twenty to as low as five per cent. The abstraction of cream is noted in many instances.

DISPOSITION OF VIOLATIONS OF THE LAW.

Only six or seven cases have been subjected to a prolonged trial before a justice of the peace and a jury. The greater majority of persons charged with a violation of the law have entered a plea of guilty, and paid into court the penalty prescribed. Although the penalty may be paid without a protest, yet many men are inclined to ease the pangs of conscience by ascribing the blame to the "hired man," or it is said that an unusual quantity of "rinsings" have found their way into the milk-can, both of these phrases being the euphonious manner of admitting the adulteration.

THE STATE STANDARD.

The State standard of 12 per cent. of solids has been repeatedly tested during the past year, and I have not yet found a sample of pure milk that fell below that figure. Many requests have been made for analyses of milk from cows reported to be poor milkers, but in no case did a sample contain less than the required amount of solids. Tests made in New York and Massachusetts indorse, in every point, the wisdom of setting up a limit, but it is acknowledged that the 12 per cent. standard does not represent milk of extra quality; in fact it is said by some that a premium for the production of inferior milk is thereby offered. If any change is to be made in this standard, it should be in the direction of increasing the severity of the test, so that no milk shall be sold that contains less than 3 per cent. of fat and 9 per cent. of solids-not-fat.

In New York State it was recently determined, after many analyses, that a minimum of 12.5 per cent. of solids would be the proper limit,

and that all milk below that figure should be rejected. The milk of 296 cows was analyzed by the chemist to the New York Dairy Commissioner. In each case the milk was drawn from the cow in the presence of an inspector, so that the authenticity of each sample was insured. The results of these tests show that the minimum of milk solids was 12.53 per cent., of fat 3.29 per cent., and of solids-not-fat, 9.17 per cent.

Rules for estimating the amount of pure milk in a given sample are printed in all works on the chemistry of milk. As they are convenient and more or less accurate, they are added here.

When the amount of total solids is known, we may compare the sample in question with the State standard in the following way. Take for instance sample No. 21, Table III., which had 8.26 per cent. of milk solids, then we have this formula:

Pure Milk.				Solids in Sample.		Pure Milk in Sample.
12	:	100	::	8.26	:	x

Carrying out the proportion, we find that x equals 68.88, or the amount of pure milk in that particular sample, which, of course, means that 31 per cent. of water had been added.

When the amount of solids-not-fat in a given sample is known, we may use that as a factor by which to calculate the quantity of pure milk in that specimen. Multiply the amount per cent. of solids-not-fat found in the sample, by 100, and divide by 9,—the minimum of solids-not-fat in pure milk. Take, for example, the same sample, No. 21, Table III., the solids-not-fat in which was 6.25 per cent; the sum will be: $6.25 \times 100 = 62{,}500 \div 9 = 69.44$ per cent. of pure milk in the sample.

METHODS OF ANALYSIS.

In my report for the year 1883 the methods of milk analysis in vogue were outlined at considerable length, but as possible improvements have been suggested recently the subject may be reviewed with profit.

The experience of the majority of the analysts of this State and New York leads them to prefer the method devised by Prof. Waller, and known as his or Cairns' method, which is a modification of Wauklyn's or the English method. Recently the American Society of Public Analysts, an association composed of public analysts,

chemists and inspectors of food, made an extended inquiry as to what was to be considered the model method of milk analysis. The results of this investigation show that nearly all chemists who had much to do with the analysis of milk were strongly in favor of Waller's or Wauklyn's method; the points in its favor being that it was accurate, rapid and convenient, and, in the hands of competent men, all that could be desired for official work.

Dr. A. R. Leeds is the only analyst employing Ritthausen's method, but in his hands it seems to be capable of yielding satisfactory results.

All the methods mentioned above may be found described at page 259 of the seventh annual report of the New Jersey State Board of Health, and space forbids a more extended reference here.

