THE GLEANER.

AND NORTHUMBERLAND, KENT, GLOUCESTER, AND RESTIGOUCHE
COMMERCIAL AND AGRICULTURAL JOURNAL.

New Series, Vol. III *Nec aranearum sane textus ideo melior, quia ex se fila gignunt, nec noster vilior quia ex alienis libamus ut apes.* No. 26.

Miramichi, Tuesday Afternoon, April 8, 1845.

Agricultural Journal.

From the English Farmer's Magazine for February, 1845.

ESSAY ON GUANO.

The design which gave rise to this essay was to present, at one view, a brief account of *all* the important facts which have been published respecting *Guano*. These facts, having been observed at different times and by men of various pursuits, occur, scattered through many books and journals, which, to a large number of the purchasers of guano, may not be easily accessible. The writer, therefore, ventures to hope that this attempt to give a *selection*, from the information he has met with from these sources, may be of some use, or may, at least, afford to others some of that pleasure which he has himself felt in examining into the nature and history of a substance, the mean origin of which on the one hand, and on the other, its important uses, present a very attractive contrast.

Guano is the name applied to those extensive deposits which occur in Peru and other places, and which are *the excrements of sea birds, as altered by long exposure to air and moisture.* Its name is an European corruption of the Peruvian word "huano," which means dung or manure. That it has originated in the manner mentioned is well established. The cormorants, flamingoes, cranes, and other sea birds, from which it has been derived, live, chiefly on *fish!* and the *chemical composition* of guano is exactly such as we should expect if it really originated from the excrements of such birds. This will be given afterwards; at present it is enough to state that, among other evidences, the bones and feathers of *birds* occur frequently in guano: and that the living sea birds have been seen to deposit *white* guano to such an extent that from 20 to 25 tons of it are sometimes collected in a single season. Moreover, this *white guano* is seen on the island of Torrecilla, on the coast of Peru, to be gradually changing into the *brown variety*, of which by far the most extensive and ancient deposits are composed. There seems, therefore, no reason to doubt that *all* the guano deposits have had their origin in the excrements of sea birds.

It is known that guano was used as manure in Peru, at least as far back as the 12th century, but was little known in Europe till quite recently. Humboldt, indeed, in his travels in South America, in 1840, had observed it, and describes its valuable properties: and Sir Humphrey Davy mentions it in his "Agricultural Chemistry;" but it is only within the last few years that the farmers of England have become aware of its value, and that it has become an article so largely imported and so generally used. Other localities than that mentioned have fortunately, too, been discovered; it has been found in Chili and Bolivia (both in South America), and on the island of Ichaboe, off the African coast. Up to the present time the amount of guano which has been imported into the United Kingdom equals 37,000 tons; of which 25,000 were from Peru and Bolivia, 7 thousand from Africa, and 1,500 from Chili.

We may be well astonished, that this enormous quantity of material, and the still more enormous quantities that remain, should have been merely accumulations of the excrements of sea birds. The time that must have elapsed since the commencement of these accumulations is difficult to ascertain, but must be very great; more especially when we consider that, according to Humboldt, the birds have formed, in 300 years, guano to the thickness of a few inches only; while the thickness of the actually existing beds is very frequently 50 or 60 feet. Perhaps there may be some exaggeration here; but much more moderate estimates do not allow less than 3,000 *years* for the formation of some of the thickest beds, and that, too even at the rate of 2 or 3 inches a *year*.

Guano can only accumulate in regions where little or no rain falls, because more than one-half of it is soluble in water. Accordingly, in Peru, it occurs in quantities only between the 13th and 21st degrees of south latitude; within these limits, the coast of Peru (from the Cordilleras to the sea), and the adjacent islands, are almost perfectly *desert*; rain falls so seldom that the roofs of the houses are made of hardened mud: ship-loads of wheat may be, and are, safely left in uncovered heaps on the mole of *Callao*; and at Iquique, a shipping port for guano, even a very light rain falls only once in many years. Although, therefore, the flocks of sea birds are as numerous to the north and south of the regions between the 13th and 21st degrees of latitude as between these limits, yet there is no notable quantity of guano beyond them, because, rain, though not abundant, yet comparatively is too frequent. It will be obvious, therefore, that both the quantity and quality of guano will greatly depend on the dryness of the climate; it is most abundant and best where there is least moisture, other circumstances being similar; and so little would it be able to resist rain, that Professor Johnston says, "the thickest deposits would be washed away, or dissolved, during a single year of English weather."

