ON

PERUVIAN GUANO;

ITS

HISTORY,

COMPOSITION AND FERTILIZING QUALITIES;

WITH THE

BEST MODE

OF ITS

APPLICATION TO THE SOIL;

BY

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SEVENTH EDITION.

LONDON:
LONGMAN AND CO., PATERNOSTER ROW.

1852.

Price One Shilling.

Entered at Stationers' Hall.

ON PERUVIAN GUANO;

ITS HISTORY, COMPOSITION, FERTILIZING QUALITIES, AND MODE OF APPLICATION TO THE SOIL.

In reviewing the history and condition of Agriculture for the last twenty years, it is impossible to avoid being struck by the remarkable progress, scientific and practical, which the latter half of that period has witnessed.

The genius of our mechanics has been shown by the invention of a wonderful variety of new and interesting instruments adapted for an improved culture of the soil. The steam engine also, hitherto almost exclusively used by the manufacturer, now lends its powerful aid to the farmer. The art of the drainer has brought into successful cultivation thousands of acres of wet and almost worthless soil; and a vast breadth of land, previously only partially drained, has been permanently and effectually ameliorated.

But perhaps the most remarkable feature of the whole is the introduction of the so-called "Artificial Manures," and the vast advantage derived by Agriculture therefrom.

Previous to 1840, with the exception of local manufacturing refuse, the only artificial manures were bones, salt and gypsum.

The introduction of bones, many years back, was of great importance to the farmer, and enabled him to grow, with comparative ease, that mainstay of the four course shift—the turnip.

To the impoverished soils of Cheshire, and other cheese exporting counties, bones were also an immense boon, and were duly appreciated.

The publication of the first edition of Liebig's Agricultural Chemistry, in 1840, forms an important era in Agriculture. Since that period the chemist has more generally directed his experiments to the investigation of the true principles of fertility, the merchant has sought for foreign sources of valuable manure, and the farmer has reaped the benefits of the labours of them both.

That an increase of solubility in bones and other phosphates would be attended by an increased productive power in the crop, was the idea of Liebig. This great chemist, in 1840, recommended, in lieu of bones, the use of the substance long well known to chemists as the acid or super-phosphate of lime, which is producible from bones and other phosphates by the action of sulphuric acid. Practice has since shown the great advantage of Liebig's suggestion.

The introduction of the dung of birds and other animals, under the name of "GUANO;" and the discovery, in Suffolk and other counties, of immense quantities of fossil bones, and other animal remains, known as "COPROLITES", have followed quickly upon each other, and there can be no doubt that by their means an entire revolution will be made in the practice of Agriculture.

The concentrated character of most of the genuine artificial manures, particularly adapts them for use in the mountainous and hilly districts of our country, where the carriage of ordinary manure is both difficult and expensive. One waggon may now easily carry enough manure for 15 or 20 acres of turnips. Formerly 15 or 20 loads were required for a single acre.

Of all the artificial manures, Peruvian Guano is perhaps not only the most concentrated, but is, from its composition, adapted to the greatest variety of crops. The chief mineral constituents of plants—lime, magnesia, potash, soda, chlorine, sulphuric acid and phosphoric acid, (the latter the most important) are found in Guano. Nitrogen, the most valuable constituent of manures, is found in Peruvian Guano in great abundance, and in a condition well adapted for vegetation.

The use of this manure in Peru is of very ancient date; and for its preservation, and that of the birds by which it was deposited, the most stringent precautions were made use of by the native Incas and their Spanish successors. At one period the punishment of death was inflicted upon any one disturbing the birds in the breeding season.

The Chincha islands, which contain the great Guano deposits, are situated in the Pacific Ocean, off the coast of Peru, at the distance of about twelve miles.

They lie between Lat. 13°, and Lat. 14°, S.; a zone within which no rain falls, where the air is dry, and the sun shines with vehement power. The waters of the surrounding ocean contain innumerable shoals of fish; and myriads of birds, after daily satisfying their voracious appetites upon the finny tenants of the deep, have for ages made the islands their nightly abode, and the receptacle of their fæcal offerings. From the arid nature of the climate, the excess of humidity has speedily evaporated from their ordure, decomposition has been arrested, and by gradual accumulation from time immemorial, these extraordinary deposits have attained the depth, in many parts, of one hundred feet.

The guano as found on the Islands is subject to slight variations in composition. Towards the S.W., the deposits are more exposed to the action of the spray of the sea, brought by the prevailing winds. Some of these guanos have lost by this means a large amount of ammonia, and are not brought to this country; in others, the deterioration is trifling, and many are simply discoloured, without having suffered any other change, and are equal in value to paler samples.

During its passage from Peru to this country, guano is subject to the casualties incident to a long voyage, through stormy seas; it is, therefore, from leakage of salt water, in one form or another, that the only natural deterioration of guano can possibly arise.

The Guanos injured by water, are, on the arrival of the vessel at London, carefully separated by the Dock Company from the undamaged portion of the cargo. The wet portions, according to the degree of moisture, are subsequently classed as Damaged, Double Damaged, and Wet; or, in commerce, as D.'s, D. D.'s, and W.'s; and are sold at public sales as inferior guanos, at reduced prices.

Messrs. Ant. Gibbs and Sons, as agents in this country of the Peruvian Government, are the sole channel through which the Peruvian guano finds its way into commerce.

The samples which contain less than 16 per cent. of ammonia, are not sold by this firm as good guano.

The ammonia, in genuine uninjured cargoes, will vary from 16 to 18 per cent., and if any farmer buys guano as good Peruvian, which on analysis is found to contain less than 16 per cent. of ammonia, he must have been defrauded by the person with whom he dealt, and no doubt the law would give him adequate compensation.

The following table will show the amount of ammonia in samples of these guanos taken from the same vessel.

	Undamaged Guano. per cent.	D. per cent.	D.D. per cent.	W. per cent.
Ammonia	17.35	13.75	12.22	10.25

That the excrementitious matter of birds, fed upon an unlimited supply of animal food, would of itself have powerful fertilizing properties, might almost be taken for granted, without either calling for the opinion of the chemist, or the experimental proofs of the farmer. But both chemist and farmer alike bear testimony to the high position assumed by Guano in the catalogue of manures. The former by comparing its composition with that of other known fertilizing bodies, the latter by actual trial in the field.

It has long been a growing opinion with chemists, that ammonia and phosphate of lime are the two most important and valuable elements of plants, and, consequently, of any manure which is to aid in the developement of vegetable life. This opinion has been founded, in the first place, upon numerous analyses of various manures; and secondly, upon practical experiment.

It has been proved, for example, that, in two samples of farm-yard dung, the one which gives the best crop in practice, contains on analysis the largest amount of ammonia and bone earth. It is a well known fact, that the seeds of a vegetable contain more nitrogen (ammonia) and phosphate of lime than any other portion of the plant; and it is also well known that the dung of animals fed upon seeds is more valuable than that of others fed only upon hay, straw or roots. Hence the practice of feeding animals upon oilcake (crushed linseed), to obtain a better quality of dung. That ammonia and bone dust are the most valuable of manuring principles, may also be inferred from the fact, that the artificial manures most used by the farmer are those which contain the greatest quantities of these elements, and that these manures are precisely those which fetch the highest price in the market.

A comparison, therefore, of the composition of various excrements of animals, and of farm-yard dung, with that of an average sample of Guano, will afford a very fair means of ascertaining their relative fertilizing powers.

The following table contains analyses of various manures, made by Boussingault, and other well known chemists, and also the analysis of an ordinary sample of Peruvian Guano.

ANALYSES OF FARM-YARD DUNG, &c.

