SESS. II.—1891.
NEW ZEALAND.

SCHOOL OF AGRICULTURE, LINCOLN

(REPORT OF DIRECTOR OF), FOR YEAR ENDED 30TH JUNE, 1891.

Laid on the Table by the Hon. Mr. J. McKenzie, by Leave of the House.

The REGISTRAR, Canterbury College, to the Hon. the MINISTER of LANDS.

SIR,— Christchurch, 18th August, 1891.

I have the honour, by direction of the Chairman of the Board of Governors of Canterbury College, to forward herewith the report of the Director of the School of Agriculture, Lincoln, for the twelve months ending the 30th June, 1891, together with Appendices Nos. 1 to 10, inclusive, attached thereto.

I have, &c.,

The Hon. the Minister of Lands, Wellington. A. CRACROFT WILSON, Registrar.

The DIRECTOR, Agricultural College, to the CHAIRMAN, Board of Governors, Canterbury College.

SIR,— Canterbury College, School of Agriculture, Lincoln, 23rd July, 1891.

I have the honour to submit my report for the twelve months ending the 30th June, 1891.

College.—The year has been a fairly successful one. During the second term, 1890, the number of students was forty-one, whilst for the first term, 1891, the number was forty-five. Several applications for admission have had to be postponed, the accommodation for students having been fully occupied.

The work done by students is about up to the usual standard. There is a fair proportion of good workers, but I should much like to be able to report an improvement on the part of the majority. I cannot say that reducing the fee to £40 per annum has given us a more industrious or intellectual class of students, though the reduction to that amount has resulted in filling the school. To have to deal with listless, dull, lazy, in fact, useless youths, is most disheartening to the teaching staff, and, as these always claim to have been here, their presence is a positive injury to the institution.

At the last annual examination the final certificate was awarded to students A. E. Fuller, T. P. Clark, and Robert Murray.

I am very glad to know that the University Senate has before it the question of recognising agriculture by conferring a degree on similar lines to the B.Sc. in Agriculture of the University of Edinburgh. I have several times brought forward the question of making our final certificate of more importance, and I gladly welcome this proposal of the Senate, trusting, however, that the taking of this degree may not be practically placed out of the reach of our students by the insistance upon the observance of conditions difficult to be complied with. Such, for instance, would be residence in Christchurch, after passing a certain time here, for the purpose of completing the science course. We have, I think, sufficient convenience here for students attaining to the necessary standard, but if we cannot prepare students for an University examination in subjects pertaining to agriculture, means should be found for the schools so doing, for I feel assured that this suggested condition of compulsory attendance at lectures in town will render almost nugatory the otherwise most valuable proposition of the University Senate, for very few agricultural students either could or would afford time and money to pass a considerable time in town. And the question of ways and means would especially be a most important one for scholarship students, amongst the ranks of whom I should expect to find the largest number of candidates for the honour. But until agriculture is introduced into the State schools as one of the subjects of tuition, there will always be a lack of interest in the subject on the part of the cleverer boys, to whom we should look for an annual draft—by means of scholarships granted to the most deserving—into this technical secondary school, where they should work up for University honours. This question of agriculture in State schools and scholarships is from time to time brought forward by one or another as something new, but I should like to state that in nearly all my reports for the last eleven years this subject has been more or less fully noticed.

The increased number of students rendered necessary increased supervision and direction on the farm, and Mr. W. H. Alington was appointed farm overseer out of some thirty-five applicants. This appointment has answered expectations.

To show how students have been employed I append copy of time-table in force (Appendix No. 10).

The cost of students has been somewhat larger than last year, owing to the higher price of meat during the latter part of 1890, and in consequence of an increased outlay for fuel, owing to the labour troubles of the same period. For the six months, July to December, 1890, the cost for food, fuel, and light was £12 12s. 2d. for each person in the establishment, and for the last six months £11 7s. 7d., or a total of £23 19s. 9d. per annum. Adding to this servants' wages, the cost was for the year £38 1s. 5d. for each student and member of the teaching staff; or, compared with the cost at Dookie College, adopting the same method of calculation, and including the same items, which resulted in the figures given by the late Royal Commission, the cost was: Dookie, 1889, £25 2s. 6d.; Lincoln, 1889-90, £27 3s. 5d., and 1890-91, £28 19s. 8d.

The College buildings are all in good order. Some improvements, such as the provision of a room for the farm overseer, were found necessary, and there was some expenditure upon improving the drainage, by which the whole of the drains can now be thoroughly flushed; but there will be little expenditure required next year beyond a little painting and casual repairs. It has been found necessary to furnish several bedrooms owing to the increased number of students, the cost of which was not included in the estimates.

Farm.—The farm year has been a most unsatisfactory one in consequence of the drought. The rainfall for 1890 was only 14·836 inches, the average being 26·739 inches (see meteorological tables, Appendix 3). All crops looked very well until November, but then began to suffer. The yield was the smallest yet harvested (see Appendix No. 5). Not only did the grain suffer, but grass, clovers, and green crops likewise, and, added to this, our turnip-crop, which promised exceedingly well, has been all but destroyed by the caterpillar of the diamond-back cabbage-moth (*Platella cruciferarum*), so that we have only about two-thirds the number of sheep we usually carry during the winter. The returns are therefore poor. But, beyond this, all experimental work initiated has been without reward. Nothing is much more disheartening than finding a season's time and trouble giving no results. Especially was this the case with the numerous manure experiments (see Appendix No. 8), but even the large number of wheats sown could not be judged as to value. The number of varieties of wheat has been increased to some eighty-five (see Appendix No. 7). I am indebted to Mr. Farrer, of Queanbeyan, New South Wales, for a great number of these wheats; others have come to me from England, America, Australia, and New Zealand. Of the hundreds of varieties of wheat tried on the farm (see former reports), but few have shown more useful qualities than those ordinarily grown and acclimatised in the colony. In fact, it is seldom that an imported wheat can be properly judged the first or second year of growth here. However, all but one of the wheats grown on the farm in the ordinary course are the produce of samples imported quite lately either by myself or others.

The new shearing-shed has been completed, and fitted with Wolseley shearing-machines. It has proved a great convenience to us. All the farm-buildings, machinery, and implements are in good condition, though more shed-room is required for the latter. We may be able to add to the available space during the year, under the supervision of the farm mechanic.

The only addition of importance to the implements has been the strawsonizer. This invention answers its purpose admirably, both as a distributor of manure and as a sprayer. This adds another to the number of implements first introduced on this farm. Of those more or less in general use, and which were first used here, may be mentioned the digging-plough, the disc-harrow, the water-drill, the cream-separator (in its early form), the hay-sweep, &c. The strawsonizer was specially imported with a view to trying to protect the turnip-crop from the cabbage-moth caterpillar already mentioned, but all applications have failed. These comprised kerosine emulsions and arsenical solutions of various strengths. The fact that the caterpillar works on the underside of the leaf presents a difficulty to treatment by spraying, but it was thought that by poisoning the leaves the caterpillar would be killed on reaching and feeding upon the poisoned spot. The increase of the insects was, however, so rapid that no practically good effect was noticeable. Birds, particularly the starling, collected in the infected crops in great flocks, but without perceptibly checking the ravages of this pest, which this year not only consumed all the leaves, but even penetrated the bulbs, often to the depth of a ¼in. This attack is a most serious matter, as it materially affects the winter supply of mutton for freezing and export.

Much work has been done in improving the lower part of the farm in draining springs, filling up dangerous swampy places, which there abounded, and in general levelling, &c. This work has been continued every autumn whenever horses were available, and, I am glad to say, with results which are now very visible in the improved appearance of this portion of the College estate. I am not sorry to be able to say that there is not much more similar work to be done, as there is little to show for the expenditure to any one not thoroughly acquainted with the former condition of this part of the farm.

The supply of water in the water-races has not yet been sufficient to enable us to irrigate even experimentally, for which purpose, no doubt, the Selwyn County Council would have allowed us to use superfluous water. I understand that the supply will be next summer greatly increased, so that irrigation experiments projected some time since may then be put in hand. Last summer being an exceptionally dry one, the demand for water was greater than the races could always supply, so much so, that I had actually to cart water for some of the stock in November last. Under such circumstances it would be folly to attempt irrigation.

The sheep-crossing experiments have been continued, and promise fairly well, especially where there-fourths Leicester blood has been used. The half Leicester and merino crosses have not kept their size, though the quality is excellent. For netting on turnips I much prefer the three-quarter Leicester type, where the coarser woollen sheep have been rigidly culled.

The reports of the examiners in practical agriculture upon the farm, &c., have been before you.

Besides the various experiments with manures on roots and grain—those on wheat being given in detail in Appendix No. 7—many connected with the germination of grain under different conditions have been carried out, more especially in connection with dressings for the prevention of smut. Bluestone is undoubtedly a preventive, but is often so injurious to the seed that some other remedy easily applied would be most valuable. Many a thin wheat crop is the—often unsuspected—result of bluestone pickling. Last year several specimens of injured seed wheat were received, with inquiry as to the cause, which was very evidently this practice.

Following up the experiments of Jensen, of Copenhagen, many trials of the effects of hot water have been made. These are detailed in Appendix No. 9. The field experiments were conducted on specially obtained smutty wheat. It is too often the case that suggested remedies are tried on the ordinary seed wheat of the farm, and successful results published, *i.e.*, as to absence of smut in the crop, but all farmers know that seed free from smut does not need pickling. No trial is therefore of any value unless made on wheat to which spores of the fungus are adhering. I find that the plan stated in evidence by a New South Wales farmer (see *Agricultural Gazette* of New South Wales) that dipping wheat for half a minute in water at a temperature of 160° to 170° Fahr. is a certain cure for smut and is in use in his neighbourhood is destructive of the seed. Of golden-drop wheat treated in this way only one-half grew, and much of that was weak, the radicle generally suffering. Of rough-chaff only one-third grew, whilst white tuscan was all destroyed.

Some few new plants have been grown experimentally. For instance, all the more likely varieties of sorghum have been tried, with a view of increasing our summer feed. Our climate is, however, too cold. Several varieties of American grasses have also been cultivated to the same end. Some of these show more promise. Other plants, as the newly-revived serradella, a madia, several "bee" plants have been tried on a small scale. The most valuable importation is, I think, the zig-zag clover (*Trifolium mediam*)—the true English cow-clover. This will grow on lighter lands than the ordinary red-clover, and that sown promises well. The Jersey tree-cabbage and the purple-branching broccoli were also imported, and sown with our turnip-crop, but, unfortunately, these suffered the same fate as other members of the brassica tribe, being destroyed by the cabbage-moth caterpillar.

Sugar-beet is again under trial, newly-imported seed having been kindly sent me by Mr. A. Werner, of Doyleston, who has also lately forwarded for analysis samples of beet-roots grown by several farmers in his neighbourhood. These are under examination by Mr. Gray, but, from the coarse appearance of most of the roots, I have no great expectation of the yield of sugar being larger than in roots examined in several previous years.

Our specimen grass-plats have been kept up, but much more ought to be done in the way of grazing trials, both with respect to yield, fattening qualities, and effects of grazing on various grasses. These I hope to be able to take in hand now that I have assistance on the farm. Mr. Gray has collected samples for analysis at least twice, but for want of time has been unable to proceed with the work.

The report of Mr. Gray upon the work of the chemical department is appended (see Appendix No. 1). This will show how much valuable work has been done in our chemical laboratory, and I should like to point out that this work is done in addition to teaching students both in the lecture-room and the laboratory, and that the time at Mr. Gray's disposal is altogether too short, even for the completion of analysis of manures or for the public, so that original investigation or research is perforce neglected. So great is the pressure on the little time that can be given to this analytical work, that analyses for the farm have stood over, and only that which seems most valuable to the public has been completed, leaving undone altogether at times such less important work as soil analysis. Even as it is reports are often necessarily delayed through sheer inability to spare the time for examination of the samples received.

As much misconception and ignorance exist as to the value of soil analysis, and as some people show annoyance at their request for analysis being at times declined, I have thought it desirable to write a short paper on this subject, which I append (Appendix No. 4).

The most valuable results from our chemical work are the outcome of the examination of manures. There has been a great deal of low-class manure sold at a high price, and even now a sample at times turns up, though, owing to our reports, some districts of the colony have been almost cleared of these, a good class of manure taking their place, to the great benefit of farmers. Still, so long as the farmer will listen to the prating of the seller that "results" is the test of the value of a manure, so long will he be liable to be taken in. For it is very well known to what substances increased crops are due, and therefore, though it may be that a poor manure has in a certain season and on certain land given good results, which cannot be denied, there is no doubt that a smaller quantity of a good manure, containing a like quantity of these useful substances, would have given like results at a very much lower cost. And there has been very much money thrown away on almost worthless rubbish, which might have been saved had farmers a knowledge of this subject, and were they not so easily led away by a glib tongue. I am aware that we have got into very bad odour with some manufacturers, but the annual saving to farmers has been very large, and I am prepared to show that by causing the substitution of good manures for fraudulent or poor ones we have more than saved to the colony the total cost of this institution.

A good Act of Parliament would assist in the work of sweeping away worthless or poor manures by giving legal protection to persons exposing those offering such articles for sale, and by giving the farmer a remedy against fraud. But an Act to be really useful must not unduly hamper manufacturers by imposing irritating conditions. In fact, if the farmer would buy his manure on analysis with a fixed allowance for deficiencies, he can protect himself without further legislation.

Mr. Gray speaks for himself in his report, but, in connection with this subject of manures, I would direct particular attention to some instances where analysis alone has shown great discrepancy in the value of samples of manure very similiar in appearance, and offered in the market at about the same price. And of other instances of what must be characterized as fraudulent manures, and, lastly, of cases of gross adulteration.

Take, firstly, superphosphates, Nos. 578 and 747, both English. No. 578 contains 9·3 per cent. of soluble phosphate; No. 747, 24·93 per cent., the values being £4 7s. and £8 per ton, though the selling prices were about alike. Look again at the Chesterfield Island guanos, and the Akaroa guanos; the values of the former range from £1 12s. 3d. to £3 16s. 4., and the latter from £1 11s. 6d. to £9 11s. per ton. Yet in the market—at any rate, in Chesterfield guanos—little difference existed in the selling price of the various samples. Next look at Nos. 681, 762, 119, 125, and 118; these are poor samples, requiring the penal clauses of an Act of Parliament to deal with them. Whilst, as for adulteration, samples of bonedust, Nos. 387, 452, 762, 774, show it in various degrees; the value of these, when compared with that of good samples, such as No. 447 or No. 682, being the best test of the extent to which farmers are at times fleeced.

I have said that good manures have, to a great extent, taken the place of the inferior ones in several districts of the colony, and this applies particularly to those manufactured in New Zealand. For instance, samples of superphosphate and of dried blood, obtained from the Belfast works, are now excellent of their kind, and, in the case of the first-named, were last year as cheap as the imported, whilst the latter is cheaper than any manure of its class that I know of. A report on the work done in the natural science department is also attached (see Appendix No. 2). This also speaks for itself with respect to the work done, and hardly needs reviewing by me.