A few details respecting the Puruvian guano may now be interesting. There are three varieties of it—red, dark grey, and white: this difference of color arises from difference of age or exposure to air. The best guano is said to be furnished by the Chincha Isles (near the Peruvian coast); these are three in number, each about five or six miles in circumference. Their surface is of granite, and very uneven, and is covered with guano—in some places to a height of 200 feet up the sides of the elevations. The guano occurs in assemblages of horizontal strata, each stratum from 3 to 10 inches thick, and it is almost entirely free from earthy matter. In some parts the guanno is only from 3 to 4 feet thick. It is worked and excavated like mines of Iron ochre. There are some places on the mainland of Peru, where owing to the neighbourhood of sand hills, and the occasional winds, the guano which has been deposited is covered entirely by sand, and its decomposition, therefore, considerably retarded. The shipping port, as already mentioned, is Equique. I am not acquainted with the method of packing the guano, but should thing that, at all events, a suggestion of Professor Johnston's, that the guano should be *rammed hard*, would be well worth adopting. This would considerably retard its decomposition, and the loss of the volatile and valuable constituent, ammonia, would be nearly prevented.

The price of Peruvian guano is about £10 a ton, but was some time ago considerably higher.

The effects of guano, when applied as manure, are most beneficial and remarkable. They are most striking when exhibited on the sandy plains of Peru, which, according to Humboldt, would be *altogether barren* without it. Roussingoult says that, in Peru, the soil, composed only of white sand and clay, yields the richest harvest of maize by being manured with guano. From 600 to 700 tons of it are annually sold for the use of the inhabitants around Arequipa: they employ it, principally, as manure for their crops of maize and potatoes. In Taracapa, Tambo, and Victor, all in Peru, the quantity used is much greater, because they employ it to manure wheat, and all kinds of fruit trees, and plants, with the single exception of the sugar cane. The quantity they employ, in Arequipa, is about 3 cwt. to the acre; in the other places mentioned, 5 cwt. to the acre are required. The produce, in potatoes, is 45 to 1; in maize, 35 to 1.

The Peruvian coast, from Arica to Chaucay, a distance of 200 miles, is manured almost with guano. Its beneficial effects, as well as its origin, were indeed so well known to the ancient government of the Incas of Peru, that it was made a capital offence to kill the young birds on the guano islands; and to carry this enactment into effect, each of these islands had what we should call an overseer.

Guano is particularly adapted to be useful to vegetation in climates where little rain falls. It attracts moisture very quickly from the atmosphere: indeed it always feels very damp: and Professor Johnston found that an average specimen absorbed six per cent, of water from the air, during ten day's exposure to it. This property alone would make it useful to plants in the climates mentioned; but when we find also that many of the most important constituents of guano are readily soluble in water, and can therefore be taken up at once by the plants when the scanty rains of these climates happen to fall, we can the more easily credit its great and peculiar fertilizing effects on the arid soils of Peru.

In the United Kingdom, though its effects have not been found so great as in Peru, yet the experience of some years, and of a great number of trials, under a great variety of circumstances, shows that these effects are generally and greatly beneficial. Some cases indeed of failure have occurred; partly, no doubt, from the guano not being of good or uniform quality; partly from peculiarities of the soil or the season, which would have more or less affected any kind of manure; but, on the whole, it is not too much to say that guano has been almost universally found of great benefit in agriculture. It appears to be servicible to all kinds of crops, but particularly to turnips, potatoes and wheat. It sometimes increases the crops of grain, turnips, potatoes, and grass to the amount of 33 per cent. On this point however, it is not necessary to enter into any detail; for every one at all acquainted with scientific agriculture must have observed many instances of its remarkable and beneficial effects. It is preferable to common animal manures because it is far superior in real value, for more portable, and more easily applied. These manures generally contain only 20 per cent. of food fit for plants, whilst almost the whole of good guano is fitted for their use. It is estimated to be four times better than the best dove-cot manure, which, of all animal munures, approaches nearest in kind to guano. The high estimation in which it is held be most agriculturists is amply supported by the opinion of the highest living authority on agricultural chemistry. Liebig states that the importation of 1 cwt. of guano is equal to that of 8 cwt. of wheat, that is, 8 cwt. can be obtained by the proper application of 1 cwt. of guano.