	Farm-yard Dung.	Horse Dung.	Cow Dung.	Pig Dung.	Mixed liquid and solid excrement of man.*	Guano.* Peruvian
Moisture	79.30	76.17	86.44	82.00	94.24	18.35
Organic matter ...	14.03	19.70	11.20	14.29	4.72	51.25
Inorganic matter	6.67	4.13	2.36	3.71	1.04	30.40
	100.00	100.00	100.00	100.00	100.00	100.00
Nitrogen (equal to)	0.41	0.65	0.36	0.61	0.94	13.88
Ammonia	0.49	0.78	0.43	0.74	1.14	16.85

* These analyses were made in the Kennington laboratories.

Boussingault, Payen, and many others of our first practical Agricultural Chemists, have come to the conclusion that the value of different manures varies nearly in proportion to the amount of nitrogen they contain. There may be cases to which this rule is not exactly applicable, but in most natural manures an increase of nitrogen is accompanied by an increase in the phosphate of lime, and every other valuable manuring element. In the above table, for instance, the 13.88 of nitrogen in the Guano is accompanied by 30.40 parts of inorganic matter, of which 20.60 parts (or more than two-thirds) is phosphate of lime.

If we take the per centage of nitrogen then, as a correct indication of manuring value, we shall find that one ton of ordinary Peruvian Guano is equal to

33½ tons of farm-yard dung.
21 of horse dung.
38½ of cow dung.
22½ of pig dung, and
14¾ of mixed human excrements.

Let those who farm in hilly countries, and other places where carriage is expensive, ponder well the above facts.

Though a good farmer will produce as much manure as he conveniently can, yet even farm yard dung may be bought *too dear;* and it is certain that on numbers of farms the cartage of dung is so expensive an item of management, that the introduction of Guano for those parts at the greatest distance from the homestead, would be productive of the same fertility, at a considerable saving of expense.

A question now arises whether the fertilizing properties of Guano will be expended in the first year of its application, or whether its operations will be discernible in after periods. If we examine the chemical constitution of Guano, we shall find it to occupy the medium position between those manures which, being altogether soluble, are somewhat transient in their effects, and that other class, which, like bones, are only slowly decomposed in the land, and yield their manuring principles with a certain degree of difficulty. Guano, in fact, possesses every advantage of both. From analyses which have been made, it is found that about one half of the fertilizing properties of Guano are soluble in water, and therefore adapted for the instant nourishment of plants. The other half continues long in the soil, eliminating nourishment for vegetables by slow decomposition. The soluble phosphoric acid, which it has been found necessary to produce artificially from bones by sulphuric acid, exists naturally in Guano. If a Guano contain in the whole say 12 per cent. of phosphoric acid, and 17 per cent. of ammonia, we shall find that water will dissolve about 6 per cent. of phosphoric acid, equal to about 13 per cent. of phosphate of lime in a soluble state,— and at least 8 per cent. of the ammonia. Guano is thus adapted, by its insoluble matter, for the lighter soils, where infiltration might too rapidly carry away the soluble matter; and by its soluble constituents it is fitted for heavier lands, where decomposition being slower, a supply of soluble manure is required at once.

At the present price of Peruvian Guano, it is more than questionable whether the ordinary plan of increasing the available manure on a farm by the importation of oil cake and the feeding of stock is at all economical. If the oilcake owes its fertilizing properties to the nitrogen and phosphate of lime it contains, it is certain, from the analyses of various chemists, that Peruvian Guano is a much cheaper source of these substances. In a lecture lately delivered by the author before the farmers of Dorchester, this subject was alluded to as follows:—

"It may here be necessary to mention another point of great importance, viz.—Is the use of artificial food (such as oilcake) for stock, the *cheapest* mode of introducing bone earth and ammonia into the land? Many farmers are content if their fat stock produce as much money as will pay for the oilcake fed, together with the price of the lean animals bought; thus sinking altogether the turnips, mangold, and hay, likewise consumed by the stock. It appears to be clear that, unless the oilcake affords a profit by the beef or mutton, a more expensive system of *manuring* could not well be pursued. The following table, comparing the manuring values of oil and rape cake with guano, may be of some service in determining the practice of the intelligent farmer.

Table of the Manuring Values of Oilcake and Rapecake compared with Peruvian Guano, from Analyses made in the Laboratory of Messrs. NESBIT, Kennington, London.

	Oilcake from Liverpool.		Oilcake from London.		Oilcake from Marseilles.		Rapecake.		Peruvian Guano.	
		lbs.		lbs.		lbs.		lbs.		lbs.
Moisture		268.8		300.7		274.4		195.8		268.8
Organic Matter		1739.6		1699.3		1718.3		1654.2		892.2
Nitrogen		109.1		118.5		118.2		115.4		295.0
Ammonia	130.6		143.8		143.4		140.0		358.4	
Inorganic Matter		122.5		121.5		129.1		274-6		784.0
Containing—										
Phosphoric Acid	47.1		30.9		39.4		43.7		224.0	
Potash	29.1		19.1		23.7		27.1		67.2	
		2240.0		2240.0		2240.0		2240.0		2240.0

From the foregoing table it appears that one ton, or 2,240lbs., of Peruvian guano, containing 16 per cent. of ammonia, would introduce into the farm six times the phosphate of lime, two-and-a-quarter times the potash, and more than two-and-a-half times the ammonia, that would be furnished by one ton of the best oil or rape cake. To pass oilcake through the bodies of animals, without some attendant benefit, is both expensive and wasteful; and unless you can find your profit in the increase of the beef and mutton, it is an improper expenditure of money."

These observations are amply supported by the opinion of the members of one of the most intelligent Farmers' Clubs in England. The Botley Farmers' Club have *unanimously* resolved, "that where there is not sufficient dung for the wheat crop, it is more profitable to apply concentrated manures than to purchase dung; and that an equal amount of money expended in the purchase of concentrated manures will raise more wheat than the same amount expended in the purchase of oilcake or corn, and converted into dung by feeding cattle." And the Rev. L. Vernon Harcourt, speaking of this decision of the Club, says, "all my experiments tend to corroborate the view taken by the Botley Club on this subject."

Leaving these facts and opinions to the consideration of those farmers who seek to combine good farming with economy of manuring, we shall now offer some suggestions as to the best mode, and the proper time, of applying Guano to different varieties of crops.

ON THE MODE OF APPLYING GUANO TO THE SOIL.

It requires but a short consideration of this subject to perceive, that before any useful practical rules can be obtained for the application of Guano, we must carefully compare the properties of the soil with those of the manure to be applied. Reference must also be made to the different conditions of the atmosphere at different seasons, particularly as respects moisture, dew or rain. The nature of the crop will also materially influence the quantity of Guano to be used, and the time of its application.

Practical men have long been aware of the great difference existing in soils as regards their retentive power for manure. On certain lands the result of the application of a given quantity of farm yard dung may be seen for a number of years. On others the effect of the same quantity ceases to be visible in a very much shorter period. The former class includes the loams, clays, and in general the heavier descriptions of land; the latter comprises the sands, gravels, chalks, and other lighter qualities, not inaptly termed by the farmer "*hungry soils.*"

These varieties of soil differ both in chemical composition and mechanical properties. The heavier in general contain more alumina and oxide of iron than the lighter ones. They are also less porous even when drained; their particles are finer, and their absorptive power is greater. The want of great porosity prevents the too rapid action of the atmosphere on the manures they may contain, and their absorptive power enables them to retain, to a considerable extent, the liquid and volatile elements of the manure, and at the same time to obtain a certain quantity at the expense of the atmosphere.

The case is, however, different with gravels, sands, and the lighter soils; upon which, in consequence of their greater porosity, the atmosphere acts freely, and to a considerable depth. When manure is applied to them it is rapidly decomposed, and unless there be a growing crop ready to absorb the fertilizing particles as they become soluble, they will be washed away; or, if they become volatile, will, to some extent, be absorbed by the atmosphere. These soils, therefore, require different treatment. We may apply to heavier lands a strong dressing of manure at once, and little loss will ensue, for some time at least, from any other source than the action of the growing crops. On the lighter soils, we must use, even of farm yard dung, a less amount at a time, but it must be applied more frequently. We thus see that light lands have the advantage of more rapidly decomposing the dung, and consequently of preparing it more quickly for the use of the plant. For this reason, among others, light soils are preferred by the market gardeners, who, by their repeated manurings and repeated croppings, practically show how these soils may be most efficiently managed.