Mr. Wilkinson's examination of seeds shows the existence at times of adulteration, of substitution, and that old and weak seed is sometimes sold. This, though I know that but few of the really bad samples of seeds on the market reach us, for obvious reasons. I would, however, direct attention to Mr. Wilkinson's observations respecting the presence of seeds of the creeping (here called the California) thistle in samples Nos. 154 and 226, both alsike clover. In one case, one of the seeds found was sown in our garden, and produced a very fine specimen of this dreaded weed. This was carefully dug up and all discoverable roots destroyed, but during the autumn I myself dug up from time to time twenty-five shoots from small pieces of root left behind after the thorough digging-out the plant had been subjected to. Few have an idea how difficult it is to get rid of this weed, and how easily it may be introduced to the land. It is evident that growers of alsike should be particularly careful that the seed purchased by them is quite free from the seed of this thistle.

The work done in the orchard in attacking the scale insect is of considerable interest, but much more requires to be done in this direction.

It will be noticed that a small apiary has been started, which should afford much information to those who care to follow up the proper treatment of the honey bee.

Certain meteorological tables that are of interest are attached to this report. Mr. Wilkinson has, at my desire, divided the observations for the last nine years into periods of four months, representing as nearly as may be—consistent with retaining the totals of each calendar year—the periods during which growth is almost stagnant; that during which it is most rapid; and, lastly, that including the months of ripening and harvest.

It is in connection with this table—my table showing the yields of grain be referred to—it will be seen that there is a close connection between yields of grain and seasons, particularly with respect to rainfall—both quantity and regularity, and also time of fall—and to temperature. Undoubtedly season affects returns more than systems of cultivation or manuring, or aught else. The number of frosts occurring during the year will probably surprise many. The rainfall of 1890—viz., 14·836in. was by far the lowest recorded here. The record of 1891, so far, is, however, anything but promising for a good season, for during the five months, March to July, there has been even less rain than during the same months of 1890—viz., 6·69in. to 8·27in. It is true that we had nearly 6in. in January and February of this year, but these summer rains hardly ever reach the subsoil, so that we have at present the prospect of having to meet even a drier time than the summer of 1890. For August is really now the only month during which we may expect rains sufficient to wet our subsoils to such a depth as would furnish moisture from below to our crops during next summer.

I have, &c.,

The Chairman, Board of Governors. W. E. Ivey, Director.

APPENDICES.

APPENDIX No. 1.

CHEMICAL DEPARTMENT.

Dear Sir,—

I beg to hand you herewith my report for the year ending the 30th June, 1891.

In the place of the usual *résumé* of the work done in the chemical laboratory, I have in the present instance, dealt with manures alone, since I venture to think that the information obtained when collated in this way will be of greater interest and value.

Samples of manure have been received from all parts of the colony for analysis, and the results here given fairly represent, I think, the quality of the various manures obtainable in New Zealand generally. Other results, which have accumulated from the analysis of milk, soil, &c., are reserved for future reports.

Yours, &c.,

W. E. Ivey, Esq., Director. George Gray, Lecturer on Chemistry.

A Review of our New Zealand Manure Supply.

During the last few years a considerable number of manures have been received from farmers and others for analysis, and it has been thought desirable to review the results obtained, so as to give a general idea as to the quality of the various manures obtainable in New Zealand.

In carrying out this work the present resources of the chemical laboratory have been fully utilised, and although the results in some cases have not been furnished as promptly as could be wished, there is reason to believe that the value of the work is fully appreciated; and several cases have occurred where the information given has been the means of checking the sale of manures of doubtful character.

Our requirements with regard to manures are year by year increasing, and it is important that consideration should be given to the quality and composition of the manures available, since on this depends, not only their power to produce the desired results, but also their money value to the farmer.

The system of special manuring demands that the manure added to the soil should contain the food constituents most needed by the crop under cultivation, and if these are absent or present in a condition not suited to the requirements of the crop, then the full effect will not be produced, and loss may result. It might be well here, perhaps, to mention that experience and experiment have shown that under existing conditions grain crops and grasses are assisted most in their growth by nitrogen manures; that root-crops require soluble phosphates; and that liguminous plants, such as beans, peas, &c., are improved by potash manures. These facts should be borne in mind in the selection of manures for special crops. The influence of general manures, such as farmyard manure, on any given crop is largely due to the action in this way of one or two of its constituents, and not on the whole of the food constituents contained in the manure.

Bonedust.

The samples of bone received have mostly been in the form of bonedust, but few coarse samples having been sent. Nearly all were well ground and in good mechanical condition.

The manurial value of bones depends to a certain extent on the treatment they receive before reaching the farmer. In the natural condition bones contain about 33 per cent. of organic matter, and about 66 per cent. of mineral matter. With the exception of a little fat, the former consists of a nitrogenous substance, ossein, which contains about 18 per cent. of nitrogen. The mineral portion consists mainly of tribasic phosphate of lime, with small quantities of calcium carbonate and other salts. The fat present, by protecting the bone, retards its decomposition in the soil, and it is generally the custom of the manure manufactures to boil or lightly steam the bones in order to remove the fat. When, however, the operation is carried too far the ossein is also more or less removed. Glue is generally prepared from bones in this way by subjecting them to a temperature of about 150° with steam under pressure. This treatment of course decreases their value by owering the percentage of nitrogen. At the same time both boiling and steaming have a great Influence on the mechanical condition of the bone, allowing it to be ground finer, and this admits of its better distribution through the soil, and consequently quicker action. Exposure to weather has somewhat the same effect as boiling and steaming, but requiring considerable time. A loss of nitrogen frequently results from the practice of heaping the bones together after boiling or steaming, by which fermentation is produced, and a considerable amount of nitrogen, in the form of ammonia, is disengaged. In all probability the bones are rendered still more friable by this treatment, but it is at the expense of the most valuable of its constituents, nitrogen.

Table I. gives the composition of the New Zealand prepared samples of bonedust that have been examined, together with that of a few imported samples.

Table I.—Analysis of Bonedust.

Laboratory No.	District received from.	Moisture.	Organic Matter	Silica.	Tricalcic Phosphate.	Calcic Carbonate.	Alkalies, &c.	Nitrogen.	Percentage of Nitrogen in Organic Matter.	Ratio of Tricalcic Phosphate to Organic Matter.	Money value per Ton. £	s.	d.
P 2	College farm	7·62	33·60	12·70	40·75	5·45	0·60	3·61	10·7	10–8·2	5	11	6
G 1	Christchurch	8·17	31·05	3·26	49·21	7·71	0·60	2·87	9·2	10–6·3	5	19	9
G 2	"	9·60	26·55	4·60	47·59	9·54	2·12	3·74	14·0	10–5·5	6	6	6
G 3	"	4·95	33·05	1·22	51·38	5·11	4·29	3·57	10·8	10–6·4	6	10	9
17	Leeston	4·00	33·48	17·72	38·55	5·40	0·85	2·23	6·8	10–8·6	4	13	6
26	Auckland	5·65	38·09	6·48	40·15	8·55	1·08	2·07	5·4	10–9·4	4	15	0
50	Belfast	6·75	35·65	6·46	41·26	8·56	1·32	2·57	7·2	10–8·6	5	2	0
120	"	5·25	35·19	6·43	46·67	3·30	3·16	2·57	7·3	10–7·5	5	12	0
146	"	6·44	38·36	6·23	44·61	3·07	1·29	2·52	6·5	10–8·5	5	7	6
255	Springston	8·00	33·80	9·34	42·70	4·00	2·16	4·27	12·6	10–7·9	6	1	9
350	Invercargill	6·75	32·63	2·70	47·00	7·80	3·12	3·38	10·3	10–6·9	6	0	9
351	"	9·15	35·36	2·08	43·55	5·72	4·14	3·92	11·0	10–8·1	5	19	9
387	Fairlie Creek	8·25	48·15	11·17	23·54	8·81	0·08	1·75	3·6	10–20·4	3	1	0
384	Auckland	9·15	33·75	3·58	46·87	5·98	0·67	2·17	6·4	10–7·2	5	8	6
395	Walton	8·62	34·43	3·50	42·27	8·88	2·30	3·08	8·9	10–8·1	5	19	0
396	"	8·05	32·30	5·45	49·05	3·86	1·29	3·36	10·4	10–6·5	6	4	3
403	Greendale	7·90	32·45	13·30	39·24	5·44	1·67	2·59	7·9	10–8·2	4	18	6
452	Methven	8·97	27·37	26·68	33·46	2·65	0·87	3·08	11·2	10–8·1	4	12	6
517	Piako	5·60	24·20	3·78	54·20	9·64	2·58	1·82	7·5	10–4·4	5	18	6
518	Waikato	8·05	24·29	9·58	49·10	8·30	0·68	2·80	11·5	10–4·9	5	18	9
634	Auckland	9·80	38·76	0·75	46·07	2·80	1·82	3·92	10·1	10–8·4	6	4	6
654	Invercargill	8·66	43·48	1·38	42·70	2·80	0·93	4·83	11·1	10–10·1	6	7	3
682	Timaru	39·22		1·38	52·32	7·08		3·29	10·4	10–6·0	6	9	8
683	"	39·96		6·20	50·57	3·27		3·29	10·2	10–6·3	6	6	6
685	Oamaru	52·04		5.28	29·90	12·78		4·48	10·1	10–14·0	5	0	0
755	Christchurch	32·66		4·58	56·68	6·08		2·52	10·0	10–4·4	6	10	0
756	Walton	45·88		4·96	40·98	8:18		3·36	8·7	10–9·3	5	9	6
762	Temuka	30·46		21·42	35·20	12·92		2·73	11·9	10–6·4	4	12	6
764	Christchurch	45·30		7·16	40·70	6·84		3·92	10·4	19–9·2	5	14	6
827	Auckland	37·84		6·26	45·00	9·40	0·90	2·87	9·5	10–6·7	5	12	0
829	Timaru	52·88		1·20	36·40	7·84	1·68	4·48	9·9	10–12·4	5	12	0
832	Waikato	46·00		2·05	45·20	4·90	1·85	3·43	8·9	10–8·4	5	18	0
885	Christchurch	43·52		12·68	35·30	6·00	2·50	4·06	11·3	10–10·1	5	6	0

Analysis of imported Bonedust.

Laboratory No.	District received from.	Moisture.	Organic Matter.	Silica.	Tricalcic Phosphate.	Calcic Carbonate.	Alkalies, &c.	Nitrogen.	Percentage of Nitrogen in Organic Matter.	Ratio of Tricalcic Phosphate to Organic Matter.	Money value per Ton. £ s. d.
383	Auckland	10·83	31·90	2·65	48·85	5·79		3·27	10·2	10–6·5	6 3 0
385	"	8·90	31·62	2·02	48·39	9·79		3·22	10·1	10–6·5	6 1 9
404	Waikato	7·15	24·65	7·00	48·83	9·77	2·60	3·15	12·7	10–5·0	6 1 9
447	Christchurch	6·35	29·33	4·40	53·19	4·57	2·16	3·43	11·6	10–5·5	6 12 9

Nos. 383 and 385 are Australian samples. Nos. 404 and 447 are from Calcutta.

The money values of the manures, of which analysis are given in this report, have been kindly fixed by Mr. W. E. Ivey, Director of the school.

Our New Zealand bonedust, as a whole, would be much improved if it contained less sand or silica. Of the thirty-three samples of which analysis are given, twenty-two, or 66 per cent., contain above 4 per cent. of sand, which is a liberal allowance to the manufacturers. In the worst samples, Nos. P2, 17, 387, 403, 452, 762, and 885, its presence to the extent indicated must be attributed to something more than carelessness in preparation, and can only be considered as wilful adulteration. Pure bonedust contains no silica, or at most a very minute trace, and its presence in the bonedust is due to contamination by earthy matter. Bones are often allowed to lie about in pig-yards and become covered with mud and dirt, and then, without cleaning, are ground-up and sold to the farmer. It is possible with ordinary care to prepare commercial bonedust so that it shall contain 1 per cent. of sand.

The ratio of phosphates to organic matter in pure bone is about 10 to 5, but in the samples referred to the relative proportion of organic matter is in many cases above this. This is due to the presence of animal matters, such as dried flesh and blood, hoof, horn, hair, &c., and the nitrogen present in these bodies compensates to some extent for the loss of nitrogen that may have taken place from the causes previously mentioned, such as steaming, fermentation, &c. The ratio between the phosphates and the organic matter is shown in the table of analyses. The results may be considered in the following way: If the ratio is much wider than 10 to 5, then extraneous organic matter is present, if much below this, then the organic must have been reduced by steaming or fermentation. That the excess of organic matter present is less rich in nitrogen than that contained in pure bone, is also shown by an examination of the columns giving the percentage of nitrogen in the organic matter present. The dry organic matter, or ossein of pure bone, after the removal of the bone, contains about 18 per cent. of nitrogen, and, although it is not to be expected that, in an article like commercial bonedust, this degree of purity will be reached, yet the results generally might be higher. No. G2, if we accept the silica, which is above what it should be, is a good typical bonedust in this respect, while in No. 387 we have a bonedust containing nearly one half its weight of organic matter, and this giving only 1·75 per cent of nitrogen, while, in addition to this, it is adulterated with 11 per cent. of sand.

The Royal Agricultural Society of England gives the following recommendations to the purchasers of manures: "(1.) Raw or green bones or bonedust should be purchased as 'pure' raw bones, guaranteed to contain 45 to 48 per cent. of tribasic phosphate of lime, and to yield not less than 4 per cent. of ammonia (= 33 per cent. of nitrogen). (2.) Boiled bones should be purchased as 'pure' boiled bones, guaranteed to contain from 55 to 60 per cent. of tribasic phosphate of lime and to yield not less than 1 per cent. of ammonia (= 0·82 of nitrogen)."

The Highland and Agricultural Society of Scotland gives as the range of phosphates in bonemeal (raw) 44 to 45 per cent. and from 4 to 5 per cent. of ammonia, and in steamed bones 56 to 65 of phosphates and from 1 to 2 per cent. of ammonia.

An American authority, Professor Johnston, considers that bones which contain less then 19 per cent. of phosphoric acid (= 41·47 per cent. of tribasic phosphate of lime) and more than 5 per cent. sand should be considered adulterated.

Phosphatic Guano.

Shipments of phosphatic guano frequently reach New Zealand from the Chesterfield and other islands, and appear to be much appreciated in some districts for turnip-growing, especially in Southland. These phosphatic guanos are formed from the deposits of sea-birds, the soluble constituents having been removed by rain. That from the Chesterfield Islands (Long Island, &c.) seems to be most in request, the other kinds being imported more for the manufacture of superphosphate of lime.

