is estimated The reason given is this. When superphosphate is sown on the field the first shower of rain dissolves out the soluble phosphate which was contained in it. The solution then immediately comes into contact with the carbonate of lime and oxide of iron of the soil and is at once precipitated either entirely as phosphate of lime and phosphate of iron. By this means the phosphorus acid is very finely divided in the soil, and by the action of water containing carbonic acid is gradually rendered soluble to supply the needs of the growing crop. If it were not for this precipitation which takes place on the soil it is evident that with a heavy fall of rain the phosphoric acid would be washed into the subsoil and lost for all practical purposes.

But it can scarcely be said that phosphate which is precipitated in the manure entirely in the form of ferric and aluminic phosphates which are insoluble in distilled water, are of equal value to the soluble phosphate which in any case must be precipitated partly as phosphate of lime, even in a soil deficient in lime. No doubt the precipitated phosphate is more valuable than the unattacked phosphates; but even this latter is of certain value as a manure. But one of the great aims of manuring should be to apply to the crop the plant food which is required by it at precisely the time at which it requires it most, and this can be done with far greater certainty by the use of a soluble manure like superphosphate than by an insoluble form of phosphate. It is for this reason that superphosphate, or manures containing it, have found such general favour.

On the Continent and in the United States the practice of allowing for the value of precipitated phosphates is in vogue; but I would here insert a word of caution to our large manufacturers. Like every other trade the price of manure is regulated by the laws of supply and demand. Let it be granted that if the practice of estimating the precipitated phosphates were to become a general custom the manufacturers would be the gainers to the extent of the value of these phosphates. This would only last so long as the farmers, the consumers, were ignorant of the value, but when it became evident that the effect in the field was not increased a consequent reduction in the price of soluble phosphates would have to be made, and the objectionable practice of having to sell on two determinations instead of one would have become general. But the evil would not stop here. Small manufacturers would use inferior raw materials such as redonda or navassa phosphate, which, when treated with acid would give comparatively small quantities of soluble phosphate, but would show large quantities of precipitated phosphate. The best makers, who use the better class of materials and who turn out manures in which the great bulk of the phosphoric acid is soluble, would thus have to compete with inferior articles on more nearly equal terms than at present. Any such change as the one proposed appears to me, therefore, to be fraught with danger to both the manufacturer and to the farmer, neither of whom would derive any substantial benefit and each of whom would be saddled with more complicated methods of doing business.

I pointed out in the early part of my paper that an important element of plant food was nitrogen in a combined state. In mixing up manures, therefore, for the market it is necessary to add some compound containing nitrogen to the manure. The quantity of the nitrogen (or its equivalent quantity of ammonia—this being the basis on which it is usually calculated) which will be required in a manure, will depend largely upon the crop for which it is intended; and the same consideration will also influence the choice of the particular form in which it is applied. For instance, for swedes only a small percentage of nitrogen is required and this can be applied partly in a compartively insoluble condition as shoddy, dried blood, etc., but for wheat it is found necessary to apply a manure containing considerable quantities of nitrogen in order to stimulate the plant in the earlier stages of growth. As the manure must be in a solid condition, the form in which the nitrogen is added must be solid also. The forms in which it is used are various—crystallized sulphate of ammonia, produced principally from the ammonia liquor of gas works, is a common and exceedingly valuable manuring agent. It contains, when absolutely pure, 21.21% nitrogen, and, as usually found in the market, about 20 to 21½% of nitrogen.

Next in importance is nitrate of soda. This is often used for mixing with manures, but is not so well adapted to the purpose as sulphate of ammonia. If there is an excess of acid in the manure it is apt to decompose the nitrate, and the valuable element will be lost, besides often doing considerable damage by the evolution of nitrous fumes. It is oftener used by itself as a top dressing in spring.

Besides these two sources of nitrogen, there are a variety of forms in which the nitrogen exists, principally in the form of organic compounds. Dried blood, shoddy, ground leather and similar compounds may be taken as examples. It is often better to mix these with the phosphate previous to the treatment with acid; but nitrate of soda must on no account be so used.

For reducing to a fine condition and mixing, Carr's disintegrator is used—and in conjunction with this an ingenious arrangement is adopted.

The material to be disintegrated is shovelled into pits, in which a Jacob's ladder picks it up and carries it to the floor above, where it is thrown upon a sieve which is kept in constant agitation by a lateral motion. What goes through the sieve passes down a shoot, constructed for the purpose, and is collected in bags at the bottom. The lumps, however, pass off the sieve and are conducted by another shoot to the disintegrater, where they are broken up, and conveyed again by the Jacob's ladder to the sieve on the floor above. The process is, therefore, continuous.

The Carr's disintegrator, which is manufactured by the Bristol Wagon Works Co., Limited, and the arrangement just described, are exceedingly useful and answer for a variety of purposes, especially for mixtures of dry materials.

Another form of disintegrator which is little known in this country is Vapart's. It will, I am informed, grind the hardest materials to a fine dust. The principal on which it works is centrifugal force. The materal to be ground is dropped upon a revolving plate of iron, and is, of course, instantly projected against the side of a drum in which the plate revolves. The material then falls in a plate below revolving on the same rod, and here receives a repetition of the smashing action, and so on, as many times as there are revolving plates.

The other valuable manuring element, which is used in the manufacture of artificial manures, is potash. This is introduced either as Kainite, so-called potash Salts, or muriate of potash. Whatever the form used it is mixed in with the manure together with the sulphate of ammonia and, if the manure is at all damp, dryers in the form of Gypsum are used.

There are other substances, such as bones, guano, etc., which must be included under the head of artificial manures which require no chemical treatment before use.

Bones are gradually rendered soluble by the decomposition of the gelatine which they contain, and are exceedingly useful where rapidity of action is not a desideratum. They are sometimes treated with sulphuric acid and sold as pure dissolved bones. It oftener happens, however, that the bones are mixed with varying quantities of ground phosphate previous to treatment, but whether treated separately, or in combination with mineral phosphate, it is not desirable to grind the bone fine. There is sure to be a sufficient quantity of phosphate rendered soluble to supply the immediate requirements of the growing crop, and the larger, partially attached portions, are gradually rendered soluble in the soil to give a subsequent supply.

(To be continued.)

On the Application of Variable Expansion Valves to High-Pressure Condensing Engines in Tug-Boats.

By A. W. Robinson, M. Am. Soc. M. E.

The prevailing type of engine, generally to be found in the smaller class of screw tug-boats on our rivers, lakes and harbours, is the single cylinder, high-pressure, non condensing engine. The building of tug-engines, however, has not kept pace with the great advances made in marine engineering of late years, many examples of the kind referred to exhibiting crudity of design, and the power developed being very disproportionate to the fuel consumed.

The engine, of which illustrations are presented, was originally a high-pressure, non condensing with a cylinder 16 inches diameter and 20 inches stroke, and a valve of the long D slide description effected the distribution of steam in a particularly defective manner