It may not be uninteresting here to introduce some experiments made at Kennington, with the view of obtaining a further insight into the properties of Guano, and the action of light soils upon it.

Experiment 1.

A small quantity of Peruvian Guano was placed in a saucer, and the whole covered with a bell glass containing a slip of red litmus paper, moistened with distilled water. In the course of an hour or two the slip became distinctly blue.* This proves the escape of a small amount of ammonia from the Guano simply by exposure to air.

Experiment 2.

A quantity of Guano was mixed with four or five times its weight of ordinary light garden mould, and slightly moistened. It was covered, as before, with a bell glass. The strip of litmus paper became blue in two or three hours.

This experiment proves that a small amount of light soil mixed with Guano will not prevent the escape of ammonia.

Experiment 3.

Two grains of Guano were intimately mixed with two thousand grains of light soil, and covered with a bell glass as before. The mixture was slightly damp, but not wet. After the lapse of twenty-four hours, the litmus was very faintly tinged with blue. A little pure distilled water was now added to the mixture. After the lapse of another day the tinge became much deeper.

From this it is apparent that even a large excess of soil will not prevent the escape of a certain amount of ammonia. From another experiment it was evident that even the soil itself exhaled a minute trace of ammonia.

Experiments 4, 5, & 6.

These were made upon a piece of meadow attached to the school, at Kennington. Two portions of land about two months before had been dressed with Guano, at the rate of 2½ cwt. and 5 cwt. per acre, respectively. Another portion received no dressing at all. A bell glass, with moistened red

* Red litmus paper is rendered blue by the action of ammonia and other alkalies. The red colour is restored by acids.

litmus, was deposited carefully, mouth downwards, upon each of the three portions of meadow. After the lapse of a couple of days it was found that the colour of the litmus had perceptibly changed in each of the bell glasses, but most on the guanoed portions of the land. At the time of making these experiments the wind was N.E., and the temperature very low.

The grass exhibited little or no signs of growth.

We infer from these experiments that there is generally a slight escape of ammonia into the air from grass land, *manured* or *unmanured*, in those seasons of the year when there is no great activity in vegetable life.*

EXPERIMENT 7.

A portion of the mixture of soil and Guano in experiment 3, was placed in a filter paper, and a quantity of pure distilled water was added. The liquid which filtered through was neutral to litmus paper. On being tested, however, in the usual way with hydrate of lime, every precaution being taken, the litmus paper was readily turned blue.

From this experiment it is apparent that from a mixture of light soil and Guano, in the proportion of 1000 to 1, water is able to dissolve and remove a portion of the ammonia of of the Guano.

The difference of soils is not the only consideration; the climate of different localities in the British Islands is exceedingly various.

In Ireland, in Scotland, and in the Western districts of England, from Cornwall to Cumberland, the quantity of rain which falls in the year is probably nearly double that which descends in Suffolk, Norfolk, and on the East coast generally. The air also is constantly more humid, and for this reason those parts of our Isles are well adapted for the growth of root and green crops, and are not so well adapted for wheat. Guano may, consequently, at any time of the year, be there used in larger quantities, without the same danger of burning

* These experiments require to be repeated on various soils, to enable us to draw from them more general truths.

the crop, which would occur in our Eastern Counties. In these latter districts, the Guano should never be applied as a top dressing in dry weather, but during a wet or showery day.

Where wheat is grown in humid climates, it is liable to lodge before harvest, and therefore Guano, if used, should be applied with caution to this crop. Two cwt. per acre is quite sufficient, one half at sowing, and the other in the spring.

From these and various other ascertained facts, we may deduce the following general rules for regulating the application of Guano :—

General Rules for Using Guano.

1st. That Guano is best applied in damp or showery weather.

2nd. That Guano should not generally be put on grass land later than April.

3rd. That when Guano is applied to arable land, it should immediately be mixed with the soil, either by harrowing or otherwise.

4th. That when wheat is sown very early in the autumn, a less than usual amount of Guano must at that time be applied, and the rest in the spring. The wheat, otherwise, would become too luxuriant, and might be injured by subsequent frosts.

5th. That Guano, and artificial manures in general, should be put on the land only in quantities sufficient for the particular crop intended to be grown, and not with the intention of assisting the succeeding one. Each crop should be separately manured.

6th. That Guano, before application, should be mixed with from two to four times its weight of ashes, charcoal, salt, or fine soil.

7th. The Guano should on no account be allowed to come in direct contact with the seed.

The preceding rules, if duly attended to, will prevent the recurrence of most of those vexatious losses of time and capital, which many, even of our intelligent farmers, have experienced from want of a due acquaintance with the properties of concentrated manures.

In order still further to guard against disappointment arising from the mis-application of Guano, we shall now describe the best practical modes of its application to the principal crops which are grown in this country.

Mode of Applying Guano to various Crops.

TURNIPS.

For this crop the Guano may be applied either by drill or broadcast. For drilling, it must first be mixed with four to six times its weight of the ashes* of wood, turf, or coal, or with the same quantity of well sifted mould. Charcoal, in powder, either from peat or wood, is also a most excellent article to be mixed with the Guano, in the proportions indicated. Its great porosity allows it to retain the volatile ammonia, and, in dry weather, to absorb considerable moisture from the air. This is of material benefit to turnips in their early growth.

Before mixing, the Guano must be finely pulverized, which may easily be done with a common garden roller, upon the floor of a barn or shed, or even by blows from a common shovel. A layer of the ashes is then spread evenly upon the floor, and a quantity of the fine Guano sifted over it. This is followed by another layer of mould or ashes, and another of Guano, until the requisite quantity of both is used. The whole must then be repeatedly turned with the shovel until thoroughly mixed. It must then be again sifted, when it will be ready for use.

In using Guano with the drill, care must be taken that the mixture fall below the seed, and that an inch or so of soil

* Some varieties of wood ashes, which contain a considerable amount of free alkali, are not suitable for mixing with Guano, as they liberate the ammonia. This may easily be shown by mixing a shovel full of the ashes with the same quantity of Guano. If a strong ammoniacal odour be immediately perceived, the ashes are not fit to be mixed with Guano.—J. C. N.

intervene between them, otherwise the strength of the Guano will kill the seed. Garrett's, Hornsby's, and other modern drills, are well adapted for depositing Guano and other concentrated manures.

In applying Guano broadcast, either for roots or corn, an equal weight of common salt may be used instead of ashes, and charcoal may also be added. The mixture with salt alone is generally sufficiently damp to fall exactly where the hand directs it. When this is not the case with the other mixtures, a small quantity of water must be added; the field must be sown with the mixture in the ordinary manner, and the manure harrowed in; the seed is then drilled as usual.

Perhaps the preferable mode would be, to broadcast two-thirds of the Guano applied, and to drill one-third with the seed. The young plants would then have enough manure under the drills to serve the early stages of growth, while the Guano sown broadcast would supply the wants of the plants in a more mature state, when the roots would have spread in every direction in the soil.

The quantity of Guano to be used per acre varies with the state of the farm. About 2 to 3 cwt. may be applied with advantage, and 6 cwt. have been used with safety on heavy soils. Two cwt. sown broadcast, and 1 cwt. drilled with the seed, will probably give the best chance for a successful result.