Table II.—Analyses of Chesterfield Island Guano.

Laboratory No.	District received from.	Moisture.	Organic Matter.	Silica.	Tricalcic Phosphate.	Calcic Carbonate.	Alkalies, &c.	Nitrogen.	Money-value, per Ton. £ s. d.
63	Timaru	6·62	11·84	0·06	34·93	42·60	3·95	0·98	3 16 4
152	Invercargill	2·85	8·63	0·26	19·90	65·20	3·16	0·14	1 18 6
190	Christchurch	7·34	14·54	0·08	17·90	59·32	0·82	0·33	1 17 0
271	Dunedin	12·38	5·00	0·40	29·40	50·11	2·71	0·53	3 0 9
295	Auckland	7·31	8·75	0·34	27·86	43·67	2·07	0·10	3 11 0
352	Invercargill	4·30	11·88	0·22	27·50	51·55	4·55	0·47	2 16 6
390	Springston	4·25	8·51	0·36	15·58	68·56	2·74	0·28	1 12 3
391	Thornbury	4·12	8·68	0·14	28·56	56·80	1·70	0·49	2 18 9
890	**Christchurch .. ..**	**14·20**		**0·18**	**34·70**	**50·80**	**0·12**	**0·56**	**3 10 10**

The above are low-class manures, with an excessive amount of calcic carbonate in the form of coral, shells, &c. If some means could be devised so that the guano could be screened before leaving the islands its value would be increased. The value of phosphatic guanos depends upon the percentage of tricalcic phosphate present. Although no doubt on many of our New Zealand soils the cabonate of lime would be beneficial, yet, where it is desirable to apply lime, it could be done in a cheaper way. One important feature in the Chesterfield guano is the small amount of sillca it contains. It is generally dry and in good mechanical condition.

Other phosphatic guanos have been examined—namely, the Coral Queen, Howland Island, Abrolhos or Rat Island, Malden Island, and Port Adelaide. The first four are of much better quality than the guano of the Chesterfield Islands, and if the supply holds out they will probably be the source of the phosphates for our superphosphate industry for some time to come. The Port Adelaide samples are inferior to the Chesterfield, and contain an unusually high percentage of sand. The following analyses will show the composition of these guanos, with that of two others, the sources of which are not known:—

Table III.—Analyses of Phosphate Guanos.

Name of Guano.	Laboratory No.	District received from.	Moisture.	Organic Matter.	Silica.	Tricalcic Phosphate.	Calcic Carbonate.	Alkalies, &c.	Nitrogen.	Money-value per Ton.
										£ s. d.
Coral Queen	247	Christchurch ..	6·46	13·04	0·26	56·40	24·00		1·09	5 17 6
"	758	Walton	21·16		0·18	53·62	25·04		0·42	5 4 3
"	826	East Hamilton ..	17·22		0·16	57·60	22·60	2·42	0·56	5 13 3
Howland Island ..	267	Waikato ..	8·66	10·04	1·60	50·10	29·05	0·55	0·36	4 17 0
"	519	Christchurch ..	12·95	11·89	0·20	61·80	12·06	1·10	0·47	6 0 0
"	633	Dunedin.. ..	5·00	9·40	0·20	56·62	25·88	2·90	0·31	5 8 6
Rat Island	580	Christchurch ..	8·90	21·72	4·00	51·52	6·62	7·24*	0·98	5 7 0
"	581	" ..	9·90	21·44	3·98	54·13	1·49	9·06†	0·89	5 10 9
Malden Island.. ..	392	Thornbury ..	3·90	8·40	0·10	61·91	24·28	1·41	0·81	6 4 3
Port Adelaide	..	Christchurch ..	18·83	10·95	31·08	16·02	3·70	19·42‡	1·33	2 5 6
"	380	Invercargill ..	10·15	10·48	36·00	30·49	6·00	6·88§	0·67	3 4 6
Not known	260	Thornbury ..	5·20	10·18	46·82	32·90	4·50	0·40	0·67	3 9 0
"	276	Christchurch ..	16·25	8·09	5·68	60·77	9·21‡		0·56	5 19 3

* Containing iron and alumina, 3·45. † Containing iron and alumina, 3·98. ‡ Containing iron and alumina, 2·25. § Containing iron and alumina, 2·76. || Containing iron and alumina, 7·00.

Akaroa Guano.

During the years 1888 and 1889 a quantity of guano was brought from the caves at Akaroa. The samples varied considerably in quality. Some were nitrogenous, and equal to the best Peruvian guano, while others were worthless. The better class ones contained feathers, which furnished a portion of the nitrogen represented in the analyses. Most of the samples, however, contained rather a high percentage of silica and insoluble matter; and, as this contained iron, the guano would not be suitable for the preparation of superphosphate, even supposing it could be procured with a higher percentage of tricalcic phosphate. The varied composition and value of these guanos shows well the importance of purchasing manures only on the results of analysis.

Table IV.—Analyses of Akaroa Guano.

Laboratory No.	District received from.	Moisture.	Organic Matter.	Silica.	Phosphoric Anhydride.	Equivalent to Tricalcic Phosphate.	Calcic Ditto.	Alkalies, &c.	Nitrogen.	Money-value per Ton.
										£ s. d.
237	Christchurch	15·32	9·78	54·99	13·39	29·25	15·86	9·89	1·66	3 18 6
238	"	16·48	21·64	10·02	13·68	29·88	16·20	2·75	3·92	5 7 0
250	"	22·28	30·26	20·80	9·25	20·21	10·96	6·45	5·11	5 1 9
251	"	23·15	49·49	5·13	6·28	13·73	7·45	8·50	11·83	8 9 6
252	Kirwee	19·83	51·53	8·33	6·52	14·23	4·59	9·20	11·62	8 7 9
259	Christchurch	45·74		34·73	7·47	16·30	5·76	5·30	4·97	4 12 6
284	"	14·40	50·46	3·32	15·07	32·99	11·00	5·75	10·43	9 11 0
286	Lincoln	13·37	24·53	17·84	19·78	43·17	16·11	8·37	3·71	6 10 9
293	"	16·85	20·67	27·88	12·90	28·16	12·32	9·38	2·94	4 12 0
347	Christchurch	45·12		16·32	11·20	24·44	8·40	18·96	3·85	4 15 0
348	"	29·46		31·10	9·80	20·39	9·85	19·79	1·68	3 1 0
349	"	40·03		27·05	9·20	20·08	9·18	14·54	1·75	3 1 0
388	"	15·50	10·32	51·64	5·27	11·50	6·21	11·06	0·70	1 11 6
389	"	13·27	12·67	47·92	6·35	13·86	8·02	11·77	0·63	1 15 4

In the above table of analyses the phosphoric anhydride is given separately, and the proportion of tricalcic phosphate to which it is equivalent is given in the next column. This has been done as in some cases a portion of the phosphoric anhydride in these guanos is in the form of soluble phosphates of the alkalies, which gives it an increased value.

Superphosphate of Lime.

The chief objection to raw phosphates, such as bones, phosphatic guanos, &c., is that they require considerable time to decompose in the soil before they become available for the purposes of plant growth. In superphosphates this objection does not exist, since the phosphates have been rendered soluble by the use of sulphuric acid. The chemistry of the process may be expressed as the conversion of the insoluble tricalcic phosphate by the action of sulphuric acid into the soluble monocalcic phosphate and sulphate of calcium or gypsum. Superphosphate of lime is therefore essentially a mixture of monocalcic phosphate and calcium sulphate, together with any tricalcic phosphate that has not been so acted on by the sulphuric acid, and any organic matter, silica, &c., that may have been present in the raw phosphate. The quality of the resulting superphosphate will therefore mainly depend on the nature of the raw material from which it is made. Mineral phosphates that are rich in phosphoric acid will, if properly manufactured, produce high-class superphosphates, while substances poor in this constituent will produce superphosphates with a low percentage of monocalcic phosphate and a relatively high percentage of other substances which were either present in the original substance or which have been formed by the action of the sulphuric acid. For this reason it is not possible to manufacture high-class superphosphates from bones in good mechanical condition. In the first place, the proportion of tricalcic phosphate is not sufficient; and, secondly, if the whole of the phosphate were converted, there is not sufficient calcic sulphate formed to thoroughly dry the mixture. Calcic sulphate has an important influence in this respect on the mechanical condition of the manure. When first made superphosphates are of a pasty consistency, but the calcic sulphate unites chemically with the water in the same way that plaster of Paris (which is the same substance) sets to form a dry mass that is easily broken down to a fine powder.

Table V. gives the results obtained with imported superphosphates examined here, and Table VI. those of the New-Zealand-made article.

Table V.—Analyses of Imported Superphosphates.

Laboratory No.	Districts received from.	Moisture.	Organic Matters.	Silica.	Monocalcic Phosphate.	Equal to Soluble Phosphate.	Tricalcic Phosphate.	Ferric and Aluminic Phosphate.	Calcic Sulphate.	Alkalies, &c.	Nitrogen.	Money-value per Ton. £ s. d.
..	College farm	12·40	17·20	6·60	29·40	39·83	1·26	..	32·30	1·40	0·14	8 14 9
9	"	14·20	10·13	1·60	30·02	39·77	1·70	1·20	37·17	3·98	0·19	9 1 0
13	"	15·85	17·14	1·95	25·98	34·55	2·24	4·70	28·85	3·02	0·07	7 17 0
49	"	12·55	7·69	1·07	29·66	39·26	2·18	2·05	40·71	4·09	0·39	9 3 6
56	"	11·06	13·91	1·60	34·27	45·20	0·43	1·45	34·51	2·77	0·06	10 1 6
122	"	11·75	6·76	1·15	32·38	42·90	3·63	2·75	41·39	0·19	0·42	10 0 0
123	"	17·21	13·25	1·74	26·84	35·55	6·84	6·84	26·72	0·56	0·61	8 10 9
144	"	10·39	17·26	1·15	31·64	41·76	0·43	3·50	33·72	1·91	3·35	9 11 6
151	Invercargill	14·18	7·24	6·62	18·11	23·97	6·00	2·30	44·81	0·74	0·19	6 1 0
154	College farm	11·46	7·13	3·70	21·75	28·79	1·00	3·70	51·88	0·38	0·05	7 1 0
243	Christchurch	3·90	12·91	5·12	32·63	43·20	0·43	1·70	38·42	4·89	0·08	9 14 3
258	Auckland	15·67	6·21	2·30	24·73	32·76	Nil	5·40	45·59	0·10	0·42	7 19 0
399	Christchurch	12·90	4·10	2·74	23·40	30·88	1·31	6·30	47·38	1·87	0·05	7 10 0
405	"	12·30	4·82	3·02	23·07	30·56	3·49	5·90	47·42	0·48	0·05	7 8 3
453	Lincoln	13·70	5·83	5·30	21·09	27·92	Nil	3·20	49·46	1·42	0·19	6 16 6
578	Hororata	7·52	15·03	5·00	9·30	12·32	9·08	8·30	44·30	1·47	1·02	4 7 0
514	St Andrews	13·37	18·96	8·32	12·19	16·09	5·67	6·40	34·45	0·64	0·70	4 13 0
747	Christchurch	13·29		1·56	24·93	33·03	1·74	5·20	53·28		0·11	8 0 0
748	"	14·23		1·60	24·93	33·03	0·87	6·60	51·77		0·05	7 18
749	"	18·47		0·18	25·25	33·45	1·30	2·10	52·70		0·02	7 18 9
759	Rangitikei	27·92		6·60	18·36	24·32	4·36	4·00	36·96		0·81	6 7 6
765	Geraldine	8·84		6·28	25·91	34·33	7·41	4·98	46·58		0·08	8 5 3
767	Timaru	10·57		1·68	25·58	33·89	1·31	5·30	55·56		0·05	8 3 3
768	"	11·42		8·54	18·36	24·32	3·92	2·90	54·86		0·08	6 3 0
769	Temuka	14·86		6·48	24·92	33·02	3·05	4·00	46·69		0·08	7 17 0
	Bone Superphosphates.											
11	College farm	13·75	18·02	9·55	17·13	22·78	2·62	3·50	34·47	0·96	0·72	6 1 6
400	Christchurch	12·35	23·75	8·50	16·15	21·31	3·93	3·00	31·18	1·14	1·12	6 2 0
750	"	34·75		5·74	15·41	20·41	1·74	4·30	38·06		1·48	6 1 0

Table VI.—Analyses of New Zealand Superphosphates.

Laboratory No.	Districts received from.	Moisture.	Organic Matter.	Silica.	Monocalcic Phosphate.	Equal to Soluble Phosphate.	Tricalcic Phosphate.	Ferric and Aluminic Phosphate.	Calcic Sulphate.	Alkalies.	Nitrogen.	Money-value per Ton. £	s.	d.
	College farm	14·72	31·58	3·25	8·33	10·99	23·18	..	15·39	2·90	2·05	6	2	0
10	"	18·10	28·17	2·60	16·16	21·49	3·91	0·50	28·98	1·58	1·22	6	1	3
19	Springston	5·90	37·22	4·28	14·18	18·85	5·32	1·65	28·22	3·23	0·84	5	4	9
39	Belfast ..	11·65	30·28	1·84	9·55	12·65	8·73	1·40	31·22	5·33	1·73	5	1	9
40	" ..	10·90	34·96	2·58	13·03	18·25	4·36	1·75	26·40	5·22	2·85	6	3	0
52	College farm	9·95	30·79	1·78	8·89	11·73	10·46	0·93	33·25	3·95	1·95	5	1	0
124	"	11·09	15·95	9·64	13·84	18·24	6·65	5·47	35·91	1·45	0·35	5	7	6
145	"	9·05	16·15	9·34	12·46	16·44	17·66	5·60	28·79	0·95	1·03	6	6	6
191	"	14·40	20·08	1·02	21·09	27·92	5·24	2·60	33·69	1·88	0·63	7	5	6
248	Auckland	18·66	16·45	11·26	9·56	12·65	5·67	2·30	34·69	1·41	1·65	4	13	3
249	"	18·16	11·48	15·60	5·60	7·41	9·60	6·80	32·88		0·78	3	12	3
257	Christchurch	15·35	45·65	3·90	9·88	13·09	4·58	1·45	17·22	1·97	3·85	5	8	6
263	Otaio ..	16·16	21·42	1·88	4·61	6·08	15·06	2·15	33·84	4·88	2·18	4	9	6
265	Green Park	9·13	39·35	2·72	14·50	19·14	9·38	1·70	17·05	6·17	3·36	6	19	0
272	Waikato	15·59	14·87	11·74	10·22	13·50	0·87	6·76	34·89	5·07	0·89	4	2	0
274	Springston	9·28	26·90	1·80	9·56	12·65	16·59	1·60	29·61	4·66	2·04	5	16	9
275	"	9·06	23·78	2·24	15·82	20·94	7·64	2·75	31·12	7·59	2·15	6	15	6
509	Otaio ..	7·43	53·93	4·32	12·69	16·80	2·83	2·36	12·30	4·14	5·46	6	7	6
511	Makihiki	6·87	39·62	3·56	15·82	21·94	5·24	5·80	15·21	7·88	3·01	6	15	6
577	Hororata	7·61	39·80	4·34	16·48	21·83	3·48	7·20	17·95	3·14	2·68	6	14	0
766	Greenpark	50·58		3·32	20·33	26·93	Nil	4·20	21·57		1·82	7	0	0
828	East Hamilton	18·81		2·30	20·99	27·70	5·23	1·60	51·07		2·63	8	10	0
886	Christchurch	37·62		2·78	22·30	29·52	2·83	3·80	27·40	3·27	1·12	7	10	6
887	"	44·82		2·94	21·32	28·22	0·43	3·90	32·97	3·62	1·68	7	8	0
888	"	39·72		4·52	21·32	28·22	0·87	4·10	29·03	0·44	1·26	7	3	6
761	"	40·03		4·56	20·00	26·50	0·43	5·60	29·38		2·03	7	3	9
757	Walton	35·51		7·34	17·38	23·01	6·54	4·90	28·33		1·48	6	15	6

For the purpose of rendering the analytical results more intelligible a few remarks on the different constituents are here given.

