

of the ash of plants and pointed out that in the absence of these mineral constituents plant life was impossible. He was also the first to show that the ash of the plant contains all the solid materials taken by the plant from the soil except the nitrogenous compounds.

Liebig, in his reports to the British Association in 1840 and 1842, demonstrated the importance of having a sufficient supply of the essential elements of plant food in soluble condition in the soil so that plants may obtain from the land the ingredients necessary for their growth. By the middle of the 19th century, it was well understood that nitrogen, potash and phosphoric acid were the essential ingredients required, which, if not already existing in the soil in sufficient proportion, must be supplied or good crops could not be had.

The chief distinction between the functions of farm manure and commercial fertilisers may in a general way be thus stated. Farm manure increases crop production by supplying the elements needed in about the right proportion for healthy plant growth, and at the same time by the addition of humus improves the general condition of the soil, while the commercial fertilisers act directly as plant food, without materially affecting soil structure. It is evident, therefore, that commercial fertilisers are not an adequate substitute for farm manure for producing permanent improvement. On virgin soils they are generally superfluous, but, as loss of plant food goes on under cropping, if restitution be not adequately made with farm manure, artificial fertilisers may be required.

The effective and economical use of barn-yard manure is without doubt one of the most important problems of modern agriculture for on this material the farmer's hopes of maintaining the fertility of his land, and thus providing for a succession of good crops, are mainly based. Experiments continued for twelve years at the Central Experimental Farm have shown that a given weight of manure taken fresh from the barn yard is equal in crop producing power to the same weight of rotted manure. It has also been shown by repeated tests that fresh manure loses during the process of rotting from 50 to 60 per cent of its weight. It is estimated that the farm manure produced in Canada amounts probably to about 100 million tons a year. The financial loss involved in the wasteful handling of such a vast amount of valuable plant food shows the great importance of this subject.

When we consider that all the food taken from the soil by plants must be furnished to the roots in aqueous solution, the necessity of a sufficient supply of water is apparent. The quantity of water held in a soil at any given period is not wholly dependent on recent rainfall, and