Experiments have proved that, when a portion of Guano is applied between the drills, and well horse-hoed in after the turnips are up, that large crops are obtained. It is questionable whether this is not one of the best means of applying Guano, as on light soils there is less liability to loss in the Guano, and the roots of the turnip are supplied with fresh manure at a vigorous period of their growth. Two cwt. broadcast before the turnips are sown, and 1 cwt. between the drills afterwards, will be found sufficient.

A combination of super-phosphate of lime with Guano has been used with much success. For this purpose, 2 cwt. of

Guano is sown broadcast, and the same quantity of superphosphate of lime, mixed with ashes, drilled with the seed.

We may here suggest to some of our intelligent practical farmers to try the effect upon the turnip crop of a mixture of Peruvian Guano and sulphuric acid.

Sulphuric acid is undoubtedly a manure *per se*, and it seems to exert a specific effect on the turnip. A mixture might be made of 4 cwt. of Guano, and 1 cwt. of white acid of Sp. Gr. 1.84. The Guano must be laid in a heap, a hollow made in the centre, and the sulphuric acid must be poured into it; the whole should then be well worked together with a spade or other instrument. Considerable chemical action will take place, but in a short time the whole will become dry and ready for the drill. If the brown acid of Sp. Gr. 1.7. be employed instead of the white, one-fourth more must be used. The above quantity will be sufficient for two acres. We believe that a mixture of this kind will prove a most efficient manure.

MANGEL WURZEL.

Guano is an excellent manure for this crop. On heavy and loamy soils the land is ploughed, and ten or twenty tons of farm-yard dung are worked into the soil, before Christmas, if possible. Two or three weeks before drilling the seed, four cwt. of Guano, with an equal weight of common salt, is sown broadcast over the field and well harrowed in. The seed is drilled in the usual way, and at thirty to forty inches apart. In thinning the plants afterwards they should not be left too near. Repeated horse-hoeings between the rows is of great importance, for air and nutriment are thus admitted to the roots of the plants. As in the case of the turnips, great advantage will be obtained by occasionally sprinkling a little Guano between the rows previously to the hoeing. This insures continued nutriment to the plants.

When no farm-yard dung has been applied in winter, six cwt. of Guano may be used instead of four cwt. On heavy land this may be put on either in the autumn or spring, and well worked into the soil, following this up by a small dressing afterwards between the drills at the time of hoeing. The land in either case will be left in good condition for wheat.

On the light chalky soils, in the neighbourhood of Guildford, a mixture of Guano, nitrate of soda, and common salt, at the rate of 2 cwt. each per acre, has been found very efficacious in the growth of mangel wurzel.

GRASS.

The experiments of Kuhlman, the French Agricultural Chemist, upon the action of ammonia on grass lands, at once point to Guano as one of the most important manures for increasing the productive power of our pasture and meadow land. This chemist applied ammonia in different forms, and combined with other simple mineral manures, and he found that in all cases the amount of grass or hay produced was in exact proportion to the amount of ammonia contained in the manure. Guano containing a large amount of ammonia, and being also, at present, its cheapest source, must, therefore, prove of great benefit in the production of grass.

For grass land, from two to four cwt. of Guano, mixed with soil, may be used per acre. Wet or damp weather should be selected for sowing it. Probably the end of March or the beginning of April is the best time. Under certain circumstances, Guano may be applied to grass land in the Autumn, particularly where the under soil is of a strong or loamy character. Thus applied it will have the effect of bringing up the grass a little earlier in the spring.

WHEAT, BARLEY, OATS, AND OTHER CEREALS.

If Guano be used for wheat, in lieu of farm-yard dung, a portion, at least, ought to be applied in the Autumn. Care, however, must be taken not to stimulate the plant too much, otherwise it will be liable to suffer injury from frost. One cwt. per acre on light lands can be applied broadcast, and harrowed in during Autumn, either before or after the drilling of the wheat.

In the Spring, a further application of not more than 1 cwt. or 2 cwt. may be made, harrowed in with light harrows. If the wheat be drilled sufficiently apart to allow of horse hoeing, it will often be found advantageous.

Should wheat, manured with dung as usual, look unkindly in the Spring, it will be greatly benefited by a dressing per acre of 2 cwt. of Guano, and 4 cwt. of salt. Salt has great effect in strengthening the straw of wheat and other cereals, and where any of these crops are liable to lodge, or whenever Guano is used, 4 cwt. or 5 cwt. of salt should always be sown per acre. For Barley and Oats, 2 cwt. of Guano, and 4 cwt. of salt, may be sown broadcast per acre, the seed drilled, and the whole harrowed in together.

POTATOES.

From the comparison of numerous series of experiments, it would appear that Guano succeeds best with this crop as a top dressing, in conjunction with farm-yard dung. The ground is prepared in the usual manner. The farm-yard dung is deposited in the bottoms of the drills, the sets of the seed potatoes laid upon the top of the manure, and the whole earthed up. Before the plants appear, the Guano is to be sown on the top of the drills, covered over with the plough, and then rolled. If the potatoes be grown on the level, and not in drills, the Guano is to be sown over the field broadcast, two or three weeks after the potatoes have been planted. The quantity of Guano to be used per acre is from 3 cwt. to 6 cwt.

Many experiments have proved the great utility of sulphate of soda, or sulphate of magnesia, in conjunction with Guano, upon this crop. As far as our own experience goes, these salts have a decided effect in diminishing the liability of potatoes to disease. We should, therefore, recommend, in addition to the Guano, to put per acre, at the same time,

1 cwt. of sulphate of soda, and
1 cwt. of sulphate of magnesia.

If farm-yard dung be not used for potatoes, broadcast and harrow in 2 cwt. or 3 cwt. of Guano, and set the potatoes as usual. Three or four weeks afterwards, sow over them, and lightly harrow in, the same quantity of Guano, and 1 cwt. each of the sulphates of soda and magnesia.

The mixture of sulphuric acid and Guano mentioned at page 18, under the head of turnips, would probably be found an excellent manure for this crop.

BEANS, PEAS, AND LEGUMINOUS PLANTS.

For beans or peas, 2 cwt. or 3 cwt. per acre may be used, either broadcast before sowing, or a portion afterwards between the drills at the time of horse hoeing. The latter would probably be the better plan.

For vetches, lucerne, saintfoin, or clover, 2 cwt. or 3 cwt. per acre broadcast may be used. This should be sown in the beginning of April, on a dewy morning, or during wet weather. It is useless to sow if there be a probability of dry weather ensuing for any lengthened period.

FLAX.

This crop, in olden time, had the renown of being one of the most exhausting crops which could be put into the land. We have now learned that white crops, and those in general which have the repute of *"drawing the land,"* are those which require the largest amount of nitrogen for the formation of seed, and for which, consequently, ammoniacal manures are precisely adapted. With the aid of Guano, or other ammoniacal manures, flax can no longer be considered an exhauster of the soil.

In using Guano for this crop, from 2 cwt. to 4 cwt. per acre, mixed with ashes, may be sown broadcast and harrowed in, a few days before the seed is drilled.

CABBAGE, CARROTS, &c.

Guano has been found of material benefit for these crops, and may be employed advantageously at the rate of from 2 cwt. to 4 cwt. per acre. It must be remembered that carrots require deep cultivation, and that both crops will be benefited by the proper stirring of the soil between the rows, and the occasional addition of a little Guano.

HOPS.

To no crop does the addition of a proper amount of ammoniacal manure prove more advantageous than to the hop. The constant withdrawing of the hops, year by year, from the land, necessitates the importation upon the soil of a considerable amount of both mineral and organic ingredients. Four cwt. of Guano and 3 cwt. of salt per acre, applied at two separate times, and well worked in between the alleys, will be found a useful application. Or the manure may be put round each hill and covered up with the soil.

From several analyses of the hop plant, the following mixture was recommended by the Author, some years ago, as a proper manure for the hop.

MANURE FOR AN ACRE OF HOPS.