Quite recently, Mr. M. A. Adams, an English chemist, described a process of analysis that has attracted considerable attention and has been investigated by many chemists with varying results. (*The Analyst*, Vol. X. No. 108.) The process is described by the author as follows: Strips of stout white blotting paper are cut two and one-half inches wide, and twenty-two inches long; each of these strips is rolled into a helical coil on a glass rod the size of a lead pencil. These coils are thoroughly dried. The milk to be examined is mixed and 5 c.c. are discharged into a small beaker. This beaker is weighed with the milk and then a coil of the paper is gently thrust into the milk, and in a few minutes the paper sucks up nearly the whole of the milk. The paper is then carefully withdrawn by the dry extremity, gently reversed and stood, dry end downwards, on a clean sheet of glass. The beaker is again weighed and the milk taken got by difference. The charged paper is next placed in the water oven on the glass plate and dried. It is next placed in a Soxhlet extractor and the fat extracted. The paper is removed from the extractor and dried in the air bath and the fat determined in the usual way. Experiments with this method show that the fat determinations are higher than with the Waller or Wauklyn methods. The many steps of the process make it more difficult to manage than either of the above-named methods, and great care is necessary to obtain concordant results. This method is now being tried and the results will probably be reported next year. Full details may be found at page 47 of the Journal quoted above.

The method of analysis devised by Dr. S. M. Babcock, chemist to the New York Agricultural Experimental Station, and described on page 167 of the second report of that station, was brought to the

attention of the American Society of Public Analysts and excited much discussion. It seems to be worthy of extended trial by chemists.

In Babcock's method the milk is put into a platinum dish containing freshly ignited asbestos and dried at 100° C. to constant weight. As he says: "The asbestos serves as an absorbent of the milk and presents a large surface, which greatly facilitates the drying." When the amount of fat is desired, the milk is placed in a test-tube with a perforated bottom and filled three-quarters full of ignited asbestos, and a plug of cotton inserted to prevent the escape of loose fibers of the asbestos. The tube and contents are weighed, the plug of cotton removed and five grammes of milk run in and the cotton replaced. The tube, connected at its lower end by a rubber tube and adapter with a filter pump, is placed in a drying oven at 100° C., and a slow current of dry air drawn through till the water is completely expelled. This tube, when cool, is weighed and the total solids calculated. The tube containing the solids is placed in a fat extractor and exhausted with ether. The fat is dried at 100° C. and weighed.

All the methods described call for extended trial at the hands of chemists, and it would well repay the State to have a series of experiments properly conducted to determine which shall be the official method. All the work so far done in this direction has been voluntary on the part of the analysts, and without remuneration; it is certainly time that some official recognition was given for this painstaking work.

Some two years ago the British Society of Public Analysts appointed a committee, composed of seventeen of the most prominent chemists in England, to go over the whole subject of milk analysis and to report the results of their investigations. After the two years of deliberation and experiment the committee has just reported to the society and recommends the following process of analysis (*The Analyst*, No. 117, page 215):

(1) *Total Solids.*—"These to be estimated by evaporating in a platinum dish about 5 grammes of milk. The residue to be dried to practical constancy, at the temperature of a water-oven or water bath."

(2) *The Process of Fat Extraction.*—"Measure 5 c.c. of milk into a beaker 2 inches deep by 1¼ inches in diameter; weigh, and place into it one of Adams' coils, which must have been previously

extracted with ether in a Soxhlet and the ether driven off. When as much as possible of the milk has been absorbed by the paper, the coil is removed and placed dry end downwards upon a slip of glass, and the beaker is at once reweighed. Dry the coil in a water-oven for one to two hours, and extract the fat in a Soxhlet apparatus, twelve siphonings at least being necessary, the flask in which the solution is collected being as small and light as possible. Boil off the ether and place the flask in a water-oven in a horizontal position and dry to constancy; allow to cool for about ten minutes and weigh."

(3) "*The Solids-not-fat* in all cases to be determined by difference."

"It is recommended that the specific gravity be taken in all cases."

This report of the committee was not adopted, but will come up for discussion during December.

Leaving, now, the considerations of analytical methods, it may be profitable to note some other facts concerning the inspection of milk.

THE LACTOMETER.

The many thousands of tests of pure milk that I have made during the past six years verify the statements often made in my official reports, to the effect that the mixed milk of healthy cows never has a specific gravity below 1.029 at 60° F., and I have not yet seen a cow that yielded milk that would register a lower figure. This result has been so often verified that it may now be accepted as being absolutely accurate.

