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Dr. THOMAS TAYLOR'S REPLY  
TO "SCIENCE."

Relating to the Crystals of Butter,  
Animal Fats, and Oleomargarine.





# Dr. THOMAS TAYLOR'S Reply to "Science" Criticism on Butter and Fats,

Published in "SCIENCE" Nov. 19, 1886.

"*Science*," September 10th, vol. viii, p. 223, says: "Dr. Thomas Taylor's microscopic method for detecting the adulterations of butter with foreign fats seems destined to assume as many shapes as 'Proteus.'" Were this even so, it should not excite surprise, considering that about sixty different compositions have been secured under United States patents for butter substitutes, from which it will be seen that oleomargarine has itself become a veritable "Proteus."

"*Science*" further says: "At first the globose forms obtained by the boiling and subsequent slow cooling of butter and exhibiting the St. Andrew's cross under polarized light were brought prominently forward as distinguishing marks of pure butter."

Answer: What I have stated is that, when pure butter is boiled, cooled, and viewed as described, globose bodies (butter crystals) appear exhibiting the St. Andrew's cross—a fact not now disputed; that lard, similarly treated, yields a crystal, spinous, without cross; that beef fat gives a branched and foliated crystal, without cross; all of which Prof. Weber admits, summing up the results of his first three experiments in the following words: "Thus far the results and statements of Dr. Taylor are fully corroborated."

If, however, "*Science*" intends the inference that I have represented that globose bodies with cross, discovered in any butter-like material when boiled, is a proof that said material is butter, I have only to say that no such idea has ever been entertained by me or published over my signature. If the inference is intended that the discovery of the butter crystal and cross has some relation to my method of distinguishing oleomargarine from butter nothing could be further from the truth. My method of distinguishing oleomargarine from butter consists simply in demonstrating that certain forms of fatty crystals not known to pure butter are constantly found in oleomargarine; and in order to accomplish this I examine the suspected material, as found in





the market, unboiled. By this means I can generally detect, at once, the lard or other foreign fats if the material is an oleomargarine. It is manifest that the St. Andrew's cross found in pure butter would not help me to discover crystals of lard in oleomargarine. But "*Science*" says "at first." Am I to understand by the words "at first" that when I, for the first time, announced publicly that I could detect oleomargarine it was owing to my discovery of the globose crystals of butter showing the St. Andrew's cross? If such is the meaning intended, nothing could be more erroneous. I did not discover the St. Andrew's cross until May, 1884, while the record shows that from July, 1879, until May, 1884, I was determining between butter and oleomargarine by the simple method described. Other helps were sometimes employed, such as testing by acids, boiling to get the odor of butter or other fats, &c., but I have always considered the presence of highly developed fatty crystals in the material conclusive evidence that the substance is oleomargarine.

In a communication to Hitchcock & Wall's Quarterly Microscopical Journal, vol. 2, July, 1879, published in New York, I set forth, among other statements about butter and oleomargarine, that I was able to detect the latter owing to particles of cellular tissue, microscopic blood-vessels, and stellar crystals of fat found in it. This paper is illustrated with several cuts, exhibiting, respectively, the stellar crystals and portions of adipose tissue.

In a bulletin of the Microscopical Division of the Department of Agriculture, published in 1884 by direction of Commissioner George B. Loring, a paper of mine appears, with six chromolithographic illustrations, two of which relate to the detection of oleomargarine and show the stellated crystals of lard as seen under the microscope. On page 6, same bulletin, the following appears: "Aware of the fact that all artificial butter was made directly from crystallized fats, I devised a method by which it could be distinguished from true butter. \* \* \* To carry out this plan I used the low powers of the microscope with Nicol's prisms. In this way I found that I had a method of detecting the crystals, whether in perfect starry form or as fragments of these forms, exhibiting all the colors of the rainbow."

In public debate at the late meeting of the American Society of Microscopists, at Chautauqua, N. Y., I said that all the convictions obtained in the courts of Washington, D. C., on my evidence, had been founded on my detection of lard or beef fat

in the fatty compounds sold as butter. Thus, first and last, my most important test has been the detection of crystals of foreign fats in butter substitutes sold as pure butter.