3 cwt. of guano,
1 cwt. common salt,
1½ cwt. saltpetre, or nitrate of soda,
1 cwt. gypsum.

This manure has been used with considerable success in various parts of Surrey, Kent, and Sussex.

It will not be necessary to give any further details of particular crops for which Guano is suitable, or to describe more fully the mode of its employment. The intelligent farmer will soon learn to vary its application to suit the end he may have in view.

Guano, however, is useful to others besides the farmer. To the horticulturist it is invaluable, and many specimens of the finest vegetables and fruits, and of the most beautiful flowers, have been indebted to the judicious use of Guano for the admiration they have excited, and the prizes they have obtained.

For fuller particulars respecting its horticultural use, we must refer the reader to the columns of the *Gardeners' Chronicle.* And in concluding this part of our subject, we cannot refrain from quoting the opinion of Dr. Lindley, the learned editor of that valuable journal, that "If the experience of the last few years has taught us one thing more certainly than another, it is the unfailing excellence of Guano for every kind of crop *which requires manure.*"

THE COMPOSITION OF GUANO.

Our space will not permit us to describe all the varieties of proximate elements contained in different samples of Guano. Nor is it, indeed, necessary for the practical man to be acquainted with them, as the commercial value of Guanos is best determined by the amount of nitrogen (ammonia), and phosphate of lime they contain.

For more minute information on this subject, the reader is refered to Dr. Ure's paper on Guano, in vol. 5 of the Journal of the Royal Agricultural Society.

In this enquiry we have devoted our observations more especially to the Peruvian Guano, as the quantity of this article at present brought into the market very far exceeds that of all the other kinds of Guano put together.*

* An account of all Guano imported into the United Kingdom in each of the years from 1846 to 1851, inclusive. Taken from a return ordered by the Honourable the House of Commons, April 2nd, 1852.

Quantities of Guano imported into the United Kingdom.

	1846.	1847.	1848.	1849.	1850.	1851.
	TONS.	TONS.	TONS.	TONS.	TONS.	TONS.
Peruvian Guano	22,410	57,762	61,055	73,567	95,083	199,732
All others	66,793	24,630	10,359	9,871	21,842	43,284
Total ...	89,203	82,392	71,414	83,438	116,925	243,016

A word or two may not, however, be out of place respecting the other varieties; the principal of which are the Angamos, the Chilian, the Bolivian, the Saldanhah Bay and the Australian. The island of Ichaboe, on the African coast, furnished a few years back large supplies of a medium Guano. It is now, we believe, wholly exhausted.

The Angamos Guano is from the western coasts of South America. It is the most recent deposit of the birds, collected by hand, with considerable danger and difficulty, from the bare surfaces of the precipitous rocks which they frequent. When pure, it is of first-rate quality, and having suffered no decomposition, frequently contains from 20 to 24 per cent. of ammonia. The smallness of the quantity, however, that can be collected, renders it of little general importance to the farmer.

The Saldanhah Bay, and other varieties, having been deposited in rainy climates, have suffered great deterioration. The valuable ammoniacal salts and soluble phosphates have been in great measure washed away, the nitrogenous animal matter has been decomposed, and little remains but the common phosphate of lime. The Chilian and Bolivian are generally contaminated with large quantities of sand, and the Shark's Bay (Australian) Guano, is certainly not worth the carriage to this country. The farmer ought at no time to buy any of these descriptions of Guano without an accurate analysis, as, owing to their varying impurities, it is otherwise possible that he may pay for them several pounds per ton above their real value.

An idea of the great difference of composition which exists in samples of Guano from distinct localities, can only be formed by a comparison of their respective analyses. To enable the agriculturist to form a correct judgment of the kinds now in the market we give a table of the composition of six varieties.

ANALYSES OF DIFFERENT VARIETIES OF GUANO.

	Angamos Guano.	Angamos Guano.	Peruvian Guano.	Chilian Guano.	Bolivian Guano.	Saldanhah Bay Guano.	Sharks' Bay Guano.
Moisture	10·90	12·55	9·30	20·46	16·00	17·92	14·47
Organic Matter, &c.	67·36	61·07	57·30	18·50	13·16	14·08	7·85
Sand, &c.	1·04	5·36	0·75	22·70	3·16	2·80	14·47
Earthy Phosphates	16·10	13·76	23·05	31·00	60·23	59·40	29·54
Alkaline Salts, &c.	4·60	7·26	9·60	7·34	7·45	5·80	33·67*
	100·00	100·00	100·00	100·00	100·00	100·00	100·00
Nitrogen (equal to)	19·95	18·24	15·54	4·50	2·11	0·63	0·35
Ammonia	24·19	22·12	18·87	5·47	2·56	0·76	0·47

* 29·54 per cent. of this was gypsum.

The whole of the above are analyses made in the Kennington Laboratories. The samples were from cargoes received in London within the last six months. The Chilian and Bolivian Guanos are much inferior to those formerly imported, in consequence, we believe, of all the finer qualities having, for some time, been worked out.

We may here caution the farmer not to put any trust in those analyses, often placed in his hands, which merely indicate that the sample analysed contains such and such a per centage of *animal organic matter*, or of *salts of ammonia.*

From these deceptive analyses, it is perfectly impossible even for the most experienced chemist to obtain the slightest notion of the value of a manure; and we recommend the farmer, under no circumstances, to buy a Guano, unless the precise amounts of *ammonia* and *phosphate of lime* are distinctly mentioned.

Should the farmer wish to prepare a sample, for analysis by the chemist, half a pound should be taken from each of five or six bags containing the bulk. These should be mixed together on a sheet of brown paper, until thoroughly incorporated and homogeneous. Two ounces of the mixture is enough for analysis; and it can easily be sent per post from any part of the kingdom. To prevent evaporation from the sample, it can be wrapped up in tin foil, or lead leaf from a tea chest, and afterwards in paper. If the tin foil cannot be procured, two thicknesses of strong paper should be used.

In order to furnish a standard of comparison to the intelligent farmer who may think it desirable to ascertain the composition and value of the Guano he purchases, we subjoin an analysis of an ordinary sample of Peruvian Guano, recently received per the Ship Augustus.

GUANO EX AUGUSTUS.

Moisture	14·24
Organic Matter, &c..	52·71
Sand, &c.	1·55
Phosphate of Lime	25·10
Alkaline Salts, &c.	6·40
	100·00
Nitrogen (*equal to*)	13·95
Ammonia	16·97

ON THE ADULTERATION OF GUANO.

After the observations we have made on the utility of Guano to those engaged in Agricultural pursuits, it would have been very gratifying to have concluded our remarks.

It is, however, our invidious duty to refer to a less pleasing, but not less important part of the subject.

The high manuring value of Guano, and its extensive sale, combined with the want of knowledge among farmers as to the genuineness of the article, and their manifest reluctance to be at the expense of a chemical analysis, have, together, induced many fraudulent dealers to adulterate this manure systematically, to a great extent. The strong desire which unfortunately exists among a large class of farmers to purchase Guano at the lowest terms per ton, without due reference to the quality or composition of the manure, has also operated most materially to their own disadvantage.

If the honest dealer offers a genuine article in the market, upon which he puts only a reasonable profit, and finds that his roguish neighbour can more readily sell an adulterated article, he has no alternative but to abandon the trade or to turn rogue himself. The man who likes *cheap* manures should be reminded that to the buyer they are always *dear*, as he has to pay the whole expense of adulteration, as well as the 20 or 30 per cent. profit of the dishonest dealer. In fact, we should recommend the lovers of cheap manures to follow, in preference, the example of Quin, who finding his milk more than half water, armed with two jugs, demanded of his milkman "to give him them *separate*, he could *mix* for himself."

It is, indeed, scarcely possible to give persons at a distance an idea of the extent to which Guano is adulterated in London and some other large towns.

The demand of the farmer for *cheap* manure, acting upon the trade through the medium of the unscrupulous dealer, has given rise to a fraudulent and hitherto successful business.