The term "organic matter" represents the loss on ignition. It is made up generally of animal-matter, which contains the nitrogen and combined water.

Silica includes sand and insoluble matter of no value.

Monocalcic Phosphate.—This is the most important constituent in a superphosphate, and on the amount present will depend the quality of the manure. Those containing over 20 per cent. may be considered high-class, those with from 10 to 20 per cent. medium-class, and those containing less than 10 per cent. poor-class superphosphates. The term "soluble phosphate" is used in the manure trade. This does not express the actual soluble monocalcic phosphate, but the amount of the original tricalcic phosphate that has been converted. The value of monocalcic phosphate in terms of soluble phosphate in any manure can be found by multiplying the percentage present by 1·3. This has been done in the analyses given for the purpose of comparison.

Tricalcic Phosphate.—This represents that portion of the original phosphate that has not been converted into monocalcic phosphate by the acid, and the percentage is always higher in cases where insufficient acid has been used; if in the form of bone it has a higher value than when derived from mineral phosphates, since it is then rendered more quickly available in the soil.

Calcic Sulphate.—The proportion of this constituent gives an indication in some cases of the nature of the original phosphate. If the amount present is much in excess of the quantity of monocalcic phosphate, then the original raw phosphate probably contained an excess of calcic carbonate, this, on decomposing, forming calcic sulphate and involving the waste of a corresponding quantity of acid.

Ferric and *Aluminic Phosphates.*—These substances are sometimes known as reduced or retrograde phosphates. They are formed when the raw phosphate contains iron and alumina. These bodies unite with a portion of the soluble phosphate, gradually forming insoluble compounds, and the proportion of monocalcic phosphate is thereby diminished. The term "reduced phosphate" is also often applied to a compound of lime and phosphoric acid, which is sometimes found in badly-made superphosphates, formed by the addition of more lime to the monocalcic phosphate. This dicalcic phosphate, as it is called, is less soluble than the monocalcic and more soluble than the tricalcic phosphate, and consequently may be considered intermediate in value between the two. It is formed when insufficient acid has been used in the manufacture of superphosphate, and also when undecomposed carbonate of lime is left in or added to the manure. A comparison of the results given of the imported with those of our New-Zealand-made superphosphates will show that the latter are much lower in grade with regard to monocalcic phosphate, but richer in organic matter and nitrogen. They are more of the character of bone superphosphates. In our superphosphates, as in our bonedust, nitrogen appears to be, comparatively, the cheapest manure constituent that we have. This is largely the outcome of our meat-freezing industry. With the phosphatic material available here, it is not likely that we shall produce high-class superphosphates; but this is not important so long as good, genuine, medium-class superphosphates are supplied at their true value.

A few examples will now be given of badly-made and adulterated phosphates.

Table VII.—Analyses of Inferior Superphosphates.

Laboratory No.	District received from.	Moisture.	Organic Matter.	Silica.	Monocalcic Phosphate.	Dicalcic Phosphate.	Tricalcic Phosphate.	Ferric and Aluminic Phosphate.	Calcic Sulphate.	Calcic Carbonate.	Alkalies, &c.	Nitrogen.	Money-value, per Ton. £	s.	d.
510	Otaio	6·11	14·82	1·54	1·31	6·68	16·56	1·10	41·21	9·77	0·90	0·81	4	2	9
512	Makikihi ..	5·31	13·95	2·50	1·64	6·89	6·98	3·20	36·78	22·35	5·80	0·36	3	1	0
513	St. Andrews ..	6·72	35·05	3·42	6·59	12·45	2·83	1·40	23·84	3·17	4·53	2·17	5	9	6
681	Timaru ..	25·48		34·26	Nil	..	4·14	2·71	4·02	29·39	..	0·28	0	13	9
762	Temuka ..	11·42		73·00	Nil	..	3·50	3·53	4·90	1·57		0·44	0	13	9
262	Ruapuna ..	10·66	31·01	4·32	11·20	..	Nil	..	25·81	16·15	0·85	2·43	4	14	6
119	Ngahauranga ..	4·30	49·96	2·60	Nil	..	16·65	Trace	10·89	12·98	2·62	0·52	2	2	3

The first three of the above manures have been manufactured from material containing calcic-carbonate, and, insufficient sulphuric acid having been used, the carbonate of lime remaining has converted much of the monocalcic phosphate into dicalcic and tricalcic phosphates. Nos. 681 and 682 are largely adulterated with sand, and contain no monocalcic phosphate whatever.

No. 262 is a manure that was fairly made in the first place, but calcic carbonate has been added, probably to dry the superphosphate. This manure was probably newly made, as none of the soluble phosphate had been reduced, but under the conditions it would no doubt, if kept, retrograde considerably.

No. 119. This manure was intended to be a superphosphate, but the manufacturer, probably to dry the mixture, added caustic lime, which had the effect of completely neutralising the effect of the acid added, and also driving off most of the nitrogen in the form of ammonia.

Nitrgoenous and Special Manures.

The use of nitrogenous manures is not so general in New Zealand as that of phosphatic ones; the principal manures of this kind imported are nitrate of soda and sulphate of ammonia, together with a little dissolved guano and a few special manures. Dissolved guano is generally Peruvian guano that has been treated with sulphuric acid, for the purpose of rendering the phosphates contained in it soluble and fixing the ammonia; it is consequently a nitrophosphatic manure. It also contains more or less potash. Special manures are generally formed with a basis of superphosphate of lime, to which is added the food constituent specially required by the crop it is intended for. Thus grain and grass manures contain nitrogen, while for beans and other liguminous crops and potatoes potash is added. Turnip manures are generally simple superphosphates.

The composition of those received for analysis is shown in Table VIII.

Table VIII.—Analyses of Dissolved Guano and Special Manures.

Name of Manure.	Laboratory No.	District received from.	Moisture.	Organic Matter.	Silica.	Monocalcic Phosphate.	Tricalcic Phosphate.	Ferric and Aluminic Phosphate.	Calcic Sulphate.	Alkalies, &c.	Potash.	Nitrogen.	Money-value per Ton. £	s.	d.
Dissolved guano	242	Christchurch ..	6·15	39·24	13·20	17·14	Nil	2·90	14·28	7·09	..	6·23	9	15	0
"	398	" ..	8·30	31·07	9·08	13·18	2·62	4·70	28·07	2·98	..	5·67	8	15	6
"	406	" ..	7·70	30·40	8·24	12·52	2·62	4·38	29·54	4·38	..	5·53	8	10	6
"	751	" ..	43·10		5·84	10·82	9·15	4·60	26·49	..	..	5·60	8	13	0
Ammonic phosphate ..	155	College farm ..	10·72	14·22	1·52	23·07	1·31	4·60	43·45	1·11	..	2·17	7	19	3
Imperial manure	244	Christchurch ..	6·20	30·76	8·70	6·26	4·36	2·30	34·34	7·08	0·81	2·24	4	12	0
Universal "	245	" ..	13·75	22·11	5·24	8·24	0·87	2·30	38·76	8·73	2·49	1·45	4	10	6
Potato "	402	" ..	12·05	13·88	4·56	15·82	3·49	3·30	41·44	4·16	1·30	2·17	7	6	0
Turnip "	401	" ..	15·98	11·63	5·74	12·19	2·18	10·40	37·91	2·54	1·46	0·53	5	1	6
Special "	752	" ..	51·23		8·48	10·49	0·43	3·80	24·36	1·20	1·21	3·89	6	10	6

In addition to these manures, all of which are imported, there is now in our local market several excellent manures which originate from our meat-freezing industry, and of which dried blood forms the basis. These are probably the cheapest forms of nitrogenous manure that we have in New Zealand. As to the efficacy of dried blood, the researches of Petermann, extending over eight years, go to show that, compared with other nitrogenous manures, dried blood is only inferior to nitrate of soda. Two samples of this manure were found to have the following composition.

Analyses of Dried Blood.

Laboratory No.	District received from.	Moisture.	Organic Matter.	Silica.	Phosphoric Anhydride.	Calcic Oxide.	Ferric and Aluminic Oxide.	Alkalies, &c.	Nitrogen.	Money-value per Ton.
										£ s. d.
636	Auckland ..	10·15	82·95	3·26	0·35	0·31	1·35	1·53	12·11	6 16 0
881	Christchurch ..	91·86		1·92	1·92	1·40	1·02	1·88	12·55	7 2 6

These are excellent manures, and should prove especially valuable for topdressing grain- and grass-crops.

Several manures were on the market a few years ago under the name of "animal guanos;" these were prepared from the offal of the freezing-works, by working it up with bonedust or phosphatic guano, and sulphuric acid. As will be seen by the analyses, they belong to the class of nitro-phosphatic manures.

Table IX.—Analyses of Animal Guanos.

Laboratory No.	District received from.	Moisture.	Organic Matter.	Silica.	Monocalcic Phosphate.	Tricalcic Phosphate.	Ferric and Aluminic Phosphates.	Calcic Sulphate.	Alkalies, &c.	Nitrogen.	Money-value per Ton.
											£ s. d.
..	Befast	17.25	47·88	1·80	16·48	0·24	..	13·57	2·78	3·50	6 7 3
12	"	18·69	44·55	5·52	15·82	1·63	1·39	11·85	0·55	3·37	6 5 3
40	"	11·05	36·70	2·54	7·91	14·41	2·40	23·63	1·36	2·18	5 1 3
51	"	9·80	68·37	7·67	4·61	Nil	3·25	5·97	0·33	4·27	3 7 6
121	"	18·50	65·90	6·84	1·97	Nil	Nil	6·36	0·43	4·69	2 15 3
264	Greenpark	6·56	62·38	0·98	..	25·95	..	..	4·10	5·79	5 4 0
760	Rangitikei	71·20		4·62	5·24	12·20	Trace	6·74		4·97	4 19 6

Potash Manure.

The only potash manure that has come under our notice is a sample of kainit imported by an association in Christchurch.

Analysis L.N. 446.

Potassic sulphate	21·16
Calcic sulphate	7·94
Magnesic sulphate	6·85
Magnesic chloride	11·89
Sodic chloride	35·57
Silica and insoluble matter.	1·18
Moisture and combined water	15·28
	99·87

This sample of kainit contains rather less potash and more sodic chloride than average samples of this manure.

Agricultural Lime.

The use of lime has become rather frequent of late years, especially in Canterbury; and beneficial results have in many cases been recorded. Three samples were submitted for analysis, and the results obtained show that each sample has been well prepared, and that the amount of silica and insoluble matter is not excessive. The percentage of magnesia is low in each case. This substance is generally considered to be detrimental when present in the lime to any great extent. The sample from Timaru (No. 680) is the best, and in all respects an excellent sample of lime for either agricultural or building purposes.

Analyses of Lime.

—	Laboratory No. 297. From Mount Somers.*	Laboratory No. 394. From Fairlie Creek.	Laboratory No. 680. From Timaru.
Caloric oxide	16·21	13·90	53·93
Calcic hydrate	45·42	57·14	31·98
Calcic carbonate	9·08	8·17	4·44
Calcic sulphate	8·99	..	3·60
Magnesic oxide	0·68	..	1·08
Potassic oxide	0·34	..	..
Iron and aluminic oxides	7·95	4·40	2·80
Phosphoric anhydride	Trace	..	Trace
Silica and insoluble matter	11·02	16·10	2·05
Undetermined	0·31	0·29	0·12
	100·00	100·00	100·00

* Lime screenings.

Miscellaneous Manures.

L.N. 825, Fish Manure. (Sold by Auction in Christchurch.)

Analyses.

Organic matter and moisture	23·88, containing nitrogen, 1·65.
Silica and insoluble matter	29·60
Tricalcic phosphate	21·83
Ferric and aluminic oxides	5·99
Calcic carbonate	12·42
Alkalies, &c.	6·28
	100·00

Fish manures generally are valuable fertilisers, containing a fair amount of phosphates and a high percentage of nitrogen (from 6 to 9 per cent.). The above, however, is a poor sample, having been adulterated with about one-third its weight of sand and earthy matter. Value, about £3 per ton.

Poudrette, L.N. 520. (Manufactured in Dunedin).

Poudrettes are preparations of nightsoil, in which earth, ashes, lime, &c., are used in order to dry the material. They are generally poor manures, and this one is no exception to the rule.

Analysis.

Moisture	6·93
Organic matter	22·11, containing nitrogen, 0·98.
Silica and insoluble matter	47·07
Ferric and aluminic oxides	9·65
Tricalcic phosphate	4·47
Calcic carbonate	3·20
Magnesia, alkalies, &c.	6·57
	100·00

Value, about £1 2s. 6d. per ton.

Patent Fertiliser, L.N. 125.

A dark-coloured moist substance, apparently vegetable mould. Of no value as a manure.

Analysis.

Moisture	48·10
Organic matter	43·00, containing nitrogen, 1·4.
Silica and insoluble matter	5·48
Ferric and aluminic oxides	1·68
Calcic oxide	0·55
Magnesic oxide	0·44
Potassic oxide	Trace
Phosphoric anhydride	0·22
Sulphuric anhydride	Trace
Chlorine	Trace
Undetermined	0·53
	100·00

Nitrogenous Manure, L.N. 118.

A dark-coloured mixture, manufactured at Upper Hutt, Wellington; apparently made up of dung and sand, with a little hair, &c. A very poor nitrogenous manure.

Analysis.

Moisture	10·05
Organic matter	35·40, containing nitrogen, 0·91.
Silica and insoluble matter	40·30
Ferric and aluminic oxides	6·35
Calcic oxide	1·88
Phosphoric anhydride	2·03
Alkalies, loss, &c.	3·99
	100·00

Worth 10s. 6d. per ton on the land, but not worth cost of carriage any distance.—W. E. I.