The *chemical composition* of guano is very interesting, because from it only can we learn why it is so beneficial to vegetation. Different specimens vary greatly in composition, owing to differences in age, in the degree of dryness of their locality, or in their more or less free exposure to air and light. The *white* or *recent* guano is of course the most valuable, because it has lost nothing by the action of the weather, as the more ancient kinds have; but of, it we possess no detailed analysis. But we have analyses of the excrements of the gannet and of the sea-eagle, which are both sea birds, and, like those which deposit guano, live mostly on fish. The excrements of the gannet consist almost entirely of *uric acid* (a compound of carbon, oxygen, dydrogen, and nitrogen). Those of the sea eagle are thus constituted, per cent.:—

Solid excrements.

Ammonia	9.20
Uric Acid	84.65
Phosphate of lime	6.13

Dried liquid excrements.

Uric acid	59
Earthy and alkaline phosphates, sulphates, and chlorides	41

There can be little doubt that *fresh Guano* is of a nearly similar composition; and with very little chance of error we may consider it as containing from 60 to 80 per cent. of organic substances, of uric acid and ammonia; the remainder being chiefly earthy phosphates with alkaline sulphates and chlorides. Knowing the circumstances to which this guano has been exposed, and knowing likewise the properties of uric acid, it is easy to anticipate the changes which will take place. An unusually heavy dew or a slight rain will enable the oxygen of the air to act on the uric acid, and produce from it urea, oxalic acid, and ammonia, among other compounds. This action will be slow, but, continuing for long periods of time, will gradually cause the dimunition of the uric acid, till it disappears entirely. Some of the ammonical compounds which results from this action, and especially the most important and abundant —*carbonate* of ammonia, being volatile, will be continually emitted. To such an extent is this the case in one of the Guano islands, that ships cannot approach it, on account of the pungent and fœtid vapours that surround it. From these considerations, it is manifest that the fresh guano will gradually change greatly in composition, according to the dampness of the air, and the length of time since it had been desposited. Its uric acid will diminish, and become, in a great measure, converted into volatile ammonical compounds, which will escape into the atmosphere. The phosphate of lime, and other earthy and alkaline salts, being little liable to change, will accumulate in the mass, and constantly increase in proportion to the organic compounds. The spray from the ocean will communicate to the guano common salt, and some other substances, and will have a tendency to hasten the decomposition above explained.

The following analysis of guano are the best that I have been able to find. Their results are such as the explanation just given would lead us to expect. The first analysis is by Dr. Ure; it was made on an average specimen of good *Bolivian* guano, of a pale yellow color, dry, and partly in lumps, partly pulverulent. It contained 24 per cent. of matter soluble in water. Of all the analysis of guano that I have seen, this seems to be the best; and the specimen was evidently much nearer the normal state than guano generally is. It contained per cent.—

(1.)

Urate of ammonia	15.27
Phosphate of ammonia, a little oxalate of ditto, and urea	11.10
Undefined organic matter capable of giving 17 per cent. of ammonia	41.73
Phosphate of lime, with some phosphate of magnesia	10.25
Common salt, and sulphate of potash	12.90
Silica	2.25
Water	6.50

The second analysis is by Professor Johnston, and was made on a brownish red specimen from Peru. It contained per cent.—

(2.)

Ammonia	7.00
Uric acid	0.80
Water, carbonic acid, and oxalic acid, expelled by a red heat	51.50
Phosphate of lime	29.30
Common salt, with a little sulphate and phosphate of soda	11.40

The third analysis is by MM. Fourcroy and Vauqulin, and gives per cent.—

(3.)

Urate of ammonia	9.00
Oxalate of ditto.	10.60
Phosphate and nuriate of ammonia	10.20
Water and organic matter	32.30
Phosphate of lime and magnesia	16.90
Oxalate of lime	10.60
Sulphates of potash and soda	8.90
Clay and sand	4.70

The fourth specimen (from South Ameriea,) was analyzed by Mr. J. D. Smith, and contained per cent.—

(4.)

Uric acid and urate of ammonia	17.92
Oxalate of ammonia	7.40
Muriate and phosphate of ditto.	8.80
Organic matter	8.76
Phosphate of lime, with some phosphate of magnesia	22.00
Oxalate of lime	2.56
Sulphate of potash	8.00
Water	22.00

We are now in a condition to understand why good guano promotes the growth of plants so powerfully: it is because it contains a very large quantity of some of the most indispnseable parts of the food of plants, and in a state very well fitted for being assimilated. All plants require, as food, the elements car-