A most extensive and profitable trade is at present carried on by parties who confine themselves to the compounding of specious-looking ARTICLES, to mix with Guano; these they supply to dealers in that manure.

The materials used to sophisticate Guano are numerous.

Sand, marl, clay and chalk, limestone, bricks, tiles, gypsum—ground, when necessary, to a fine powder, constitute the materials for which the farmer is destined to pay £8 or £10 per ton. The marls of Stratford, Wanstead, and other places in Essex, and the yellow loams of Norwood, in Surrey, are in particular request. These, mixed in proportions to counterfeit the colour of Guano, are sold to roguish dealers in town and country, who *introduce a little genuine Guano* to give the necessary odour.

The requisite smell, however, is more generally produced by admixture with damaged Guano; and the duped farmer buys bad Guano, and worse marl, in lieu of the real manure.

The two following analyses will give some idea of the adulterations in the Manure market:—No. I, came into the London market, per ship, from Liverpool.—It was offered for sale by sample; in some places, as Peruvian Guano, at £6. 10s. to £7. per ton; in others, as Saldanhah Bay Guano, containing 60 per cent. phosphate of lime, at £4. to £5. per ton. The samples were contained in bags of blue paper, purporting to come from some ship from Valparaiso. About 150 tons were brought into London, the greater portion of which found its way to the farmers of the southern counties. No. 2 was offered for sale as Saldanhah Bay Guano, at £3. or £4. per ton.

No. 1—Guano?		No. 2—Saldanhah Bay Guano?	
Gypsum	74.05	Sand	48.81
Phosphate of Lime	14.05	Phosphate of Lime	10.21
Sand	2.64	Gypsum	5.81
Moisture and loss	9.26	Chalk	22.73
		Moisture	12.44
	100.00		100.00
Ammonia	0.51	Ammonia	a trace.

Though numerous unprincipled dealers exist in the manure trade, yet there are certainly many others, honest men, upon whose fair fame there has never yet been a breath of suspicion.

We advise the farmer therefore to purchase his manures from men of established reputation, who have a character to lose, and who will not demand from him more than a fair and reasonable profit.

It should also be remembered, that £9. 5s. per ton, less 2½ per cent. for cash, is the lowest price at which Messrs. Ant. Gibbs & Sons sell Peruvian Guano; and this only in wholesale quantities. The country dealer has, in addition, to pay wharfage, carriage and other expences, which must be added to the cost of the Guano. He is also entitled to a reasonable interest for his money, if he gives long credit for that manure which he himself is compelled to pay for in cash.

We leave it, therefore, to the common sense of the English farmer to judge whether a genuine Guano can possibly be purchased at the prices at which Guanos, *purporting to be genuine*, are constantly offered in the country markets.

To assist still further in preventing the frauds to which the incautious buyer is continually subject, we shall offer some simple observations on the methods of detecting adulterations in Guano.

METHODS OF DETECTING THE ADULTERATION OF GUANO.

The chemical analysis of Guano is, of course, the best means of ascertaining any fraudulent mixture which may have been made; and it is a subject of regret that few farmers yet avail themselves of chemical aid, though the expense of the necessary information is quite insignificant compared with the importance of the object to be attained.

It has long been a desideratum to obtain some method of ascertaining the purity of Guano, sufficiently simple to be easily understood and put in practice by any person of ordinary intelligence. With this object in view, we have tried in our laboratory many long series of experiments. These have ultimately led us to propose a few simple tests, which will readily discover the adulterations in any sample of sophisticated Guano which has yet appeared in the market.

As Guano is generally adulterated with marls and sands, much heavier than itself, our attention was first directed to the specific gravity of Guano as a means of detecting the admixture.

In a lecture delivered some time since before the London Farmers' Club, we had shown that an ounce of good Guano, put into a cylindrical glass tube, occupied nearly twice the space of an equal weight of an adulterated sample. We subsequently tried many hundreds of experiments with various Guanos, in tubes of like dimensions, but though the tube easily detected all the adulterated samples we procured, yet it was thought desirable to propose some more delicate test.

Various other experiments were undertaken, and the following series gave us the necessary foundation for the method we ultimately selected.

A stoppered bottle, capable of holding 3000 grains of water, had 4 oz. avoirdupois of good Guano placed in it. Water was then added, and the materials shaken until well mixed. A little more water was added, and the bottle again agitated, and then allowed to rest for three or four minutes, to permit the air bubbles to arise. The bottle was now filled completely with water, the froth running over; the stopper was then gently, but accurately, fitted to its place, and the bottle wiped with a cloth.

A counterpoise, previously made equal to the weight of the bottle alone, was then placed in one pan of a small ordinary pair of scales, and the bottle, with the Guano, in the other. From a numerous series of experiments, it was found that the bottle and Guano, on an average, weighed 664 grains more than the bottle and water alone: that is, the water in the bottle would weigh 3,000 grains, and the Guano and water 3,664 grains.

The following table contains the result of the experiments tried with samples of genuine Guano, and substances used for adulteration.

WEIGHTS INDICATED BY GUANO TESTER.

The Bottle holding 3,000 grains of water.

	oz.	NAME OF VESSEL.	Grains.
1	4	Field	3663
2	4	Columbia	3662
3	4	Princess Victoria	3668
4	4	Digby	3665
5	4	Liskeard	3655
6	4	Duncan Richie	3669
7	4	Rosina	3677
8	4	Mary Ann	3668
9	4	Albyn	3679
10	4	Johann George	3661
11	4	Rosamond	3645
12	4	Ann Dashwood	3648
13	4	Alfred	3645
14	4	Juno	3659
15	4	Brothers	3665
16	4	Richardson	3641
17	4	Hamilton	3679
18	4	Anna	3677
19	4	Midas	3659
20	4	Will Willmot	3659
21	4	Macdonell	3653
22	4	Cumberland	3651
23	4	Retriever	3677
24	4	Lucy	3677
25	4	Vigilant	3669
26	4	Julius Cæsar (damaged)	3719
27	4	Vicar of Bray (damaged)	3703
28	4	Field, adulterated 10 per cent.	3709
29	4	Ditto 20 per cent.	3757
30	4	Ditto 30 per cent.	3815
31	4	Guano, £7 10s. per ton (adulterated)	3867
32	4	Guano, £7 12s. 6d. per ton (ditto)	3894
33	4	Salt	3930
34	4	Sand	4095
35	4	Gypsum	4065

From the preceding experiments is deduced the following simple plan, which will easily detect all the ordinary adulterations of Guano.

Procure from any druggist a common wide-mouthed bottle, with a *solid* glass stopper; one known as a wide-mouthed 6-oz. bottle will do very well. Let this bottle be filled with ordinary water, the stopper inserted, and the exterior well dried. The scales to be used ought to turn well with a couple of grains. In one pan of the scales place the bottle, and exactly counterpoise it in the other by shot, sand, or gravel. Remove the bottle from the scale, pour out two-thirds of the water, and put in 4 ounces avoirdupois of the Guano to be tested. Agitate the bottle, adding now and then a little more water; let it rest a couple of minutes, and fill with water, so that all the froth escapes from the bottle; insert the stopper carefully, wipe dry, and place the bottle in the same scale from which it was taken. Add now to the counterpoised scale 1½ ounce avoirdupois, and a fourpenny piece, and if the bottle prove the heavier, the Guano is, in all probability, adulterated. Add in addition a threepenny piece to the counterpoise, and if the bottle and Guano prove the heavier, the Guano may be considered as adulterated. By this simple experiment, the admixture of a very small amount of sand, marl, &c., is distinctly shown.

We venture also to propose another method, founded on the properties of the mineral constituents of Guano. When Guano is burnt to ashes at a red heat, the ash has a pearly white appearance, which is owing to the absence of iron and other colouring metallic oxides.