Productive Manure. (Manufactured in Dunedin).

Analysis.

——	Laboratory No. 830.*	Laboratory No. 831.†
Organic matter and moisture ...	32·88	26·90
Silica and insoluble matter ...	7·86	14·46
Monocalcic phosphate ...	Nil	Nil
Dicalcic phosphate ...	Nil	Nil
Tricalcic phosphate ...	13·53	14·17
Calcic sulphate ...	22·77	14·75
Ferric and aluminic phosphates ...	3·20	...
Calcic carbonate ...	15·66	28·83
Potash ...	0·25 }	0·89
Loss and undetermined ...	3·85 }	
	100·00	100·00

* Containing nitrogen, 0·42; value per ton, £2 1s. 6d. † Containing nitrogen, 1·09; value per ton, £2 4s. 6d.

This manure is advertised with the following analysis:—

Free moisture ...	14 per cent.
Combined water and organic matter (containing nitrogen equal to 3·87 per cent. of ammonia)	16 "
Dry sulphate of lime ...	30 "
Soluble phosphate of lime (equal to 10·7 of insoluble phosphate)	8·1 "
Insoluble phosphate of lime ...	6 "
Carbonate of lime...	8 "
Sulphide of lime ...	2 "
Slaked lime ...	1·9 "
Potash salts ...	2 "
Earthy matter (clay, sand, &c.) ...	13 "
	101

The manure may have been prepared with the best intention of producing an article similar to that of which the analysis is published, but the effect of caustic lime (probably gas-lime) used in its preparation has been to reduce the phosphates and liberate the nitrogen. It may be again mentioned that the presence of caustic lime is incompatible with the existence of either monocalcic phosphate or nitrogen.

Soot, L.N. 253.

Analysis.

A fair sample of soot.

Moisture ...	7·55
Organic matter ...	39·15, containing nitrogen, 2·10.
Silica ...	39·14
Ferric and aluminic oxides ...	5·73
Calcic oxide ...	3·16
Phosphoric anhydride ...	0·42
Sulphuric " ...	2·50
Alkalies, &c. ...	2·35
	100·00

Value, £1 15s. per ton.

Mixed Manure, L.N. 254.

A combination of soot, vegetable-matter, sand, and bonedust.

Analysis.

Moisture ...	10·5
Organic matter ...	31·6, containing nitrogen, 2·30.
Silica ...	31·1
Tricalcic phosphate ...	18·4
Calcic carbonate ...	7·1
Alkalies, &c. ...	1·3
	100·00

Value, £2 17s. per ton.

Bonedust, L.N. 973.

This manure was sold as a bonedust, but from its analysis it is shown to be adulterated with about one-fifth its weight of carbonate of lime. Probably Chesterfield guano has been added.

Analysis.

Organic matter and moisture	40·70, containing nitrogen, 3·01.
Silica and insoluble matter	4·30
Tricalcic phosphate	20·05
Iron and alumina oxides	4·15
Calcic carbonate	26·92
Alkalies, &c.	3·88
	100·00

Value, about £3 7s. 6d. per ton.

APPENDIX No. 2.

Report of the Natural Science Department, First Term, 1891.

The examination and identification of seeds, plants, &c., received from the public has been carried on, and the results, since the last report, may be tabulated as follows:—

No.	Name.	Source.	Germinating Power per Cent.	Impurities per Cent., and Remarks.	Total Impurities per Cent.
49	Grass-seed	North Island..		Is doub-grass (*Cynoden dactylon*).	
50	Meadow-fescue ..	College farm..	5	Weevil-eaten fescue-seeds, 12; rye-grass, 11½; dog's-tail, 2; Bromus sp., 1½; small fescue and Poa, 1	16
51	White-clover ..	Gore ..	..	Sorrel, 3; and occasional timothy and plantain or rib-grass	3
52	Alsike	" ..	..	A few odd seeds of white-clover, sorrel, plantain, timothy, &c.	
53	Grass-seed	Masterton ..	..	Is a tussac-grass (*Poa anceps*, var *B. foliosa*).	
54	Red-clover	College farm..	..	Occasional undetermined.	
55	Lucerne ..	" ..	..	Occasional plantain.	
56	*Poa trivialis* ..	" ..	..	Pure.	
57	Crested dog's-tail ..	" ..	..	"	
58	Italian rye-grass ..	" ..	..	"	
59	Cow-grass	Christchurch	84	Occasional seeds of sorrel, plantain, timothy, white-clover, and undetermined.	
60	Mixed turnip ..	"	..	Contains about equal proportions of two sorts.	
61	Grass	Greymouth ..	..	Is meadow-fescue.	
62	"	" ..	..	Is Italian rye-grass.	
63	White-clover ..	Masterton ..	59	Sorrel, 3; alsike, 1; and occasional undetermined	4
64	" ..	" ..	58	Similar to above, with occasional chickweed	4
65	American red-clover..	" ..	90	Pure.	
66	Alsike	" ..	71	Occasional white-clover.	
67	"	" ..	67	Hedge-mustard, 1; undetermined, 1; and occasional black-medick	2
68	English cow-grass ..	" ..	78	Occasional plantain.	
69	" ..	" ..	83	Pure.	
70	American cow-grass ..	" ..	91	Occasional timothy, hedge-mustard, and sorrel.	
71	" ..	" ..	89	Apparently same as No. 70.	
72	Japan clover ..	" ..	52	A grass (Trisetum sp.) and undetermined	5
73	Trefoil	" ..	90	A caryophyllaceous seed	2
74	Lucerne	" ..	86	Red-clover, 1; plantain, 1	2
75	Sheep's fescue ..	" ..	48	Misnamed for hard fescue; occasional *Anemagrostis spica-venti*.	
76	Hard fescue ..	" ..	47	Pure.	
77	Crested dog's-tail ..	" ..	6	Yorkshire fog	3
78	" ..	" ..	10	"	7
79	Timothy	" ..	95	Pure.	
80	"	" ..	81	Undetermined, 3; white-clover, 1; various, 3 (chiefly sorrel, plantain, chickweed, and sp. of composite plant)	7
81	Meadow foxtail ..	" ..	12	Occasional wavy mountain hair-grass.	
82	*Poa trivialis* ..	" ..	7	A small percentage of *P. pratensis*.	
83	*P. nemoralis* ..	" ..	3	Indistinguishable from *P. pratensis*.	
84	*Poa pratensis* ..	" ..	5	Pure.	
85	Fiorin	" ..	..	Pure, but nearly all chaff.	
86	Lawn-grass mixture ..	" ..	36	Sheep's fescue, var. 57; rye-grass, 24; meadow-fescue, 11; dog's-tail, 6; foxtail, 1; small Poa, 1; and occasional sorrel and plantain	12
87	White stubble turnip	" ..	98	Pure, but variety not vouched for.	
88	Plantain	" ..	56	Red-clover, 13; alsike, 4; sorrel, 2	19
89	Meadow-fescue ..	Christchurch	80	Rye-grass	20
90	" ..	"	10	Pure.	
91	Colonial red-clover ..	Waimate ..	47	Dock, 2; occasional rye-grass (with ergot), Scotch thistle, plantain, and sorrel	2
92	Devonshire evergreen	Christchurch	..	Rye-grass, 49; cocksfoot, 49; Yorkshire fog, 2; and occasional sorrel, fiorin, goose-grass, dock, plantain, thistle, and lesser clover	51
93	Seed	Masterton ..	..	Is black-medick (*Medicago lupulina*).	
94	Plant	Ohaiawai ..	..	Is buttercup (*Ranunculus rivularis* var.).	

REPORT OF THE NATURAL SCIENCE DEPARTMENT, FIRST TERM, 1891—*continued.*

No.	Name.	Source.	Germinating Power per Cent.	Impurities per Cent., and Remarks.	Total Impurities per Cent.
95	Mixed grass ..	Christchurch	..	Contains rye-grass, 61; tall fescue, 14; meadow-fescue. 4; Italian rye-grass, 8; lesser clover, 11; white-clover, 1; sorrel, 1; dock, sow-thistle, and hard fescue, 1; and frequent soft broome or goose-grass	2
96	Lawn-grass	"	..	Consists of meadow-grasses (Poa sp.), 44; rye-grass, 21; white-clover, 11; crested dog's-tail, 10; sheep's fescue, 9; hard fescue, 6.	
97	White-clover ..	Oamaru ..	..	Lesser clover, 5; sorrel, 1; with occasional plantain, chickweeds, shepherd's purse, cleavers, timothy, ragged robin, and quartz particles	6
98	" ..		79	Trifolium sp. 2; sorrel, 1½; red-clover, ½	4
99	" ..		79	Sorrel, 2; plantain, ⅓; and occasional trifolium sp., as in No. 98	2⅓
100	Colonial red-clover ..	College farm ..	90	Occasional alsike, white-clover, rye-grass, and plantain.	
101	Rye-grass	" ..	..	Goose-grass, 2; Yorkshire fog, 1; and occasional mouse-ear chickweed, sterile broomegrass, ox-eye daisy, and shepherd's purse	3
102	Cocksfoot	Akaroa ..	74	Yorkshire fog, 1; and occasional goose-grass, cat's-ear and ox-eye daisy	1
103	Colonial red-clover ..	Doyleston ..	..	Some alsike, white-clover, and rye-grass.	
104	Colonial clover ..	Chertsey ..	..	Consists of *Trifolium minus*, 88; white-clover, 7; sorrel, 2; mouse-ear chickweed, 2; Yorkshire fog, 1; and occasional twitch (*Poa pratensis*), chickweed (Stellaria), and red-clover	5
105	De graine de dactyle	Christchurch	..	Consists of cocksfoot (Dactylis), 84; oat-grass (Trisetum), 8; meadow-fescue, 6; small Poa, 1; undetermined, 1; and occasional cleavers, Bromus, &c.	16
106	Japan clover ..	Masterton ..	73	Pure.	
107	Bokhara clover ..	" ..	68	Occasional plantain, red-clover, dock, and black-medick.	
108	American cow-grass	" ..	90	Occasional timothy.	
109	Alsike	" ..	62	Occasional sorrel, plantain, timothy, &c.	
110	"	" ..	56	Similar to No. 109, with addition of odd ox-eye daisy and chickweed (Stellaria).	
111	Timothy	" ..	99	Pure.	
112	Rib-grass	" ..	81	Occasional undetermined composite plant.	
113	White-clover ..	" ..	92	Sorrel, 2; and occasional plantain and chickweed ..	2
114	" ..	" ..	76	Plaintain, 2; and occasional sorrel, chickweed, and hedge-mustard	2
115	*Poa trivialis* ..	" ..	20	Occasional impurities.	
116	*Poa pratensis* ..	" ..	2	Pure.	
117	*Poa nemoralis* ..	" ..	4	Occasional hard fescue and chickweed.	
118	Meadow-fescue ..	" ..	90	A few odd seeds of *Bromus secalinus*, dock, and red-clover.	
119	Sheep's fescue ..	" ..	57	Misnamed for hard fescue; contains a few odd sorrel-seeds.	
120	Hard fescue ..	" ..	56	Pure.	
121	Fiorin	" ..	53	A few odd seeds of timothy and white-clover.	
122	Hungarian forage-grass	" ..	85	Pure.	
123	Meadow-foxtail ..	" ..	10	Rather frequent dock, hair-grass (Aira), fiorin, sweet vernal, &c.	
124	Crested dog's-tail ..	" ..	64	Too frequent ox-eye daisy, and Yorkshire fog, and occasional rye-grass, fiorin, timothy, and undetermined (dusty).	
125	" ..	" ..	66	Frequent ox-eye daisy and Yorkshire fog, and cat's-ear (Hypocharis), with odd black-madick, sweet vernal, and rye-grass.	
126	White mustard ..	" ..	98	Pure.	
127	Lucerne	" ..	91	Odd red-clover and plantain.	
128	White-stone turnip ..	" ..	91	Pure.	
129	Late red Trifolium ..	" ..	99	"	
130	Sheep's parsley ..	" ..	29	"	
131	Grass	Waimate ..	..	Is reed canary-grass (*Phalaris arundinacea*).	
132	Local-grown meadow-fescue	Masterton ..	..	Consists of sorrel, 50; *Trifolium minus*, 20; meadow-fescue, 16; mouse-ear chickweed, 5; cocksfoot, 2; goose-grass, 2; white-clover, 2; hair-grass, 1; buttercup, 1; dock, 1; and occasional rye-grass and Yorkshire fog, sedge, geranium, thistle, (Sonchus), *Poa pratensis*, sweet vernal, &c.	84
133	Plant	Lincoln ..	..	Is garden orache (*Atriplex hortensis*).	
134	Thistle	Little River ..	..	Is star-thistle (*Centaurea calcitrapa*).	
135	Grass	McKenzie Cnty.	..	Is *Poa colensoi*.	
136	"	"	..	Is *Danthonia pauciflora*.	
137	"	"	..	Is *Poa foliosa*.	
138	Sedge	"	..	Is *Carex colensoi*.	
139	Grass	Le Bon's Bay	..	Is tall fescue (*F. elatior*).	
140	Devonshire grey-stone turnip	College farm ..	95		
141	Purple-top	" ..	91		
142	Green-globe ..	" ..	93		
143	Grass	Timaru ..	..	Is erect bristle-grass (*Setaria viridis*).	
144	"	" ..	..	Is naked oat-grass (*Danthonia nuda*).	
145	Red-clover	College farm ..	6		
146	"	" ..	39		

