CHEMISTRY

$5,000 Prize to Prof. Babcock For 40-Year Old Invention

He Filled a Request For a Test to Show How Much Butterfat Milk Contains---And it Has Made Dairymen Honest

THIS WEEK a Senator gave a Professor five thousand dollars.

There was in the transaction no hint of any cause for other Senators to start an investigation, fond as Senators have become of doing that sort of thing. On the contrary, everybody knew why the Senator gave the Professor the five thousand dollars, and everybody applauded the donation.

For the Capper prize of $5,000 and a gold medal for the most distinguished service to American agriculture was awarded to Prof. Stephen M. Babcock of the University of Wisconsin because forty years ago he invented a machine that made dairying an honest business, and put the old farm pump out of commission as a source of sure-fire jokes. The award was made Thursday, October 9, in Madison, Wis., at the thirteenth annual banquet of the American Country Life Association.

The rewards of science are sometimes a bit leisurely in arriving. But then, perhaps Senator Capper didn't have so many $5,000 prizes to spare forty years ago, and in the meantime Professor Babcock hasn't missed the money.

For the genial old gentleman (he'll be 87 on his next birthday, Oct. 22) is one of those rare souls who in a commercial age has never bothered about money. When he invented the Babcock test in 1890, it was recognized instantly as something of tremendous possibilities, and he was urged to patent it. Had he done so, and collected even the smallest of royalties, he would be a very rich man today. But he preferred to give his idea freely to the world, for everybody's profit, and he has never expressed the least regret at doing so.

Troubles of Dairymen

It is the milk test that bears his name that has really made Professor Babcock famous. And unlike many discoveries in science, even in applied science, it did not have to wait long years and fight its way against obstinate conservation and entrenched opposition. It brought immediate and world-wide recognition and acclaim.

Some of the praise that has been bestowed upon the Babcock test would seem extravagant if it were not quite sincere and fairly demonstrable. The outstanding bit is the epigram attributed to former Governor Heard of Wisconsin: "It has made more dairymen honest than the Bible has ever made."

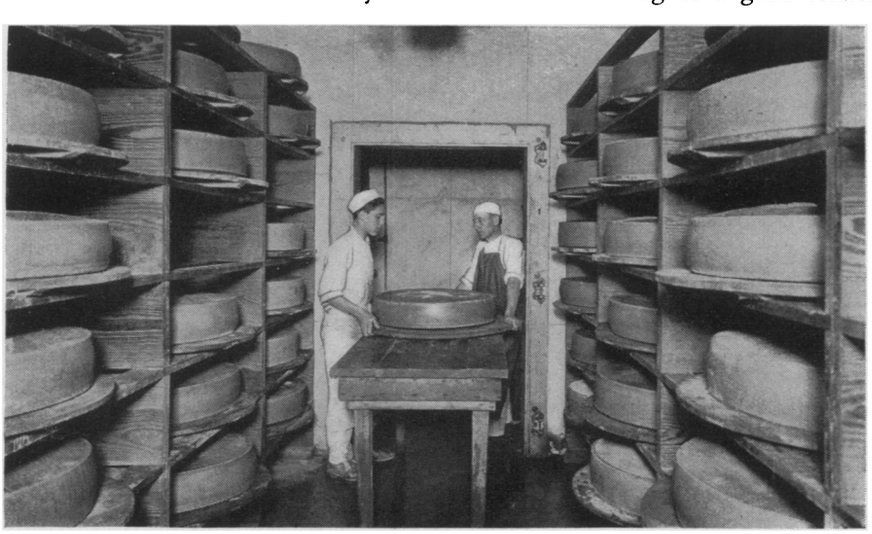
That is not so much of an exaggeration as it may sound. A generation and a half ago, when commercial creameries were beginning to figure as a major factor in American rural economics, they had troubles of their own. Their aim was to deliver milk, and especially butter, of high and uniform quality to the public, replacing the old uncertainties of small-scale milk peddling and "tub" butter made by rule of thumb at individual farmhouses. But they had to strive for this uniformity and quality pretty much in the dark, and often against sheer dishonesty. For milk is anything but uniform.