As iron is always found in marl, clay, &c., the ash of any sample of Guano contaminated with them will not only be coloured, but its weight will be increased.

The per centage of mineral matter or ash in different samples of Guano is very uniform, varying, as the annexed table shows, only from 30 per cent. to 35 per cent.

Table of the per Centage of Mineral Matter contained in Peruvian Guano.

	Name of Vessel.	Per cent of Ash.
1	Johann George	33·4
2	Ann Dashwood	32·2
3	Alfred	32·0
4	Juno	32·3
5	Brothers	33·2
6	Richardson	30·7
7	Hamilton	33·4
8	Anna	32·5
9	Midas	33·0
10	Will Willmot	34·0
11	Macdonell	33·1
12	Cumberland	32·3
13	Retriever	31·9
14	Lucy	31·8
15	Vigilant	33·5
16	Rosamond	35·0
17	Julius Cæsar (damaged)	38·2
18	Success (ditto)	33·6
19	Guano, £7. 10s. per ton (adulterated)	62·7
20	Guano, £7. 12s. per ton (ditto)	65·8

These facts give us the following method of detecting adulteration.

A small pair of scales, a little platinum capsule, a pair of little tongs or pincers, and a spirit lamp, are all that are required. Ten grains of the Guano are placed in the platinum capsule, which is held by the tongs in the flame of the spirit lamp for several minutes, until the greater part of the organic matter is burnt away. It is allowed to cool for a short time, and a few drops of a strong solution of nitrate of ammonia added, to assist in consuming the carbon in the residue. The capsule is again gently heated (taking care to prevent its boiling over, or losing any of the ash), until the moisture is quite evaporated. A full red heat must then be given it, when, if the Guano be pure, the ash will be pearly white, and will not exceed 3½ grains in weight. If adulterated with sand, marl, &c., the ash will always be *coloured,* and will weigh more than 3½ grains.

Even the simple burning of a few grains of Guano, on a red hot shovel, will often indicate by the colour whether a fraud has been committed; but we cannot particularly recommend this method, as the iron of the shovel will itself sometimes give a tinge to the ash.

It will be perceived, that the per centage of ash will not always detect damaged Guano, nor are the tests generally intended to apply to wet or moist samples, which are palpably from damaged cargoes. Good Peruvian Guano is perfectly dry to the touch.

If the adulteration be made with light or floculent matters, they may be detected easily, as follows: Dissolve in a quart of water as much common salt as it will take up, and strain the solution. Pour a quantity of it into a saucer or basin, and sprinkle on the surface the Guano to be tested. Good Guano sinks almost immediately, leaving only a very slight scum. The adulterated leaves the light materials floating on the water.

If chalk or ground limestone be used, it may be shown by pouring strong vinegar over a teaspoonful of the sample placed in a wine glass. On stirring, effervescence shows its presence. Genuine Guano, under the same circumstances, merely allows the escape of a few air bubbles.

If farmers could be prevailed upon to spend a small portion of their time in trying the foregoing simple experiments on the samples of Guano they use, the fraternity of rogues would certainly have far less chances than they at present possess of pursuing their calling with profit. Still these little operations are only offered as a means of detecting the grosser adulterations of Guano. Minor ones may still be practised, and men of real intelligence and business habits will regularly call to their assistance the aid of the analytical chemist.

Summing up the experiments, the following facts would appear:—

1st. If 4 oz. of Guano, weighed with bottle and water, as previously directed, take more than $1\frac{1}{2}$ oz. and 1 fourpenny piece to recounterpoise it, its purity is doubtful.

If an additional threepenny piece is required, the Guano may be considered as adulterated, and the sample should be immediately analysed.

2nd. If the ash be coloured in any way, and not of a pearl white, the Guano is bad.

3rd. If the ash of 10 grains of the Guano weigh more than $3\frac{1}{2}$ grains, or less than 3 grains, the genuineness of the sample is doubtful.

4th. If strong vinegar cause a considerable effervescence when mixed with the sample, the latter is adulterated,

5th. If the Guano floats, when sprinkled on a strong solution of salt and water, it is not genuine.

Note.—A complete set of the Apparatus necessary for making the previous experiments can be obtained at a moderate cost from Mr. G. SIMPSON, Operative Chemist, 1 & 2, Kennington Road, London.

PRACTICAL EXPERIMENTS WITH GUANO.

Our limits will only permit us to introduce a few out of the numerous experiments made with this manure. For more extensive details, the reader is referred to the journal of the Royal Agricultural Society, the transactions of the Highland Society of Scotland, the Mark Lane Express, the Gardeners' Chronicle and Agricultural Gazette, Bell's Weekly Messenger, &c.

Experiments by ROBERT MONTEITH, ESQ., *of Carstairs.*

1.—OAT CROP, 1843.—Part of a field manured with 267 lbs. of guano, at the cost of 31*s.* per imperial acre, produced, per acre, 59 bushels.

Manured with 10 bushels of bone-dust, at the cost of 23*s.* 4*d.* per imperial acre, produced, per acre, 43 bushels.

The difference may be stated as follows :—

			£	s.	d.
Cost of guano	31*s.* 0*d.* ;	produce, 59 bushels, at 2*s.* 6*d.*	£7	7	6
Cost of bones	23*s.* 4*d.* ;	produce, 43 bushels, at 2s. 6*d.*	5	7	6
	7*s.* 8*d.*		2	0	0
		Deduct difference of manure	0	7	8
		Leaving in favour of guano	£1	12	4

II.—Hay Crop, 1843.—To part of a field, manured the previous year with farm-yard dung, was given 267 lbs. of guano per imperial acre, at the cost of 31*s.*, and the *extra produce*, per acre, was 22 cwt. of hay,

	£	s.	d.	
Which, at 3*s.* per cwt., is	£3	6	0	
Deduct expense of guano	1	11	0	
Leaving in favour of guano.........	£1	15	0	per acre.

Elburton, near Thornbury, Gloucestershire,
February 28th, 1844.

Gentlemen,

I beg to hand you the result of an experiment with guano purchased from you last May.

The total quantity cropped (to potatoes) was 3 a. 1 r. 18 p., of which 30 perches were manured with 131 lbs. of guano, at the rate of 6 cwt. 1 qr. per acre ; the remaining portion had no manure.

	Sacks.		Sacks.	
The manured produced	16,	being......	16	per 30 perch
The unmanured produced	167,	being hardly	10	„
Increase of manured part			6	

Thus the manured portion produced per acre	85	Sacks
The unmanured „	52	„
Total increase per acre	33	„

By thus taking the average per 30 perch of the whole unmanured part against the 30 perch manured, is not giving the guano full credit, as full half the field was planted to an inferior potato, which produced a greater bulk than the sort on which the guano was tried ; but I am aware, where an experiment has succeeded, and thus pleased the experimenter, that too often favour is shown it, either by selecting an inferior part of the crop against which to test it, or perhaps by making the measure a little more on the one hand and a little less on the other ; but in all cases I have given the purchaser's measure, which will not be liable to an error on this side.

	£	*s.*	*d.*
The increase of crop in the 30 perch manured was 6 sacks, which I sold out of the field at digging time, at 5s. per sack	1	10	0
The cost of 131-lbs. of guano, including carriage and additional labour..............	0	15	7
Or a clear profit on 30 perch of	0	14	5

The same potatoes, if kept and sold, would at the present price have yielded a further profit of 6s.

The profit, in the same proportion, on one acre would be,

	£	s.	d.
Increase per acre 33 sacks, at 5s.............	8	5	0
Cost of guano, carriage, and additional labour	4	3	2
Clear profit per acre	4	1	10

Or, if kept to the present time, a profit per acre of £5 14s. 10d.

The manured part produced by far the best sample ; they were a week at least before the others, and retained, throughout the season, a marked difference.