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No.	Name.	Source.	Germinating Power per Cent.	Impurities per Cent., and Remarks.	Total Impurities per Cent.
147	Rape	Christchurch	70		
148	Rye-grass	Rangitata ..	..	Frequent Yorkshire fog and odd seeds of Brassica sp., goose-grass, and hair-grass, (*Festuca bromoides*), with traces of cocksfoot and ergot growths.	
149	Cocksfoot	" ..	..	Frequent Yorkshire fog, and odd seeds of cat's-ear (Hypochaeris), goose-grass, and dock.	
150	Alsike	Christchurch	69		
151	White-clover ..	Oamaru ..	..	Sorrel, 1; odd plantain	1
152	English red-clover ..	" ..	..	Various, 1; consisting of an undetermined umbelliferous plant, sorrel, dock, plantain, black-medick, fathen, timothy, &c.	1
153	English cow-grass ..	" ..	..	Plantain (*Plantago lanceolata*)	2
154	Alsike	" ..	..	Occasional timothy and sorrel, and odd seeds of Californian thistle, and of an undetermined composite plant.	
155	Rye-grass	" ..	..	Nearly pure.	
156	Cocksfoot	" ..	..	Yorkshire fog, 3; and odd seeds of goose-grass and timothy	
157	Red-clover	Rakaia ..	..	Rib-grass, 3; millet-grass (*Milium effusum*), 6; and various	9
158	Rye-grass	Methven ..	75	White-clover, 5; Italian rye-grass, 2; sorrel and dock, 4; goose-grass and Yorkshire fog, 2; with odd dissected geranium and many bits	13
159	"	" ..	91	Sorrel, 2; hair-grass (Festuca), 1½; cat's-ear, ½; soft-brome and fog, 1	5
160	Cocksfoot	" ..	47	Fog (*Holcus lanatus*)	10
161	Grass	Christchurch	..	Is *Poa breviglumis.*	
162	"	"	..	Is *Poa colensoi.*	
163	"	"	..	Is common twitch (*Poa pratensis*).	
164	Canterbury - saved green-top turnip	"	21	Very poor sample.	
165	Wheat	Springston ..	..	Attacked by the grain-aphis.	
166	"	Oamaru ..	..	"	
167	Sutton's hybrid turnip	College farm..	93	Two-year-old seed.	
168	Vine-leaves	Christchurch	..	To state if attacked by the Phylloxera. No.	
169	Plant	Springfield ..	..	Is *Cerastium arvense*, a perennial English chickweed.	
170	Grass	Fairlie Creek	..	Is small tussac poa (*P. intermedia*).	
171	"	"	..	Is small tussac poa (*P. intermedia*).	
172	Sedge	"	..	Is *Carex colensoi.*	
173	Grass	"	..	Is crested hair-grass (*Kolleria cristata*).	
174	"	"	..	Is *Poa intermedia* var.	
175	Seed	Masterton ..	..	Is black-medick (*Medicago lupulina*).	
176	Grass	Christchurch	..	Is reflex bristle-grass (*Setaria verticillata*).	
177	Fiorin	"	12	Pure.	
178	Cocksfoot	"	..	Fog, 10, with occasional goose-grass, meadow-fescue, rye-grass, and hair-grass (Festuca), and much chaffy matter	10
179	"	"	..	Occasional Yorkshire fog; also meadow-fescue and rye-grass, as in No. 178, with a few cat's-ear; other impurities absent.	
180	Meadow-fescue ..	Masterton ..	53	Practically pure.	
181	Timothy	" ..	91	Practically pure; a few odd red-clover, fat-hen, Poa sp., &c.	
182	"	" ..	78	Odd seeds of small Poas, bent grass (Agrostis), &c.	
183	Crested dog's-tail ..	" ..	42	Frequent fog (Holcus), some agrostis, and odd plantain, ox-eye daisy, &c.	
184	" ..	" ..	44	Occasional undetermined and fog.	
185	Fiorin	" ..	56	Frequent rush (Juncus sp).	
186	*Poa nemoralis* ..	" ..	7	Occasional various, white-clover, alsike, chickweed, sorrel, undetermined, composite plant, &c.	
187	*Poa pratensis* ..	" ..	10	Odd chickweed, white-clover, sorrel, &c.	
188	White-clover ..	" ..	55	Sorrel, 2; occasional plantain, and various	2
189	American cow-grass ..	" ..	70	Frequent seeds of a species of umbelliferous plant, and occasional rye-grass and plantain.	
190	" ..	" ..	79	Occasional rye-grass, plantain, and various.	
191	English cow-grass ..	" ..	84	Odd seeds of plantain and dock.	
192	American red-clover..	" ..	84	Frequent seeds of a species of umbelliferous plant; also rye-grass and plantain.	
193	Alsike	" ..	69	Occasional timothy, and three species of undetermined composite plants; odd plantain, sorrel, and cleavers (Galium).	
194	"	" ..	84	Occasional timothy, and odd red-clover, and corn (Galium).	
195	Espercet (Sainfoin) ..	" ..	35	Red-clover, 3; sheep's parsley, 2	5
196	White-mustard ..	" ..	98	Odd Bromus sp., sorrel, red-clover, Lucerne, and corn (Galium).	
197	Grass	Timaru	..	Is slender glumeless grass (*Gymnostichum gracile*).	
198	"	" ..	..	Is *Agrostis youngii.*	
199	Sedge	" ..	..	Is snow-grass (*Schoenus pauciflorus*).	
200	Grass	" ..	..	Is Italian rye-grass.	
201	"	" ..	..	Is meadow-fescue.	
202	"	" ..	..	Is crested hair-grass (*Koelaria cristata*).	
203	Sedge	" ..	..	Is *Carex forsteri.*	

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No.	Name.	Source.	Germinating Power per Cent.	Impurities per Cent., and Remarks.	Total Impurities per Cent.
204	Sedge	Timaru ..	..	Is nigger-head (*Carex virgata*).	
205	Grass	" ..	..	Is *Poa breviglumis.*	
206	"	" ..	..	Is smooth-stalked meadow-grass (*Poa pratensis*).	
207	"	" ..	..	Is *Poa breviglumis* var.	
208	"	" ..	..	Is *Poa colensoi.*	
209	"	" ..	..	Flowering head of one grass—*Poa intermedia*—and leafy shoots of another, Danthornia sp.	
210	Plant	" ..	..	Is *Anthericum hookeri.*	
211	Grass	Christchurch	..	*Poa colensoi* var.	
212	"	"	..	Is *Echinopogon ovatus.*	
213	Trefoil and white-clover	Rangitata ..	..	Consists of *Trefolium minus*, 89; white-clover, 7; rye-grass, 4; with odd hair-grass and mouse-ear chick-weed.	4
214	Grass	Christchurch	..	Is brown bent grass (*Agrostis canina*).	
214A	Plant	Chertsey ..	..	Is *Cerastium arvense*, a perennial chickweed.	
215	English red-clover ..	Oamaru ..	93	Odd seeds of timothy, English millet (*Milium effusum*), &c.	
216	English cow-grass ..	" ..	92	Plantain (*Plantago lanceolata*)	1
217	English white-clover	" ..	77	Occasional sorrel, and various.	
218	English alsike ..	" ..	50	Occasional timothy, and odd chamomile, &c.	
219	English trefoil ..	" ..	88	Occasional cleavers (*Galium aparine*).	
220	English timothy ..	" ..	96	Pure.	
221	Rye-grass	" ..	35	Occasional sorrel and cat's-ear.	
222	"	" ..	46	Pure.	
223	Cocksfoot	" ..	61	Odd seeds of fog, goose-grass, and cat's-ear.	
224	Radish	Waipawa ..	70		
225	Cow-grass	Rakaia ..	..	Occasional timothy and English millet, with odd Scotch thistle, sorrel, dock, alsike, and undetermined.	
226	Alsike	" ..	..	Timothy, 4; and occasional red-clover, with odd seeds of small poas, Plantago sp., dock, rib-grass, ox-eye daisy, and Californian thistle	4
227	Timothy	Gore ..	..	Frequent white-clover and alsike, occasional cat's-ear, chickweed (*Cerastium arvense*), and fog, with odd rib-grass and sow-thistle.	
228	Grass	Methven ..	..	Is annual meadow-grass.	
229	Plant	Christchurch	..	Is bladder catchfly (*Silene inflata*).	
230	"	"	..	Is penny cress (*Thlaspi arvense*).	
231	"	College farm..	..	Is narrow-leaved cress (*Lepidium rudervale*).	
232	Grass	Rakaia ..	..	Is knee-joint foxtail.	
233	Plant	" ..	..	Is field-spurrey (*Spergula arvensis*).	
234	"	" ..	..	Is a species of Galium.	
235	"	College farm..	..	Is thorn apple (*Datura stramonium*).	

No. 94.—A sample of this plant, called wauraki by the Maoris, was sent from the North Island. The plant was supposed to have been the cause of the death of certain cattle which had been feeding on recently-burnt fern-lands, where the ranunculus was growing. The symptoms were inflammation of the membrane of the stomach, with appearance of intense pain. The plants of this genus are all acrid in different degrees, and another species common about here (*R. scebratus*, the most acrid of any) has been stated to have caused the death of a number of sheep in this district some years since.

No. 134.—This plant was thought by the sender to be the Californian thistle. The star thistle is only an annual (closely allied to the English cornflower), and may be easily distinguished by the stiff spines—from ½in. to 1in. long—projecting from underneath the flower-heads. These spiny heads are very injurious in sheep's wool.

Nos. 145 and 146.—In connection with these two samples an experiment was made to test the statement that camphor assisted germination. The experiments showed an appreciable difference between the seeds moistened with solution of camphor and those with plain water.

Nos. 154 and 226.—The samples are noticeable, owing to the presence of seeds of the Californian thistle. The samples seem to be quite distinct from one another, and show how easily this and other weeds may be introduced and spread through the country. Farmers cannot be too careful as to purity of their seeds.

Nos. 169 and 214A.—This weed mats the ground completely together by means of its very fine underground stems, and it promises to give much trouble in eradicating it. It is one of the English perennial chickweeds, and differs from the common, hairy, annual chickweed (*Cerastium vulgatum*) in having its petals about twice as long as the sepals.

No. 176.—This grass was stated to come from very dry soil, and to have kept green all through the dry weather. It is an annual grass, which Parnell says is "of no agricultural value."

Nos. 178 and 179.—These samples show the value of a special fog-cleaning apparatus. No. 178 is before cleaning, and No. 179 after.

In connection with the seed-examination department a McLaren's Patent Seed-germinator has lately been obtained from Edinburgh. It has not yet been fully tested, but the patentee claims that it prevents the growth of fungus, and gives rapid results. The principle seems good, there being adequate provision for heating and ventilation.

Entomological.

A few experiments have been made to try and find a satisfactory remedy for the apple-scale insect. This pest can be attacked at two seasons of the year—either in winter, when the eggs are lying dormant under the scale, or else towards the end of spring, when the eggs hatch out. In the first case the dressings must be strong enough to penetrate or destroy the leathery scale, and so reach the eggs. In the second case, the larvæ, being naked, are killed by a weaker dressing, but the difficulty is that the eggs will continue hatching out for from a month to six weeks, and, as the larvæ are only naked for about three days, the trees would have to be dressed some ten times over, unless some adhesive dressing can be found which will remain on the tree and kill the insects as they hatch out. Perhaps some resin soap mixture may effect this.

It is obvious that if a dressing can be found which will destroy all the eggs in winter time, without hurting the tree, it will be most satisfactory, on account of the ease of application at this time. Such a dressing must be cheap and sufficiently liquid to use with a spray.

The following experiments have been tried:—

A.—Winter Season.

Castor-oil.—This thinly brushed on is very successful, but the cost of application is too great. Care should be taken to apply this dressing only in midwinter as, if the sap is moving at all, it is likely to kill the part dressed. One-fifth part of kerosene makes it easier to apply, and perhaps more effective.

Greenbank Caustic Soda, 98 per Cent.—One pound to the gallon, sprayed on at a temperature of 130° Fahr. This promises fairly well; it turns the scales quite white, and loosens their hold on the tree. Some of those, however, that seem to have been quite destroyed were found to have some sound eggs beneath them; perhaps a slightly stronger solution might be used in midwinter. The soda cost about 8½d. per pound, and perhaps half a gallon of solution would dress a medium-sized tree.

Sheep-dips—Little's, Carbol Crystal, and perhaps Others.—Strong dressings of these (1 in 10?) may be effective, and further experiments will be made.

Kerosene Emulsion (1 in about 5) has been used with good results elsewhere.

B.—Summer Season.

Sheep-dips (1 in 100) and Kerosene Emulsion (1 in 20?).—These would probably be effective if persevered with.

Sulphur-and-lime wash, formed by boiling 1lb. of sulphur and 2lb. of lime in from four to six gallons of water for half an hour. This would have to be persevered with also. In the experiments here the proportion of lime was increased, as much of the residue, after boiling, was pure sulphur and sand.

Soap.—This was used 4oz. to the gallon, warm. The solution was found to choke up the nozzle (cyclone) of the spray if it cooled too much. Common hard soap was used; probably the soft soap would be better. It is believed, as stated above, that some form of soap-dressing would be satisfactory, and further experiments will be made.

Greenbank Caustic Soda, 98 per Cent.—This was tried 2oz. to the gallon, but was thought to have more effect on the tree than on the larvæ. Even if successful, it would have to be repeated at short intervals.

Carbolic Acid (No. 5).—1 in 240 and 1 in 120 were tried on a pear-tree, but seemed to have no effect on either larvæ or tree.

It has been suggested to give time for all the eggs to hatch out, and then to dress the freshly-formed scales with kerosene emulsion or sheep-dip, using stronger washes than for the naked larvæ. This was tried with emulsion 1 in 14, and dip 1 in 80; but, though some good seemed to have been done, the result was not at all satisfactory. Further experiments might be made in this direction.

American Blight.—It was thought that this would be killed by the castor-oil used for the apple-scale, but it came again next spring very strong; possibly the oil had not been brushed sufficiently well into the crevices. It is believed that the greenbank soda sprayed on in winter, as for apple-scale will be effective.

Red Spider.—It does not seem to have been yet recorded that the red spider, common in Canterbury, is not the *Tetranychus telarius*, as is usually supposed. Our species differs considerably in its much greater size, its more angular shape, the absence of so much web, the red colour of the egg, and other points, and does not seem to agree with any described by Mr. Andrew Murray in his "Economic Entomology." Dressings that will be successful for the apple-scale, will probably be so also for the red spider, only that as some hibernate under logs, &c., winter dressings to destroy the eggs may not be wholly effective in clearing the orchard. The sulphur-and-lime wash, before mentioned, was tried specially for it, but some days afterwards the tree was found to have some spiders moving about on the leaves, notwithstanding that these were more or less covered by a thin deposit of free sulphur.

The Currant-borer.—This has done much harm at the school and elsewhere—seemingly general—through its habits of boring out the pith of the stems. Specimens of the mature insect have not yet been seen, but, from the size and general appearance of the caterpillar, it is thought that it must be the currant clearwing (*Algeria tipuliformis*). A magnified photograph of two larvæ and chrysalis cases is attached. The usual remedy recommended is to thoroughly prime out and burn the infected branches; but the attack might be prevented by spraying the plants with some obnoxious or poisonous dressing at the time of egg-laying—about the New Year, or after the fruit is gathered—though after a tree has once been badly attacked the old branches are so weakened as to break off freely in the fruiting season, and it would be better to start with new wood.

Injurious Farm Insects.

The Grass-grub (Odontaria).—This has been very severe in its attack this season, not only on perennial pastures, but also on the young grass, and in some cases fear has been entertained for the early-sown wheat. The general policy seems to be to let this insect alone to the starlings, gulls, and sea-swallows (or terns), which certainly do an inestimable amount of good. The little white-eye (Zosterops) even has been seen swallowing the grubs whole. I believe, however, that experiment might show the practicability of dealing with the attack, to a certain extent, at any rate, by either broadcasting some cheap noxious dressing at the egg-laying season, to render the ground distasteful to the beetles, or by heavily rolling the pastures when the grub is in them feeding close to the surface. The latter treatment would not only kill many of the grubs, but also give the attacked plants a better chance to root again.

