recognised to-day that by cultivation without return, soils lose to their detriment, phosphates and nitrogen, and some few potash and lime. Soils of very inferior natural productiveness can, by the application of these four bodies, be raised to a high condition of fertility. The remaining constituents of plant ash, mysoda, magnesia, alumina, iron, silica, sulphuric acid, and chlorine may be ignored, an abundant supply existing in the very poorest cultivated soil. Having examined the "nitrogen theory" of Sir J B. Lawes, the importance of which he thought had been exaggerated in the same way that Liebig's "mineral theory" had been exaggerated, Mr. Brown continued :—

I was invited by our president to address you on artificial manures. Now, what are artificial and what are natural manures? If I hastily run over the names of the substances in common use here or elsewhere, you will see how difficult it would be to decide which are and which are not artificial. We have farmyard manure, stable dung, and animal droppings in general, marl, lime, crag, rape, and other seed, cakes, malt dust, greaves, soap boilers' waste, meat refuse, soot, guano, bones, basic slag, ground mineral phosphates, gypsum, wood ashes, blood, horn, and leather meal, hair waste, skin, salt, town refuse, dried sewage, fish refuse, gas lime, seaweed, ivory turnips and dust, superphosphates, bone manures, nitrates of soda and potash, sulphate and chloride of ammonium, kainit, carnelite, and muriate of potash. Now sulphate of ammonia differs little from soot, save that it contains about 25 per cent. of ammonia, and soot about 5 per cent. Bones in the rough are, I suppose, natural, but ground fine are artificial. A crag containing 4 per cent. of phosphate of lime is, I presume, a natural manure, but the fossils in the crag, containing 55 per cent. are artificial. This classification is purely arbitrary. All are in a sense artificial, all are natural bodies made available to the farmer by human labour. As a chemist, I should prefer to classify such matters as phosphatic, potassic, calcic, or lime-giving, nitrogenous, or as compound manures, the latter including such bodies as bones and guano, which would be both calcic, phosphoric, and nitrogenous. The fertilising materials of former times may usefully be also so classified. We shall find that marls, clays (so-called), crags, sea shells, supplied phosphates, lime, and potash, wood, ashes, supplied potash, and soot, malt dust, blood, hair and skin refuse, seaweed, and other organic bodies supplied nitrogen. Our forefathers did not know why marling was useful, nor why some marls gave such excellent results, while others were almost inert. Had they known that some deposits were rich in phosphates and potash, and that others contained mere traces, and that it was the presence or absence of these elements that gave the value, they would have saved themselves much useless labour in working worthless deposits. The marked results that followed the use of some organic bodies led to the adoption of the "humus" theory; the humus gained the credit of that which was due to the nitrogen therein Hence frequently bodies were used that were comparatively worthless, and the absence of result was attributed to the weather, or to other surrounding conditions. Science having explained to us the basis of this classification, we are in a position to make a preliminary examination of any body, and thereby to ascertain how much it contains of either of these fertilising properties, and to select or reject accordingly. It leads us naturally to select those that are richest in those elements our soils or crops most need, more especially if the cost of the element required is cheaper per lb. weight, or, as we generally speak, per unit, in the concentrated form. To illustrate, no one who has made himself acquainted with the principles we have been considering would to day cast 40 loads of marl upon his fields (the marl containing 6 or 7 per cent of phosphate of lime), in order to supply to his soil 5 or 6 cwt. of phosphate per acre. He knows how to supply this substance at a much less cost. (Allow me to state here I am ignoring the cases where lime is needed, for in these the marl constitutes the cheapest source of this article.) There are still left a few of ancient ways, who lament their inability to marl their fields, and who doubtless look with affection at the great pits remaining in ruins. Nor will any but the obtuse look to town refuse as a source of nitrogen, even when it is nicely sifted and placed in bags labelled guano. Those abreast of the times know that a body containing less than one per cent. of nitrogen will not pay the cost of carriage and distribution, but will resolve to obtain this substance in a more concentrated form. I think I shall be justified in passing by without attempting a description of the many manurial bodies that are, so to say, "out of date," and in noticing only those, the names of which I suppose I ought to say, from the survival of the fittest and natural development, at once enter our minds when we speak of artificial manures We have then in the market phosphates offered as superphosphates, basic slag; potash as kainit, or muriate of potash; lime as gypsum, or quicklime; and nitrogen as nitrates; sulphate of ammonia, wool refuse, soot, greaves, and rape cake. Then we have a mixture of phosphates and nitrogen in guano, bone, and bone manure, and dried fish and a combination of nitrogen and potash in the nitrate of potash. In addition to these we have a considerably long list of prepared compound manures, as corn, turnip, mangel, potato, grass; &c, manures made up of varying quantities of the former mentioned phosphatic, potassic, calcic, and nitrogenous bodies.

Having classed our substances, the question each one here may be supposed to ask is to which class should I turn my attention? and which of the bodies in that class will serve my purpose best? To the first question I can reply without hesitation that phosphates are needed, and repay application on almost all our soils. So much has been removed in corn, in meat, in milk, in roots, that even the fertile virgin soils of America are showing exhaustion. Last year it is computed that much over 1,000,000 tons of phosphatic manures were used in North America. In the February number of the American "Journal of Analytical and Applied Chemistry," it was stated that over 500,000 tons were used in the Southern States of the United States alone. Even the rich and deep soils of our marshlands are greatly benefited by the application of superphosphates. Again, nitrogen is demanded by almost all our soils, the few peats, moulds, and rich alluvial soils being excepted, unless a very severe system of cropping has been adopted. In marsh land very little nitrogen is used or needed beyond that supplied in feeding stuffs. It should be borne in mind that feeding cakes yield 1 cwt. of nitrogen in every ton consumed, that is, a ton of linseed cake, unless waste is allowed, supplies as much nitrogen to the farm as 5 cwt. of nitrate of soda, so that the farmer who buys cake supplies artificial nitrogen as surely as he who top dresses his wheat with nitrate of soda. Potash is deficient in many long-cultivated soils, but in others there exists a sufficiency for hundreds of years of ordinary farm practice, without even approaching the exhaustion line. Actual experiment alone will decide whether its application is called for or not. It has always seemed to me possible for a farmer to keep an exact ledger account of the stock of available vegetable food in his fields. Almost every work on agriculture gives the amounts of food substances existing in a ton of wheat, of barley, or of potatoes, in a cwt. of beef or mutton; in a tod of wool; or in a gallon of milk. He may thus, by a simple calculation, easily obtain the exact amount exported from the farm, which will form the debtor's side. He may with equal ease ascertain the amounts brought to the farm in superphosphates, bone manure, cake and nitrates, which will complete the cre-