The remaining portion of the guano I tried in several ways, and in all found it succeed; but I made no exact account of its efficacy. I intend trying it on a much larger scale next year, and feel sure it will yield a proportionate return.

I am, Gentlemen, yours obediently,

Messrs. Gibbs, Bright & Co. GEO. B. OSBORN.

Experiments upon the Hay Crop, by R. OSBORN, ESQ., *Brunswick Lodge, Henbury.*

Guano per Acre.	Grass per Perch.	Grass per Acre.	Hay per Acre.	Increase per Acre from use of Guano.
		Tons. cwt. qrs. lbs.	Tons. cwt. qrs. lbs.	Tons. cwt. qrs. lbs.
2 cwt.	105 lb.	7 10 0 0	2 7 0 21	0 17 3 25
4 „	155 „	11 1 1 20	3 9 2 18	2 0 1 22
None.	65 „	4 12 3 12	1 9 0 24	

Experiments on the Application of Guano and other Manures, in the Duke of Somerset's Park at Stover, near Newton Abbot, Devon. By E. S. BEARNE.

No. I.—Report of an experiment to test the comparative efficiency of five different kinds of artificial manure in improving pond mud, the experiment being made on an acre of inferior pasture land in Stover Park, in the years 1847, 1848, and 1849. The land on which the experiment was conducted is of uniform quality, the land being of a light sandy loam a few inches in depth, incumbent on a stratum of white clay. The land underwent a thorough drainage in 1844, previous to which it would not produce a rent of more than 5s. per acre. No manures were applied to the land in 1848 or 1849. The object sought to be attained by extending the experiment over a period of three years, is to test the *durability* of the different manures.

TABLE I.

No.	Manures applied in 1847.	Weight of Hay cut in 1847.	Weight of Hay cut in 1848.	Weight of Hay cut in 1849.	Weight cut per acre in 1847.	Weight cut per acre in 1848.	Weight cut per acre in 1849.	Cost of the Manures.
		lbs.	lbs.	lbs.	Seams of 3 cwt.	Seams of 3 cwt.	Seams of 3 cwt.	£. s. d.
1	Six cubic yards of mud mixed with 6 cwt. of SALT	312	327	613	4¾	4¾	9	0 14 0
2	Six cubic yards of mud mixed with 1½ hogshead of LIME .	353	337	538	5¼	5	8	0 13 6
3	Six cubic yards of mud mixed with 3 bushels of BONEDUST	511	419	670	7½	6¼	10	0 14 3
4	Three cubic yards of mud mixed with 3 cubic yards of TAN YARD REFUSE	524	354	558	7¾	5¼	8⅓	0 14 0
5	Six cubic yards of mud mixed with 90 lbs. of PERUVIAN GUANO	930	550	725	13¾	8	10¾	0 14 0

N.B.—The after Grass in 1847 was stocked with sheep, but in 1848 it was left unconsumed.

No. II.—Report of an Experiment made with the undermentioned manures on an acre of pasture land in Stover Park, in the year 1849. The manures, when mixed with a small quantity of fine earth, were applied broadcast on March 29th, and during the rainy weather which prevailed at the time. The land is of a fair average quality, and was formerly used as tillage land, but has been in pasture for many years. The crops were mown on 22nd June, and the herbage produced by the different manures was of a superior quality.

TABLE II.

No.	Manures applied.	Quantity of Manures applied.	Quantity applied per acre.	Weight of Hay cut.	Weight cut per acre.	Cost of Manures.	Cost of the Manures per acre.
		cwt.	cwt.	lbs.	Seams of 3 cwt.	£. s. d.	£. s. d.
1	None	...	...	401	4¼	......	......
2	Superphosphate of Lime	2¼	9	616	7⅓	0 18 0	3 12 0
3	Nitrate of Soda	1	4	706	8⅓	0 18 0	3 12 0
4	Peruvian Guano	1½	6	1210	14⅛	0 18 0	3 12 0

GRASS.

The following experiments were made in the year 1843, at the Botanic Gardens, Manchester, by Mr. Alex. Campbell. They are interesting, as showing a decrease in the production of grass when more than 10 cwt. of Guano was used per acre.

APRIL EXPERIMENT.	RATE PER ACRE.						
	PRODUCE. GRASS.				MANURE. GUANO.		
	Tons.	cwts.	lbs.	oz.	Cwts.	lbs.	oz.
The produce of 1 square yard, on which 1 oz. guano mixed with ashes was spread, weighed 3 lbs......	6	9	72	0	2	78	8
The produce of 1 yard, on which 1½ oz. guano mixed with ashes was spread, weighed 3 lbs. 2 oz.......	6	15	5	0	4	5	12
The produce of 1 yard, on which 2 oz. guano mixed with ashes was spread, weighed 3 lbs. 11½ oz....	8	0	78	12	5	45	0
The produce of 1 yard on which 2½ oz. guano mixed with ashes was spread, weighed 4 lbs. 4 oz.......	9	3	74	0	6	84	4
The produce of 1 yard on which 3 oz. guano mixed with ashes was spread, weighed 4 lbs. 11 oz. ...	10	2	63	8	8	11	8
The produce of 1 yard on which 3½ oz. guano mixed with ashes was spread, weighed 5 lbs. 14 oz. ...	12	13	99	0	9	50	12
The produce of 1 yard on which 4 oz. guano mixed with ashes was spread, weighed 4 lbs. 10 oz. ...	9	19	92	0	10	90	0

Extract from a Letter from J. M. PAINE, ESQ., *of Farnham.*

(From the Gardener's Chronicle.)

"As regards the application of ammonia to the cereal crops, I repeat that it is of no importance in what form it is given to the soil; therefore apply that which gives the largest per centage of ammonia for your money. At the present time Peruvian Guano (not adulterated rubbish), giving 17 or 18 per cent. of ammonia, is the cheapest source of supply. Last year, after a large crop of pulled off swedes, I put 3 cwt. of Peruvian Guano, mixed with the same quantity of phosphoric marl, per acre; and the result, as I have before stated, was a trifle over 8 quarters of barley per acre; and in 1848, on a field of barley, after swedes fed off by sheep, and top-dressed, when about 6 inches high, with 84lbs. per acre of the sulphate of ammonia, mixed with 2 cwt. of phosphoric marl,* we

* The first discovery of the presence of phosphoric acid in the Farnham Marls was made by me in the year 1847; but no notice was taken of this fact in the paper which subsequently appeared on this subject in the 9th volume of the Journal of the Royal Agricultural Society, although the writers received the original information directly from myself.—J. C. N.

omitted a few lands in different parts of the field, and we considered that we obtained from 12 to 16 bushels more barley per acre on the top-manured portions. Last year my oat crop averaged full 12 quarters per acre; we have now just finished cutting this year's crop, and we expect to obtain an average of 14 quarters. This crop is after turnips and swedes, about half of which were drawn from the field. When the oats were sown, 4 cwt. per acre of the Guano and soot mixture with the fossil powder was applied. The land is naturally a poor gravelly clay, resting upon chalk. A neighbour of mine, upon a similar soil, after trenching it, applied 6 cwt. per acre of Peruvian Guano, and his crop is about equal to my own; while another neighbour, in an adjoining field to my oats, who farms in the old-fashioned way, will not grow much above a fifth of either of our crops. I ought, perhaps, to add that we do not obtain a crop of weeds as well as corn, it being our object to have no trouble in cleansing our turnip fallows. If I had pulled off all my turnips, I should have doubled my artificial manuring for my oats. In manuring ammoniacally for wheat, if the soil were a clay or stiff loam, I would apply the whole dose in the autumn; if gravelly or chalky, half at the time of sowing, and the remainder early in March. In conclusion, when we have weak spots of corn in any field, we mend them with guano in the spring."

FINIS.

H. Kemshead, Printer, Lower Kennington Lane, Lambeth.