The Diamond-back Turnip-moth (Plutella conciferarum).—The attack by the caterpillar of this insect was also very severe this season. A noticeable feature was that the caterpillars, after (with the assistance of the turnip aphis) destroying the leafage, descended to the exposed part of the root, and in some cases completely honeycombed them. Of late years they have attacked the spring cabbage in the same way, sometimes completely mining through the hearts and rendering them nearly unfit for use. At the present time (22nd July) they may be found in the larval stage on winter cabbage, probably owing to the comparatively mild winter, and it seems reasonable to expect that, should the weather continue dry, the attack will be worse next turnip season than the last. Though the attack seems to have been very general this year, I was informed by a resident of the Rakaia district that, of two fields divided by a road, one had been attacked and the other not. This seems unaccountable. A study of this insect, with a view to finding means of dealing successfully with it, is much needed. Considering the way in which turnips are usually fed off, it seems impossible that any of the chrysalids should be left alive. Perhaps there may not be, and the attack may extend to the next season's turnips from off the summer cabbages. It is noticeable that a crop of white mustard was destroyed by them here in the summer of 1890. The starlings may be seen in countless flights in the attacked turnip-fields, but the caterpillars are too numerous for any impression to be made.

The Turnip-fly.—Although this insect is often spoken of, I believe few are aware that it has no connection with the English turnip-fly or flea-beetle (*Haltica nemorum*). Our "fly" is a minute globular-bodied Collembolan insect, and belongs to the genus Smynthurus. The terms "ground-flea" and "springtail" are applied to all the insects of the order Collembola, from the fact of their possessing a special hopping-organ attached to the lower side of the abdomen. On this account the term "turnip ground-flea" seems more suitable to designate the ones referred to here. Sir John Lubbock has written very fully on them in his "Monograph of the Collembola and Thysanura," issued by the Ray Society in 1873; but the species here seem to be quite distinct to any described by him. The photo-micrograph attached will give a slight idea as to their general appearance. They are of a fairly uniform colour all over—some being orange and others purple. They are always wingless, have no metamorphosis, and have a chewing mouth. They may usually be found in countless numbers, from about the middle of September to the end of February, on paddocks of grass, grain, seedling turnips, &c. They have been found congregating on the young turnips in their seed-leaf stage, the leaves being much mutilated and eaten, and in some cases merely the stump of the plant being left. The danger seems to be over as soon as the rough leaves come out; and, consequently, any means to hasten this—such as good cultivation and the water-drill with manures—will be desirable as a prevention. No experiments have been made to find a remedy, but means somewhat similar to those used against the English Haltica would probably be useful.

Mealy Bug (*Dactylopius poæ*, Maskell) is quite common, and apparently increasing on various grasses here, and seems to do an appreciable amount of damage. It is a small oval pink-coloured insect, more or less imbedded in a white mealy matter, and lives by sucking the juices from the underground parts of the stems and from the roots. A small plot of cocksfoot just dug up showed them sprinkled all through it to the full depth of a spade. Cultivation would seem to be the only practical remedy.

New Forms of Insect Attack.

The Bean Aphis (Aphis rumicis).—This aphis, popularly known as the "collier" or "black dolphin," was reported from Ohoka last season. It may readily be known by its black colour. Cutting off and destroying the top shoots, with the aphis on them, seems the best remedy.

Horse Bot Fly (*Œstrus sp.*).—One of these appeared in great numbers last season, and caused much trouble among the horses. The eggs were deposited upon the tips of the hairs under the jaws, and about the throat, chest, and forelegs. It seems a feature of these flies to frighten the animals they attack; and there seems no reason to suppose that the horses were in any way punctured, as many think. Washing the horses coat daily with some noxious dressing (sheep-dip, &c.) would probably prevent attack. There is no remedy. The larval stage of these flies is passed in the stomach and intestines; when full grown it is passed out, and the pupa stage is taken in the ground, the perfect fly appearing again next summer.

Apiculture.

Scientific bee-keeping was recommenced at the school in connection with this department last season. It was decided to use the Langstroth hive, and a start was made by transferring and uniting two weak colonies from old Cox hives. Another colony was obtained and transferred later on, and six swarms were obtained from various sources. Full sheets of foundation were used in all cases. The season was a very poor one for bees, swarming not beginning till the second week in November; but, still, 100lb. of surplus was taken from four hives, and most of them seem wintering well. The ordinary black bee was obtained to start with; but it is proposed to Italianise these later on, as the Italian (or Ligurian) bees are considered more tractable, and better honey-gatherers.

APPENDIX No. 3.—METEOROLOGICAL.

THE following tables should be of interest as showing the meteorological conditions prevailing in this district. The observations are recorded at 9.30 a.m. daily, and the altitude of the school is 65ft. above sea-level:—

TABLE I.—MONTHLY ABSTRACT for the Year ending 30th June, 1891.

Month.	Barometer, reduced to 32° F. and Sea-level.			Self-registering Thermometers.									Degree of Moisture of Atmosphere.		Rainfall.			Wind.		Cloud.
				Shade.				Exposed.												
				Maximum.		Minimum.		Solar.		Terrestrial.										
	Daily Means.	Maximum.	Minimum.	Daily Means.	Extreme	Daily Means.	Extreme	Daily Means.	Max.	Daily Means.	Min.	No. of Frosts.	Daily Means.	Min.	Total.	Wet Days.	Max. Fall.	Daily Means.	Max.	Daily Means.
1890.	Inches.	Inches.	Inches.	°	°	°	°	°	°	°	°	Days.	Per cent.	Per cent.	Inches.		Inches.	Miles.	Miles.	Per cent.
July	30·008	30·529	29·580	47·5	56·2	36·3	27·8	85·3	102·2	31·8	20·2	17	81·5	?	3·377	22	·802	207	501	70
August	30·042	30·545	29·537	56·3	69·6	37·1	27·0	104·5	123·7	31·5	20·4	19	72·0	51	·508	4	·364	198	495	50
September	29·968	30·381	29·213	58·5	69·6	42·3	28·2	114·5	130·2	37·8	23·4	8	75·0	60	1·219	8	·485	243	578	63
October	29·578	30·100	28·947	66·4	76·0	43·8	34·0	129·6	148·8	37·5	27·7	9	62·5	44	1·440	9	·404	322	518	54
November	29·823	30·337	29·068	66·2	80·2	46·3	35·8	134·2	151·6	41·1	30·4	3	67·3	52	1·667	7	·597	314	639	55
December	29·751	30·145	29·146	73·2	87·2	50·4	40·2	142·2	159·4	45·4	32·8	0	59·0	40	·528	6	·211	296	596	55
1891.																				
January	29·860	30·493	28·976	72·8	94·2	52·1	43·2	140·1	157·4	46·8	36·8	0	60·6	35	2·099	9	·472	302	480	66
February	29·889	30·278	29·167	68·0	82·4	52·8	43·8	128·7	147·4	50·6	39·4	0	72·9	52	3·845	12	1·403	288	475	61
March	29·951	30·497	29·071	70·9	87·4	50·1	39·0	131·0	153·2	45·5	33·8	0	63·0	48	·594	4	·504	290	649	45
April	29·896	30·495	29·012	64·9	79·8	44·5	34·8	116·9	136·8	40·4	29·0	5	65·5	44	1·738	7	·659	262	532	57
May	30·174	30·673	29·636	57·1	70·6	39·1	28·6	102·9	124·8	36·2	24·2	7	73·6	58	1·679	6	1·250	213	416	45
June	30·085	30·446	29·043	48·9	58·2	31·3	22·8	91·2	104·4	27·9	19·2	26	82·0	67	1·299	8	·289	163	508	51
Total ..	..	..	..	..	..	..	..	..	..	..	..	94	..	..	19·993	102	..	..	..	..
Mean ..	29·919	..	..	62·6	..	43·8	..	118·4	..	39·4	..	..	69·6	..	..	..	..	258	..	56

TABLE II.—MEAN MONTHLY ABSTRACT, compiled from the Nine Years' Readings ending 30th June, 1891.

Month.	Barometer reduced to 32° F. and Sea-level.	Self-registering Thermometers.					Rainfall Totals.		Degree of Moisture of Atmosphere.	Wind.	Cloud.
		Shade.		Exposed.							
		Maximum.	Minimum.	Solar.	Terrestrial.	Days of Frosts: Totals.	Average Monthly Fall.	Average No. Wet Days.			
	Inches.	°	°	°	°	Days.	Inches.	Days.	Per cent.	Miles.	Per cent.
January	30·009	71·5	51·4	133·7	47·1	0·4	1·662	9	67·9	269	60
February	30·073	71·3	51·8	132·9	47·6	0·6	1·470	7	68·0	257	57
March	30·083	68·7	49·0	125·6	45·0	1·0	2·462	10	69·8	238	60
April	30·207	63·1	43·7	111·3	40·0	6·1	2·097	9	72·1	214	62
May	30·168	56·1	39·3	98·8	34·5	12·1	2·384	11	77·2	197	59
June	30·134	51·9	35·0	89·5	30·4	20·0	2·368	10	79·0	167	57
July	30·039	50·8	34·5	86·9	29·6	20·4	2·839	15	80·7	180	59
August	30·043	53·0	36·4	98·9	31·5	16·4	3·206	13	76·0	212	58
September ..	30·005	57·7	39·3	112·4	34·2	11·1	2·187	10	72·7	233	57
October	29·906	62·2	42·5	126·5	36·5	8·6	1·636	11	69·3	277	59
November ..	30·024	62·7	44·7	127·7	40·1	3·0	2·731	11	72·6	290	58
December ..	29·929	69·0	49·0	135·9	44·3	1·0	1·697	9	66·6	279	56
Total ..	..	..	..	..	..	100·7	26·739	125	..	..	..
Annual mean ..	30·052	61·5	43·0	115·0	38·4	..	..	..	72·7	235	58

TABLE III.—TRI-YEARLY and YEARLY ABSTRACT, from September, 1882, to April, 1891, inclusive.

Years and Periods.	Barometer, reduced to 32° F. and Sea-level.		Self-registering Thermometers. Shade. Maximum.		Shade. Minimum.		Exposed. Solar.		Exposed. Terrestrial.		No. of Frosts: Totals.		Degree of Moisture of the Atmosphere.		Rainfall: Totals.		Wet Days: Totals.		Wind.		Cloud.	
	Periods.	Years.	Periods.	Years.	Periods.	Years.	Periods.	Years.	Periods.	Years.	Periods.	Years.	Periods.	Years.	Periods.	Years.	Periods.	Years.	Periods.	Years.	Periods.	Years.
	Inches.	Inches.	°	°	°	°	°	°	°	°	Days.	Days.	P. cent.	P. cent.	Inches.	Inches.	Days.	Days.	Miles.	Miles.	P. cent.	P. cent.
1882.																						
September to December ..	29·879	..	64·2	..	44·1	..	122·0	..	36·6	..	..	..	70·7	..	10·290	..	37	..	233	..	47	..
1883.																						
January to April ..	30·023		67·5		50·6		114·6		44·9		..		73·7		8·696		48		227		63	
May to August	29·931	29·967	53·8	60·4	37·1	43·7	90·6	108·9	..	..	..	..	78·8	74·0	9·470	30·336	48	139	172	214	47	54
September to December ..	29·946		60·0		43·4		121·5		..		..		69·6		12·170		43		242		52	
1884.																						
January to April ..	30·050		64·9		46·4		119·6		..		..		75·2		9·410		39		202		52	
May to August	30·095	29·994	53·6	60·0	35·3	41·6	87·8	108·4	..	..	..	..	75·5	78·2	8·565	28·451	37	126	179	220	51	56
September to December ..	29·838		61·4		43·1		117·8		..		23		84·0		10·476		50		280		64	
1885.																						
January to April ..	30·083		66·6		47·8		120·3		..		12		76·8		8·598		39		207		62	
May to August	30·145	30·101	54·0	61·6	36·8	42·5	96·5	115·4	30·6	..	74	127	78·5	74·8	8·877	22·130	45	118	174	208	52	53
September to December ..	30·075		64·2		42·9		129·5		36·9		41		69·2		4·655		34		243		45	
1886.																						
January to April ..	30·094		69·0		49·6		127·6		43·1		10		70·8		8·777		38		194		65	
May to August	30·054	30·057	50·3	60·6	35·6	43·4	92·2	115·6	28·4	37·4	78	101	79·2	73·6	19·685	35·287	55	138	164	219	70	67
September to December ..	30·023		62·5		44·9		127·0		40·6		13		70·8		6·825		45		298		65	
1887.																						
January to April ..	30·172		71·8		51·2		129·7		48·1		4		66·7		5·976		31		247		60	
May to August	30·115	30·089	52·1	61·8	37·1	44·0	93·2	116·7	34·2	40·6	58	80	83·0	73·3	16·215	32·890	69	149	235	254	67	62
September to December ..	29·981		61·6		43·8		127·1		39·5		18		70·2		10·699		49		281		60	
1888.																						
January to April ..	30·029		68·7		46·7		132·7		42·4		9		65·5		9·631		35		301		54	
May to August	30·180	30·086	53·4	61·6	37·3	41·9	97·0	119·5	34·2	38·2	52	88	78·5	69·6	12·508	29·155	51	128	203	267	63	60
September to December ..	30·050		62·6		41·6		128·7		38·1		27		64·8		7·016		42		297		62	
1889.																						
January to April ..	30·204		70·5		49·7		129·7		45·3		8		62·7		6·256		28		269		63	
May to August	30·222	30·184	52·0	62·0	35·6	43·6	95·7	117·4	30·9	38·5	78	110	78·3	69·5	6·844	20·384	45	109	182	238	66	64
September to December ..	30·125		63·5		45·6		126·7		39·4		24		67·5		7·284		36		262		64	
1890.																						
January to April ..	30·283		69·5		48·8		129·6		44·7		9		67·7		3·600		26		271		60	
May to August	30·164	30·076	53·7	63·1	36·1	43·5	95·4	118·4	31·6	38·9	69	98	75·9	69·8	6·382	14·836	45	101	192	252	61	59
September to December ..	29·780		66·1		45·7		130·1		40·4		20		65·9		4·854		30		294		57	
1891.																						
January to April ..	29·899	..	69·1	..	49·9	..	129·2	..	45·8	..	5	..	65·9	..	8·276	..	32	..	286	..	57	..

APPENDIX No. 4.

YIELD of GRAIN for Years 1883 to 1891.

Harvest of	Bushels per Acre. Wheat.	Oats.	Barley.	Average.	Total Grain Grown (Bushels).
1883	40	44¼	52	42½	8,582
1884	31⅔	57	17	35½	7,513
1885	44¼	54¾	47½	47½	11,400
1886	30½	41½	19½	31¼	6,892
1887	25¾	30	37¼	29	5,848
1888	40	40	37½	39	7,952
1889	33	62	20½	35	7,009
1890	42¼	63¼	35	45½	9,200
1891	27	29¼	15½	27	4,915
Average of nine years ...	35	47	31¼	37	7,701

APPENDIX No. 5.