High grade milk contains around five per cent. butterfat, but there are plenty of mediocre cows whose milk yields less than three per cent. And to the unaided eye it all looks pretty much alike. Add to that the tricks of the godless, adding water to the milk or "high-grading" some of the cream off it, and you have a riddle nobody could solve with his eye, no matter how experienced a milk handler he might be.

And there wasn't a scientific test for the percentage of butterfat in milk in existence during the eighties. So when young Doctor Babcock went to the University of Wisconsin from the New York Agricultural Experiment Station, with most of the shine still on his Göttingen Ph.D., his dean, W. A. Henry, put it up to him to devise one. He worked out two or three, but they didn't satisfy him; and he would not give up the search, although his colleagues thought that the others would be good enough for all practical purposes. Babcock wanted the right test; for him no bread has always been better than a half-loaf.

A Made-to-Order Test

The Babcock test is remarkable not merely for its very literal bread-and-butter importance, but for the manner of its discovery. It is, so to speak, a scientific discovery made to order. It is the claim of many scientists, sometimes most vehemently made, that "the spirit inspireth where it listeth," and that a scholar cannot be expected to make discoveries nor an inventor to invent like an army officer carrying out orders. As a rule this is true, and it is most true in the strictly theoretical fields. But often, especially in applied science, a set problem can be placed before a properly trained man, and if he has the making of a good soldier



SET AWAY TO CURE

The cheese-making industry was revolutionized by Dr. Babcock.

in him, and can see the importance of the job, a real discovery of major importance will result. That at least was the history of the Babcock test.

The test is such a simple thing when you see it made that you are tempted to wonder why the scientists and agricultural technologists of the world have been heaping praises and prizes on Professor Babcock's careless head for half his lifetime. The answer to that is the old story of Columbus and the egg. Somebody had to think of it first.

All there is to the Babcock test is to put samples of the milk to be tested into some long-necked bottles with marks at proper intervals on their calibrated necks, pour in sulphuric acid, and whirl the bottles in a centrifuge. When the machine is slowed down the milk is in the bottles and the butterfat is up in their necks, where the percentage can be read off directly by the grade marks. Sounds simple.

But it is worth while to look at milk a little more closely, to see why through all the centuries of butter-making nobody ever worked out this test, and why it was a chemist at last, with really very little knowledge about the practical problems of commercial dairies, who thought of dumping sulphuric acid into milk and then whirling it around to make the cream "rise."

Milk is not a single, simple, uniform substance like water. It looks as though it were "all one piece" when it comes out of the cow, but as everybody has seen thousands of times, if milk is left to itself for a little while it separates itself into two parts. One of these we call cream, the other skim milk. And if we churn the cream, we again get a separation, this time into a nearly pure fat—butter—and thickish milk we call buttermilk. But, if we squeeze the butter, a thin watery stuff comes out; so butter has at least two substances in it. And if we let the skim milk alone until souring bacteria have done their work upon it, we find that it "curdles"—separates into a semi-solid, cheesy substance and a thin, watery fluid called whey.

What Is In Milk

So even without any chemicals or any knowledge of chemistry, we have all seen what a complicated substance milk is. Chemists, with their more exact methods, have not yet unriddled all its complications. But they do know that the things that are mixed into the water that makes up somewhere near 90 per cent. of even the best milk can be divided into two general classes. One is made up of a lot of things—sugar and proteins and mineral salts—that can be dissolved in water. This constitutes the "milk plasma," roughly corresponding to skim milk. The other class contains a single substance—butterfat.

A FARM YARD MILK TEST.

A Babcock "laboratory" is very likely to be used in the open.

Butterfat, like all fats and oils, will not dissolve in water. But like all fats and oils, it can be shaken up in water or a watery solution so that it is separated into a host of tiny droplets that hang suspended, rising to the surface only slowly. This kind of a solution-full-of-fat-drops is called an emulsion. Whole milk is an emulsion of butterfat in skim milk.

But to get a real picture of how much butterfat there is in a given lot of milk you should be able to get the butterfat droplets—all of them, even the tiniest—out of their films. The fat must come to the top not as the complex stuff we call cream, but as pure fat, and nothing else but. And it must be done in a hurry, too: no time in the rush of a modern dairy business to pound it for hours in a churn until the films are broken by sheer brute force. Anyhow, even churning doesn't get out all the fat.