On page 224, "*Science*" observes further: "Prof. Weber, however, upon testing the method described by Dr. Taylor, found that although the so-called butter crystals could be readily prepared from butter they could as readily be prepared from beef fat or a mixture of beef fat and lard under like conditions." Answer: According to Prof. Weber's own statement, (see Bulletin 13 of the Ohio Experiment Station), he did not use *beef fat* but a substance known to the trade as "oleo," said to be a manufactured product, containing a much smaller proportion of stearine and palmitine than does beef fat, and made, purposely, by oleomargarine manufacturers to resemble butter as nearly as possible in its chemical composition. The Professor triturated this butter-like substance with salt and water, boiled it, and when it was cooled discovered that it formed into globose bodies showing a cross, and he says that the crystal thus formed cannot be distinguished from that of pure butter. In this the Professor is greatly mistaken. When "oleo" crystals are observed under an  $\frac{1}{2}$  in. objective, they can at once be distinguished from butter by their highly spinous character; but, I ask, what bearing has this experiment upon the question of my method of detecting oleomargarine, since crystals resembling those of boiled butter are never found in oleomargarine or butterine as sold.

"*Science*" further says (2d paragraph): "After the publication of these results, the butter crystal and its St. Andrew's cross were relegated to a subordinate position." Answer: The St. Andrew's cross of butter has never been, and cannot be, "relegated" from its original position, viz: that of a constant factor of the globose butter crystal, nor can it be used as a means of detecting crystals of lard or of beef fat in oleomargarine. Pure *unboiled* butter never exhibits either globose or stellar crystals, while oleomargarine and butterine, as sold, show the crystals of fats foreign to butter.

"*Science*" says, further: "Dr. Taylor insists that his most important test has been neglected, viz: the appearance of the unboiled material under polarized light with selenite plate. According to Dr. Taylor, butter shows an uniform tint, while lard and tallow show prismatic colors." Answer: The assertion that the above is my most important test is found nowhere in my



writings. In my open letter to Prof. Sturtevant, of the New York Experiment Station, March 21, 1886, I say: "The crystals of lard or of tallow generally observed in great numbers are easily distinguished from the mass of amorphous fats with which they are combined. This is one of my most important tests of oleomargarine and butterine." My assertion, "This is one of my most important tests," is thus made the foundation of a statement that something else is my most important test. In my publications relating to the detection of oleomargarine, from 1879 to the present time, I have reiterated the necessity of finding in the suspected material crystals of foreign fats in order to prove, beyond a doubt, its spurious character. "*Science*" further says: "Here again, however, he (Dr. Taylor) has been pursued by Prof. Weber, who shows that either butter fat, or lard, or tallow, when quickly cooled, will show a uniform tint, while if slowly cooled, so as to admit the formation of large crystals, prismatic tints are shown by both. Since the imitation butter is liable to undergo sufficient changes of temperature after manufacture to allow of a partial recrystallization, the test is plainly fallacious."

As regards the first sentence of the above, it may be stated that *large crystals of butter* can never be found in unboiled oleomargarine from the very nature of its manufacture, since the only butter it contains is derived from the milk with which it is churned. In the manufacture of butterine, however, butter melted at the lowest possible temperature is added to liquid "oleo" and "neutral lard" and churned. Even in this case the butter does not crystallize. Were the butter melted at a high temperature its odor and taste would be objectionable; it would also crystallize in large globose forms, giving the butterine the granular appearance of lard which would render it unsalable.

In the latter sentence of the above paragraph "*Science*" acknowledges that imitation butter is liable to undergo sufficient changes of temperature after manufacture to allow of a partial recrystallization. For years past I have been endeavoring to convince those interested in this subject of this very fact thus acknowledged by "*Science*." But, be it remembered that in the recrystallization that takes place after manufacture it is not the oleo crystal with cross that reappears but a stellated body resembling lard.

Normal butter always shows a uniform tint; lard and tallow as sold everywhere show prismatic colors. What Prof. Weber al-

cludes to is strictly neither lard nor tallow, but a specially prepared material known as "oleo" and "neutral lard." These he chills suddenly to prevent crystallization, a condition not suggested by the broad statement contained in my paper. No unbiased mind would compare the evanescent results of this experiment with an ounce of "neutral lard" or "oleo" with the constant crystalline condition of the million of pounds sold daily in our markets.