Martin, in a recent exhaustive monograph on this subject,* has, with great care, collected and tabulated the results obtained in this country and Europe by twenty-one competent observers. He says "That the average lactometric standing of all the milk as given in the tables, the result of testing some 20,000 specimens, is 1.319. If, then, the average specific gravity of milk is placed at 1.029, it certainly is at its lowest possible limits."

It was found by Martin, after testing the individual milk of over seven hundred cows, that no specimen registered a lower specific than 1.029, at 60° F.

I am strongly inclined to the belief that the specific gravity, and the amount of fat in milk, when taken together, enable us to judge of the purity of milk more accurately than the total solids, for a rich

*Report on milk and its adulterations, by Edward W. Martin, Ph.D., Albany, 1885.

sample of milk may be watered down to the State standard of twelve per cent. of solids, and thus be passed as a pure milk, while the lactometer may easily detect the fraud in such a case.

The specific gravity of milk is simply its weight compared with water, and alone gives no indication of its quality, being dependent upon two constituents, namely: the solids-not-fat and the fat. The former raises the gravity above that of water while the latter lowers it. This explains the reason of skimmed milk indicating higher on the lactometer than whole milk, and this fact is used by those ignorant of what this instrument really indicates to base the claim that it is valueless. It is so, in the hands of one incompetent, but when used by one who understands what causes the fluctuations, and who has more or less practical knowledge of the physical appearances of milk, it is seldom that he cannot tell pure milk from that which has been either skimmed or watered.

The fact that the relation of the fat to the solids-not-fat influences the specific gravity, has led several chemists to attempt the production of a formula by means of which, if two of the factors are known, the third may be obtained by calculation.

Mr. Otto Hehner, in *The Analyst* for August, 1882, gives a formula by means of which the solids-not-fat, and hence the fat, may be determined, if one knows the specific gravity and the total solids in a sample of milk. His formula is follows:

(Total solids $\times .725$)+specific gravity$\div 4.33$=solids-not-fat.

Mr. Shippen Wallace, one of the Public Analysts of this State, has investigated this formula and has tested it in the analyses of some two hundred samples. He reports that "This formula is, with milk containing from two to three and a half per cent. of fat, to be depended upon as a check and verification of solids-not-fat, as obtained by extraction of the fat, and if there should occur a greater difference than one meets with in duplicate analyses, the analyst should then look for a reason and determine the amount of ash, when the probable cause, such as the addition of some solid substance to the milk, will no doubt be found."

THE LACTOSCOPE.

As was said above, the amount of fat in a sample of milk greatly influences its specific gravity, hence an instrument for the rapid determination of the fat is of great value to the inspector. Mar-

chand's lacto-butyrometer, which was described in previous reports, is of value in the laboratory, but what is needed is an instrument that can be used in ordinary inspection and without the use of chemical agents. Many such instruments have been devised, amongst which may be mentioned the lactoscopes of Donné, Vogel, Hoppe-Seyler, Seidlitz, Tronimmer, Heinrich, Feser, Leeds and others. These instruments all aim to enable an observer to ascertain the amount of fat by optical methods, by measuring the degree of capacity or turbidity caused by mixing a certain quantity of milk with a known quantity of water, or *vice versa*. Two modifications of these methods are employed: either a uniform dilution of the milk with water is used, which still permits one to recognize through the tube a certain object; or else the experiment is begun with a stated and uniform quantity of milk, which is diluted with water until a black line or figure may be seen through the mixture. The former method is not very accurate, while the latter admits of a considerable degree of accuracy. Of all the instruments devised for this purpose Feser's lactoscope is the most satisfactory and the one most in use. For the past two years I have used it considerably and have found it to be a rough-and-ready means for estimating the amount of fat in milk, and when very carefully used its readings approximate quite closely the results obtained from an analysis. The difficulty of obtaining concordant results is against its use, for the light used, the eyesight of the observer and other factors interfere with a correct reading of the instrument. The milk inspectors of Brooklyn and Boston have used it for two or more years and claim good results by its use.

The instrument is a hollow glass cylinder, graduated with two scales, one giving the number of cubic centimeters it contains, the other the per cent. of fat. In the lower part of the tube a piece of milk-white glass is inserted upon which are black lines. When testing a sample of milk 4 c.c. are transferred to the lactoscope and water added until, after thorough shaking, the black lines are just visible. The difficult point to decide is when to commence the reading.