No, the job has to be done some other way. And that was the problem that was put up to Professor Babcock forty years ago. He solved it not by thinking especially of milk, but by going back to the fundamental principles of chemistry. He knew that one reason why the films that surround the fat droplets are so obstinate about letting go is that they are not pure water, but contain, among other things, the substances known as proteins. We see some of them later on, more or less solidified, in cheese. In the milk they are thin and runny, but tough, like a mixture of white-of-egg in water. So they tend to bounce or stretch rather than to break when they are in thin films surrounding a fat droplet.

Hard to Satisfy

Professor Babcock pondered these things as he messed around with innumerable milk samples, back in the late eighties, devising some tests that were satisfactory to other people but not to himself. For Professor Babcock is an obstinate man, and hard to satisfy, when his own results are concerned.

His general knowledge of chemistry reminded him that proteins and protein-like things are soluble in sulphuric acid, and that fats in general are not.

Here was the key to the problem. He began adding sulphuric acid in various quantities to milk samples, and was rewarded by seeing the butterfat come to the top, not as cream containing a lot of milk films, but as clear yellow drops of oil. It took a while longer to find just how much acid was needed, for he wanted enough to release *all* the butterfat, yet not an excess.

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The most suggestive sign is stiffness of the spinal column and neck. The child will hold his head and neck rigidly and often he cannot sit up comfortably without propping himself on his arms.

Every stiff neck is by no means an indication of infantile paralysis, of course. The stiff neck of this disease is a rather special one. But if the mother finds such a symptom, she should at least suspect the disease and have the matter further investigated without delay.

The paralysis may set in anywhere from one to three days after the onset of the disease. The extent of it varies. When death occurs, it is from paralysis of the muscles used in breathing and not from the severity of the fever.

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ICHTHYOLOGY

Nature Ramblings

By FRANK THONE

A Sarcophagus of Pearl

THERE is in the American Museum of Natural History in New York a most curious pearl-shell specimen. Embedded under the nacre, or pearl substance, is the clearly outlined body of a tiny fish, the only fish known that has so costly a sepulcher. It is not rare for other objects to be so impearled. Every pearl starts with an irritation to the oyster—a grain of sand, a tiny parasitic animal, or something of that kind. Japanese pearl culturalists start pearls by inserting tiny beads between the lips of the pearl mussel's shell.

The story of the pearl-ensepulchered fish may be a drama of the oyster's conflict with a parasitic robber, or it may be a tragedy of the death of a comrade. Many small fish of the goby family love to lurk about in the shelter provided by larger animals instead of in natural rock cavities. "Messmates," some of them are called; others are known as "commensals." But commensalism may pass over, by insensible gradations, into sheer parasitism; and at least a few cases are known of small fish parasitizing large molluscs.

So the oyster that buried a fish in pearl was not necessarily giving mournful sepulture to a departed house-mate; it may have found the house-mate unendurable, killed him, and then sealed him over to get the carcass out of the way.

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Prof. Babcock

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That feature satisfactorily settled, he sought for some way of getting the drops to the top to be measured, faster than they would float there naturally. He bethought him of our old friend centrifugal force. That is the natural force that keeps the water in a kid's play-bucket when he whirls it round his head on the end of a string—we've all done that trick.

When you whirl a mixture of things in a centrifugal machine the heaviest parts of the mixture go to the outside and the lightest come to the inside. The faster you whirl the quicker this sorting is accomplished.

The watery-solution part of milk is heavier than butterfat. That is why cream rises to the top. Why not centrifuge the acidified milk samples, and thus make the butterfat drops get a move on?

That is what Professor Babcock did. Then he added the highly practical detail of so regulating the size and shape of the bottles he put into the machine to be whirled that the percentage of butterfat could be read off directly by the marks scored on their long necks.

Thus was the Babcock test given to the world forty years ago, and thus it remains to this day, without the change of a single essential feature. There are dozens of manufacturers of testers all over the world, making machines all the way from modest two-bottle affairs whirled by hand up to big ones holding a couple of dozen bottles, warmed by steam and driven by electric motors. But basically they are all alike. There is probably no modern invention that has so radically reformed a great industry with so little change in itself over more than half a lifetime.

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