With regard to the optical test of oleomargarine observed in the use of polarized light and selenite plate I have said: "If the sample is submitted to the action of polarized light and selenite plate, and appears of a uniform color according to the color of the selenite used, we have another *indication* that the substance is *pure normal butter* which, under these conditions, never exhibits prismatic colors. Sometimes large crystals of salt cause the appearance of prismatic colors in pure butter by refraction; these should be removed. Butter that has been exposed to light until it is bleached, or butter that has been in immediate contact for a long time with a substance that absorbs its oil, as when placed in wooden tubs, has undergone a chemical change and should not be considered as normal butter." (Extract from the Sturtevant open letter, which Prof. Weber professes to have reviewed). But even butter of this description never exhibits crystals resembling those of either lard or "oleo." The prismatic colors of an abnormal butter, described by Prof. Weber and accounted for by me in my earlier papers as observed in decomposing or over-heated butters, etc., could not be mistaken by any but a novice for the gorgeous tints seen with, and sometimes without, the aid of selenite plate in butter substitutes in general. In a letter addressed to me, April 8th, current year, Prof. Sturtevant says: "Your claim for the selenite plate received our attention a long time ago, as we observed it in Prof. Wiley's report for 1884. This test seems to offer promise of value." Prof. Wiley, Chemist of the Department of Agriculture, says: "Pure unmelting butter, when viewed through a selenite plate by polarized light, presents a uniform tint over the whole field of vision. On the other hand butter substitutes give a field of vision mottled in appearance. This phenomenon is so marked that with a little experience the observer will be able to tell a genuine from an artificial butter with a fair degree of accuracy. While the examination should never stop with this optical test above, it can be advantageously used as a preliminary step." My bulletin was issued in 1884.



The agricultural report for 1884 was issued in 1885. In a footnote to my paper, already mentioned, (Hitchcock and Wall's Journal), the following appears: "Well made oleomargarine may be quite free from any crystalline appearance, at least while fresh. \* \* \* The sudden cooling on ice seems to prevent the immediate formation of crystals, but it is not unlikely that these will gradually form in course of time." Thus it is shown that Prof. Weber was anticipated by seven years in this case. A tub of fresh oleomargarine, direct from Armour's factory, Chicago, the present month, was examined as soon as received. Stellated crystals were at once observed in it, and the entire field was covered with prismatic colors.

Prof. Weber states that a sample of butter, subjected to heat and cold in his laboratory, but which did not actually melt, showed, under the microscope, prismatic colors, and he pointedly, although mistakenly, asserts that this butter fairly represents the condition of butter generally. In a paper read before the American Society of Microscopists, August, 1885, published in the proceedings of the Society, I say: "When oleomargarine or butterine is newly made, crystals of fat are seldom observed in it when viewed under the microscope, but in course of time, owing to its being subjected to light and increase of temperature in stores, it exhibits crystals of fat more or less. . In butter substitutes of commerce the crystals are seldom absent."

"*Science*" further says: "Apparently, Dr. Taylor prepared his official report with these results in mind, for in his paper before the annual meeting of the American Society of Microscopists at Chautauqua, Aug. 10-16, he gives his method a still different exposition." Answer: The most important part of this sentence, to me, is its personal character. It contains an indirect charge that I so altered my official report to the Commissioner of Agriculture as that it might appear that I had anticipated Prof. Weber in his novel views and experiments. It is sufficient to say that my official report was placed in the hands of Col. Nesbit, Chief Clerk of the Department of Agriculture, at least six months before Prof. Weber made his experiments. The points to which "*Science*" alludes are all contained in my report to Prof. Kellcott, Secretary of the American Society of Microscopists, at Buffalo, N. Y., sent him by mail Oct. 7, 1885, and were not afterwards altered by me, as the publishing committee will testify. Independently of all this, there is on file in the Department of



Agriculture a copy of my original report, made by one of the clerks of the Statistical Bureau over one year ago, which agrees with my published official report.

"*Science*" further says: "Dr. Taylor's first step is now to search for fat crystals in the test sample by plain transmitted light." Answer: As has been shown, this was my method for the first several years, for the simple reason that lard crystals are by this means easily detected; but I subsequently discovered that the crystals of beef fat could not be properly defined without the aid of polarized light.