The instrument under discussion has been thoroughly tested by the German Board of Health, and a recent report gives the results of the investigation as follows:*

*Arbeiten aus dem Kaiserlichen Gesundheitsamte. Erster Band. Erstes und Zweites Heft. Berlin, 1885, page 36.

"The results of different observers, in reference to Feser's instrument, deviate not only from the chemical test, but also amongst themselves, so considerably that, in spite of Feser's warm recommendation, this instrument does not appear to be practicable for the *exact* test of the amount of fat."

"The optical instruments in their application encounter a number of difficulties. First—the kind of light existing at the time of examination influences the test very markedly. Second—the power of the observer's eyesight is of great importance. The degree of turbidity, which is considered the measurement of fat, depends not only on the quantity of fat in the milk, but also on the casein which it contains. Besides this, the butter is contained in the milk in globules of different diameters, and it is plain that a certain amount of fat in the form of smaller globules obstructs the light more than the same quantity of fat in larger globules. If the cream is removed the larger globules are also withdrawn, and then the smaller ones preponderate, then the amount of fat is easily found too high in the lactoscopic examination."

From this we may claim that the lactoscope is of little value from a scientific point of view, but as a rough means for inspection it may be depended on to a great extent.

NIGHT AND MORNING MILK.

The popular idea that the night's milking is richer than the morning's, is, as a general rule, true, and recent experiments made at the New York Experiment Station show conclusively that this fact has some foundation. Over one hundred and fifty separate analyses of the night and morning milk were made, and the work continued for nearly three months. The figures show that almost invariably the night's milk contained more fat than the morning's. This report is of value, as it settles a disputed point. But it does not affect the methods now in use to test commercial milk as shipped on railroads through this State, for, as a rule, no attempts are made to keep separate the two milkings.

THE DETECTION OF IMPURE WATER ADDED TO MILK.

The addition of water to milk is a practice much to be deprecated, but adulteration by means of foul or polluted water, or that contam-

inated with sewage, is a very dangerous crime, for it is well known that milk so poisoned may carry such diseases as cholera and typhoid fever into the human organism.

We have seen that chemistry can not distinguish between pure water and the water normally existing in milk, and that the most satisfactory way to determine the amount of added water is to compare the sample in question with a standard. The question now comes up, Can chemistry determine whether or not polluted water has been used to dilute milk? This is an important problem, for if contaminated water can be detected, we have another link in the chain of evidence. Fortunately we are able to answer this question in the affirmative, at least to a partial extent. To determine the existence of organic pollution, we naturally look to the methods employed for the detection of pollution in drinking-water.

Waller and Martin have found (*op. cit.*, p. 74,) that nitrites may be detected in milk adulterated with contaminated water in the same manner that nitrites are determined by methods employed in water analysis. They say: "In order to detect impure water in milk we can apply a modification of the ordinary sanitary analysis of water, as follows: 300 c.c. of milk are to be coagulated with acetic acid and filtered; to 100 c.c. of the filtrate are added about 10 c.c. of a mixture of a solution of equal parts of sulphanilic acid and sulphate of napthylamine. Now, should the milk contain nitrites, or in other words water contaminated with sewage, a rose-red color will commence to form, deepening in intensity on standing, and the deeper the color the more the nitrites present. I have tried this test on milk which I knew to be pure with negative results, and have detected the presence of nitrites in milk to which one part in a million had been added."

Any of the tests usually employed to detect nitrites may also be be used, such as Griess' method.

As a corroborative test, the one described by Uffelman (*The Analyst*, No. 113, p. 146,) may be employed. This has for its object the detection of nitrates and is used as follows: A small quantity of diphenylamine is put in a white capsule; over this is poured about 25 minims of sulphuric acid, free from nitric acid; the mixture is stirred with a clean glass rod until it is of a pale rose color. Now let three or four drops of the suspected milk trickle down the side of the capsule. If nitrates or nitric acid be present a blue color appears.

In closing, I may offer as an excuse for the length of this report that it was thought important to collect together the scattered facts relating to the subject under discussion. The literature of milk analysis is rapidly multiplying and the work in this direction is great, the analysts of this State having contributed no inconsiderable portion to our stock of knowledge bearing on sanitary chemistry.