mere book knowledge in natural history: "It is a sham and a delusion," or in the words of Agassiz, "It is a poor basis of culture." Without practice in connection with most or all of their studies in horticulture, students cannot fully understand it.

MILK SETTING.

Prof. Arnold says, in the London Agricultural Gazette, that, 1. To make the finest-flavored and longest keeping butter, the cream must undergo a ripening process by exposure to the oxygen of the air while it is sweet. This is best done while it is rising. The ripening is very tardy when the temperature is low. 2. After cream becomes sour, the more ripening the more it depreciates. The sooner it is then skimmed and churned the better, but it should not be churned while too new. The best time for skimming and churning is just before acidity becomes apparent. 3. Cream makes better butter to rise in cold air than to rise in cold water, and the milk will keep sweet longer 4 The deeper milk is set the less airing the cream gets while rising. 5. The depth of setting should vary with the temperature; the lower it is the deeper milk may be set; the higher, the shallower it should be. Milk should never be set shallow in a low temperature nor deep in a high one. Setting deep in cold water economizes time, labor and space. 6. While milk is standing for cream to rise, the purity of the cream, and consequently the fine flavor and keeping of the butter, will be injured if the surface of the cream is exposed freely to air much warmer than the cream. 7. When cream is colder than the surrounding air, it takes up moisture and whatever escapes from the cream. In the former case the cream purifies the surrounding air; in the latter, the air helps to purify the cream. The selection of a creamer should hinge on what is more desired—highest quality or greatest convenience and economy in time, space and labor.

Undissolved Phosphates as manure.

We have now to speak of the comparative value of dissolved and undissolved phosphates as manure. The question is a purely practical one, and can be answered only by actual experience in the field. A few words on the chemical aspects of the question may, however, serve to clear our ideas on the subject before proceeding to look at the evidence yielded by field experiments.

In a good ordinary superphosphate we should probably find 32 per cent, of phosphate of lime (reckoned as tricalcic phosphate), of which 25 per cent. would be in a form freely soluble in water, and 7 per cent. existing partly as undissolved and partly as reduced phosphate. It has been assumed by some writers that the acid soluble phosphate in a superphosphate is not directly taken up by plants, but that it must first be precipitated within the soil before the roots can make use of it. This opinion, as far as I am aware, is not supported by any actual experiment: while the acid nature of plant sap and the fact that plants grown in solutions flourish best when these solutions are kept slightly acid, seem to support the view that acid phosphates can be directly assimilated.

When superphosphate is applied to soil the soluble phosphate is dissolved by the first shower, and is distributed by the rain through a greater or less bulk of soil. As this distribution proceeds, the soluble phosphate is precipitated on the particles of the soil, and assumes a less soluble condition; there is, consequently, no fear of its being washed out of the soil by heavy rains. In a soil containing carbonate of lime, the phosphate may be first precipitated in the form of bicalcic phosphate (a phosphate intermediate in solubility between the perfectly soluble monocalcic and the little soluble tricalcic phosphate), which by the further action of water is converted into tricalcic phosphate. In a soil containing no carbonate of lime the phosphoric acid will be more slowly precipitated as phosphate of iron, or phosphate of aluminium. The same action will gradually take place in almost every soil; all dissolved phosphates, whether derived from superphosphates, or from the solution of powdered mineral phosphates, in the soil, being finally converted into phosphate of iron or aluminium. It is chiefly owing to this fact that the residues left in the soil from previous applications of phosphates are so much less effective than a fresh dose of manure.

We should expect, from the facts just stated, that a small quantity of superphosphate would prove as effective as a much larger quantity of undissolved phosphate. With the superphosphate we have a great gain in time, the phosphoric acid being immediately available, we have a better distribution in the soil, owing to the solubility of the manure, the precipitated phosphate formed in the soil will also generally be more readily attacked by the roots of a plant than the phosphate supplied in a powdered mineral, lastly, the superphosphate has the advantage of supplying the crop with gypsum as well as phosphates. On some soils, naturally destitute of lime, which have been long treated with superphosphate, ammonia salts, or other manures supplying acid matter, the soil may possibly have aquired a condition of excessive acidity, in which nitrification and other functions of the soil become difficult, in such cases a powdered mineral phosphate may perhaps produce a better effect than another dose of superphosphate, the mineral phosphate supplying to some extent the base of which the soil stands in need. Excepting such cases, we should expect that phosphoric acid in the form of soluble phosphate would prove a far more effective manure than any undissolved phosphate

Comparative field experiments with dissolved and undissolved phosphates are already very numerous, and more will doubtless be made; indeed, the best advice that can be given to a farmer interested in the question, is that he should make a careful experiment on his own land. The value of such experiments depends, however, entirely on the manner in which they are conducted, and upon a full statement of all the facts being made when the result is reported.

We require to know the character of the soil, whether light or heavy, and, if possible, the percentages of nitrogen, organic carbon, and carbonate of lime present. We should know also the history of the soil, especially as to previous applications of farmyard manure. Care must be taken that the phosphates used are exactly what they pretend to be; that for instance, South Carolina phosphate is not employed under the name of coprolite. The degree of fineness of the powdered phosphate (that is, the fineness of the sieve through which it will pass) should also be stated. A chemical analysis of all the phosphates used is clearly requisite. The proportions of dissolved and undissolved phosphate employed should either be arranged so that the two manures supply the same amount of phosphoric acid, or that they may have the same money value; the latter plan appears the best for a farmer's experiment, as the result then shows at once, without any calculation, which is for him the most economical manure. In making the report, information must be given as to the mode in which the manure was applied. The experimental plots should if possible not be less than one-tenth of an acre; errors due to irregularity of soil and thinness of plant are greatly increased when small plots are adopted. It is absolutely essential that there should be a plot on which no phosphate is applied, without this the results will have little meaning. The dates of sowing and of harvest should be mentioned, with a general account of the weather experienced during the period of