"*Science*" further says: "By the application of polarized light, amorphous crystals, whatever these may be, may be detected." Answer: I have applied this term, "amorphous crystals," to mottled fats which, seen by polarized light without selenite, exhibit no particular form or structure, but seen by polarized light with selenite plate exhibit specks and prismatic colors, thereby showing their crystalline condition. "*Science*" further says: "To determine whether these amorphous crystals are of lard or of beef fat, the sample is boiled and cooled slowly, as already described, and mounted in oil." Answer: In my official report, I say: "Having *first* examined the suspected material under the microscope, it may be boiled." The precaution of a preliminary examination by polarized light is highly necessary, for, should the sample contain a large per cent. of butter, boiling might cause it to crystallize in large globose bodies, by which the small crystals of lard and other fats might be absorbed and thereby escape detection. In the case of a true oleomargarine, which consists almost wholly of "oleo," the process of boiling would develop beef-fat crystals without cross, which would not be modified in form by the small quantity of butter in the compound.

"*Science*" further says: "Under these conditions he now finds, in accordance with Prof. Weber, that butter, lard, and beef fat all give globular crystalline bodies which (apparently with the exception of lard) show the St. Andrew's cross." Answer: "*Science*" is misinformed in this case. The above statement is not in accordance with the facts. Prof. Weber's language in Bulletin 13 is: "The butter revealed a well-marked black cross;" "The lard, small irregular stellated bodies;" "Beef fat only, small stellate crystals." The last is an erroneous description of beef fat, however, which has a branched and foliated crystal. It must be confessed that Prof. Weber has an odd way of "cor-

roborating" the correctness of my experiments, employing "oleo oil" instead of rendered "beef-kidney fat" according to the statement in my "Abstract." "Oleo," a substance not mentioned in my experiments, is no more beef fat than phenic alcohol is coal tar, although the one is a product of the other.

"*Science*" says: "The above account of Dr. Taylor's method, as at present described by him, is mainly drawn from his last annual report to the Commissioner of Agriculture." Answer: "*Science*" is in error on this point. The points referred to by "*Science*" are taken mostly from my open letter to Prof. Sturtevant, and from Prof. Weber's bulletins, 13 and 15, of the Ohio Experiment Station. My method of detecting oleomargarine has nowhere appeared in the columns of "*Science*," nor in the reports of Prof. Weber. My official report for 1885 was not issued when Prof. Weber published the paper of March 1, 1886, nor does he seem to have been aware of my other publications mentioned in this paper. In point of fact, Prof. Weber, unfortunately, undertook to discuss my method of detecting oleomargarine by reviewing an abstract that did not so much as mention the subject.

In conclusion, "*Science*" says: "We shall endeavor to keep our readers informed of the changes which the method undergoes in the future." This last is, to me, the most gratifying sentence in the whole article.

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#### DESCRIPTION OF PLATE I.

- Fig. 1. Represents a number of crystals of boiled butter as seen by a pocket lens.  
 Figs. 2, 3, 6, and 7. Represent crystals of boiled butter as seen under a magnifying power of about 150 diameters with polarized light, exhibiting the St. Andrew's cross.  
 Fig. 4. A butter crystal as seen under plain light.  
 Fig. 5. Represents a butter crystal in its second stage of crystallization; a small rosette crystal forms in the centre of the crystal and separates from the primary or parent crystal as shown by Figs. 8 and 9.  
 Fig. 10. A butter crystal as seen under polarized light and selenite plate.  
 Fig. 11. A boiled "oleo" crystal by polarized light.  
 Fig. 12. A boiled "oleo" crystal by polarized light and selenite plate.  
 Fig. 13. Lard crystal.  
 Fig. 14. Lard crystal under plain light.  
 Fig. 15. Lard crystal under polarized light and selenite plate.  
 Fig. 16. Oleomargarine.  
 Fig. 17. Pure butter, both unboiled, under polarized light and selenite.  
 Fig. 18. Boiled beef fat crystal under polarized light and selenite.



CRYSTALS OF FATS, BUTTER, BEEF & LARD,  
Representing Butter, Oleomargarine & Butterine.

PLATE I