SHOWING the CROPPING of the FARM, 1891.

—	No. of Field.	Kind.	Acreage. A. R. P.	Totals. A. R. P.
Wheat	1	White Tuscan	22 0 0	
"	15	Essex rough chaff	24 3 0	
"	26	Golden drop	26 0 0	
"	28	Velvet	9 2 0	
"	33	Minnesota, hard	16 0 0	
				98 1 0
Oats	14	Canadian	24 3 0	
"	16	Sparrow-bill	24 3 0	
"	24	Long Tartarian	21 1 0	
				70 3 0
Barley	6	Golden melon	16 1 0	
"	23	Winter	3 0 0	
				19 1 0
Beans	30	Tick	...	13 0 0
Peas	30	Dun	...	7 1 0
Vetches	23	Golden	...	3 0 0
Spring feed	3	Winter barley	19 1 0	
	25	Vetches and oats	15 3 0	
				35 0 0
Fallow	...	For roots	...	86 1 0
		Rotation grasses	...	156 2 0
		Permanent pasture	...	126 1 0
		Total available area ...	...	615 2 0
Occupied by buildings, yards, plantations, orchard and garden, experimental plots, roads, waste places, &c.			...	46 1 0
Grand total			...	661 3 0

APPENDIX No. 6.

ON the VALUE to the FARMER of SOIL ANALYSIS, by W. E. IVEY, M.R.A.C., F.C.S., F.I.C., &c.

THAT the chemical analysis of soils is of considerable scientific value all experts will allow, but that the analysis of the soils of his farm will afford the ordinary farmer much assistance in profitable cropping or in manuring will not be so readily granted.

It is a more or less general impression with many who have but a superficial knowledge of agricultural chemistry that, by determining in a soil the quantities of those substances it contains which are required by plants as food, it would be possible for the chemist, having an exact knowledge of the composition and requirements of plants, to advise the farmer as to the kinds of crops he should grow; or, as the farmer would say, what crops his soil is fitted for, and as to the kinds of manure he should apply in order to make up apparent deficiencies in his soil, and thus restore the fertility thereof.

The notion that it is possible, from the mere inspection of the statement of the percentage composition of a soil, one might prescribe the treatment of such soil, both as to cropping and manuring, is certainly very attractive; so much so, that farmers holding this opinion are often disappointed when the inability to advise on these matters from soil-analysis alone is confessed, and they are told that the expensive work of analysis is not warranted by the amount of information afforded them, even if they understood the figures at all. Of course if, as I saw in an auctioneer's advertisement in a Sydney paper some years ago, the quantity of a constituent is used to give sale value to land it may be said to be of use. In this case the percentage of nitrogen the soil contained was calculated into pounds per acre, and shown to be equal to the quantity in so many tons of Peruvian guano, and therefore, as this chemist—or charlatan—said in his report, this land was of very great value, but in ordinary cases—*i.e.*, where no abnormal conditions exist, it is as easy for the farmer to judge what crops to grow, and, from a general knowledge of the wants of the various crops, what manure to use for each kind of crop, as it would be if he had the most elaborate analysis in his hand, and it would be much safer.

In case of infertility, and in many other instances of abnormality in soils, chemical analysis is often of great value. I have myself analysed many samples of soil which were absolutely barren, and yet had the appearance of being good soil, and had been taken up as such. The analysis showed in some cases that infertility was caused by such poisonous substances as ferrous salts, or humus acids, or excess of alkali. And it is often of use to know whether your soil contains much or little lime, &c., but to deal with soil-analysis as a sort of medical diagnosis, with the view of prescribing a pill of phosphates or nitrates, or what not, is absurd.

I repeat, in the hands of an expert, having also a knowledge of the soil *in situ*—*i.e.*, of its peculiarities, of its surroundings, aspect, climate, &c., soil-analysis might be of use, and often is; but from analysis alone no one should venture to say that this soil will grow, for instance, white grapes and that red grapes, because the one contains more or less lime, or potash, &c., than the other.

Let me explain why this is so: Firstly, chemical analysis alone is absolutely valueless as indicating agricultural value, as there may be laid before a professing adviser two statements of the results of analysis which may be exactly the same, and yet one may be the outcome of an examination of a mixture of pulverised rock and humus of no agricultural value, and the other that of a very fertile soil. Or we might have an indurated almost useless clay of similar composition with a really rich soil, or even showing a larger percentage of the acknowledged valuable constituents.

But it is in connection with manuring, *i.e.*, in reply to the question "What does analysis say that my soil wants in the shape of manure?" That advice, based upon the percentage of the various constituents a soil is shown to contain, and upon that alone, must especially be fallacious. Why?

It will be admitted that an application of 2cwt. of superphosphate of lime to an acre of land may make the difference between a bad and a good crop of turnips. Would a chemical analysis of two samples of soil from the same field, the one having received such a dressing, the other not, show necessarilly which was the one manured? And if not, how can any one, from a statement of the results of analysis alone, say whether or not a soil requires an addition of phosphates?

An acre of soil to the depth of about 8in. weighs about 2,500,000lb. The amount of anhydrous phosphoric acid in an ordinary 26 per cent. superphosphate is, say, 31¼lb. If it were possible to mix intimately 2cwt. of such a superphosphate with the soil of an acre of land and obtain a fair sample for analysis, the result of the analysis would be theoretically an increased percentage of this item of ·0012. That is to say, it would require the addition of 2cwt.—a very good dressing—of superphospate to supply phosphoric acid enough to affect the third place of decimals in a percentage statement. And no chemist, in determining phosphoric acid in soils, can be sure of working so accurately as to be certain that he is correct to the third place of decimals. In fact, ·001 per cent. is within the possible—nay probable—error of analysis.

Again, for the purpose of determining the amount of phosphoric acid in a soil, he generally takes about 60 grains—*i.e.*, one-eighth of an ounce, or one three hundred and twenty millionth of the soil of an acre of land; and to determine whether he was dealing with soil to which had or had not been added 2cwt. of superphosphate, he has to deal with one three hundred and twenty millionth of 31¼lb. of phosphoric acid, or about ·00075 of a grain.

Leaving out of the question possible errors of manipulation during analysis, there is the question of sampling to be considered; and I may say that it is practically impossible to select two one-eighths of samples from a bulk which would agree in results to ·001 per cent. or to ·00075 of a grain of phosphoric acid.

And, lastly, published results of analyses of soils seldom tell us the condition of the phosphoric acid therein; and this is all important, for it is upon the solubility of this substance that its value to a great extent depends. So that it may be the case that the soil containing the lower percentage, and yet the larger quantity of available phosphoric acid, that is the more fruitful one.

Take a case in point: Were I to attempt to value the soils of the College Farm for their percentage composition alone I should be wofully out, for in several instances the poorer—and in some cases much the poorer—soil contains the larger percentage of phosphoric acid. In one case it would require 95cwt. and in another 60cwt. of superphosphate per acre to equalise the phosphates in two soils.

Of course it may be said that fertility is not due to phosphates alone. True, but like results obtain when dealing with nitrogen, and were it worth while to enter into the necessary calculations this could be easily shown.

To attempt to advise upon the inspection of a statement of results of analysis of a soil as to whether that soil requires nitrogen, or phosphates, or potash, is to undertake to do what one is not warranted in doing in cases of ordinary soils, though of course it may be stated that the quantity is above or below the average. And to the ordinary farmer, what does a statement of result of analysis mean to him? Does it necessarily convey any meaning at all to him? I do not think it does in any but exceptional cases.

The analysis of soils of a country should be systematically carried out for the information of scientists, but not for the farmer with a view of ascertaining what is the most suitable crop or what manure he should apply. As I have said, mechanical condition, locality, subsoil, climate, &c., affect the productiveness of soils more than their chemical composition, and in cases of useful soils which may have been worked out, it is better to rely upon the application of phosphates for turnips, nitrogen for cereals, grasses, &c., than to worry over analysis.

If soils are not useful the farmer does not want analysis, for he does not take up such soils, knowing intuitively that not all the phosphates or nitrogen he could apply would render them so fertile that he could produce from them payable crops of wheat, or grass, or other crop.

APPENDIX No. 7.

List of Wheats growing experimentally on the Farm.

1. Blount's Trap.
2. Pringle's No. 6.
3. Egyptian.
4. Blount's Basalt.
5. Hedgerow.
6. Dominion.
7. Lost Nation.
8. Golden Globe.
9. China Tea.
10. Meekins.
11. Rustproof.
12. Australian Club.
13. Saxon Fife.
14. Cretan.
15. Centennial.
16. Square-head.
17. Australian Winter.
18. Chili.
19. Blount's.
20. Touzelle.
21. Samara.
22. Mediterranean.
23. Blount's Hybrid.
24. Walker.
25. Australian Hard.
26. Canadian Club.
27. Brooks's.
28. The Blount.
29. Dallas.
30. Lambrigg.
31. Purple Chaff.
32. Australian Loft.
33 Pringle's No. 4.
34. Rio Grande.
35. Roseworthy.
36. Minnesota Fife.
37. Oregon Fife.
38. Indian.
39. Eldorado.
40. White Mexican.
41. Durmur.
42. Polish.
43. Odessa.
44. Russian.
45. Sherman.
46. Defiance.
47. Suvator.
48. Vermont.
49. Prussian.
50. White Fife.
51. White Russian.
52. Early Baart.
53. Gallant's Hybrid.
54. Indian.
55. Indian Beardless.
56. Champlain.
57. Ward's Prolific.
58. Sonora.
59. Improved Fife.
60. China Spring.
61. Zealand.
62. Steinwedel.
63. Du Toits.
64. Farmer's Friend.
65. Rattling Tom.

66 to 76. Carter's Cross-bred A to K.

77. Poulard.
78. Rieti.
79. Souvenir de Mars.
80. Sample No. 5.

APPENDIX No. 8.

Particulars of Manurial Experiments on Wheat.

No. 10, ¼-acre Plots.	Kind of Manure.	Quantity per Acre.	Cost per Acre.
No.		Cwt.	£ s. d.
1	Sulphate of ammonia, one dressing (in winter)	1½	1 2 6
2	Sulphate of ammonia, two dressings (winter and spring)	1½	1 2 6
3	Sulphate of ammonia (in winter)	¾	1 4 0
	Superphosphate of lime (in winter)	1½	
4	Sulphate of ammonia (in winter)	1½	2 6 6
	Superphosphate of lime (in winter)	3	
5	No manure.		
6	Lime (in winter)	5	0 6 6
7	Sulphate of ammonia, two dressings (winter and spring)	3	2 5 0
8	Sulphate of ammonia (in spring)	¾	1 4 0
	Superphosphate of lime (in winter)	1½	
9	Sulphate of ammonia (in spring)	1½	2 6 6
	Superphosphate of lime (in winter)	3	
10	Superphosphate of lime (in winter)	3	1 4 0
11	Patent silicate manure	5	...

PARTICULARS of MANURIAL EXPERIMENTS on WHEAT—*continued.*

No. 15, 2-acre Plots.	Kind of Manure.	Quantity per Acre.	Cost per Acre.
No.		Cwt.	£ s. d.
1	Sulphate of ammonia	1½	1 2 6
2	Dried blood (Belfast)	3	0 18 0
3	Sulphate of ammonia ... ... Superphosphate of lime	1 1	1 2 6
4	Dried blood ... ... Superphosphate of lime	2 1	0 17 6
5	No manure.		
6	Sulphate of ammonia	¾	0 11 3
7	Dried blood	1½	0 9 3
8	Superphosphate of lime	2	0 16 0
9	No manure.		
10	Sulphate of ammonia	1½	1 2 6
11	Superphosphate of lime	3	1 4 0

NOTE.—Manure on plots Nos. 1 to 4 and 6 to 8 drilled with the seed. Manure on plots Nos. 10 and 11 sown with strawsonizer.

APPENDIX No. 9.

EFFECTS of HOT WATER and other DRESSINGS on the GERMINATION of WHEAT.

Tuscan Wheat (sown under glass).	Temperature of Water.	Period of Immersion.	Per Cent. germinated on 5th day.	7th day.	10th day.	12th day.	15th day.	Remarks.
	Deg. F.	Min.						
1. Water only	150	1	35	70	...	89	..	Rest dead.
2. 〃	145	1	92	...	...	...	...	〃
3. 〃	145	½	100	...	...	...	...	Strong growth.
4. 〃	140	1	96	...	...	...	...	〃
5. And in bluestone, 1oz. to 1qt. water	140	1	3	6	18	36	51	Rest dead.
6. Water only	140	½	96	...	...	...	...	Stronger than 3.
7. 〃	135	2	82	96	...	...	...	Not as strong.
8. 〃	135	1	100	...	...	...	...	Strongest.
9. And in bluestone, 1oz. to 1qt. water	135	1	0	3	21	32	36	Rest dead.
10. Water only	130	2	91	...	...	...	...	Equal to 3.
11. 〃	130	1	96	...	...	...	...	Equal to 6.
12. And in bluestone, 1oz. to 1qt. water	130	1	0	0	9	24	27	Rest dead.
13. Water only	125	1	100	...	...	...	...	Equal to 6.
14. And in bluestone, 1oz. to 1qt. water	125	1	0	0	6	21	27	Rest dead.

Smutted Hunter's (in sand), No. 23.			10th day.	12th day.	16th day.	20th day.	23rd day.	
1. Water only	127	5	...	42	90	...	...	
2. 〃	127	2	...	60	98	100	...	
3. And in bluestone, 1oz. to 1qt. water	127	2	2	15	52	80	88	Rest dead.
4. Water only	135	5	0	50	98	...	...	
5. 〃	135	2	0	57	93	...	...	
6. 〃	135	1	3	53	98	...	...	
7. And in bluestone, 1oz. to 1qt. water	135	1	0	5	25	67	77	Rest dead.
8. Bluestone only, 2oz. to 1qt. water	...	...	0	2	10	22	38	〃
9. Water only	142	2	2	36	82	85	...	
10. And in bluestone, 1oz. to 1qt. water	142	1	0	5	40	87	...	
11. Cold water, 6 hours, and bluestone as 10	...	...	0	5	20	40	50	And 63 in 30 days; rest dead.
12. Carbolic acid and Calvert's No. 5, 1oz. to 1qt. water	...	...	0	10	50	74	75	Rest dead.
13. No dressing	...	...	8	75	98	...	...	

APPENDIX No. 10.

Time-table, First Term, 1891.

<table>
<tr><th rowspan="2">Hours.</th><th colspan="3">Monday.</th><th colspan="2">Tuesday.</th><th colspan="2">Wednesday.</th><th colspan="3">Thursday.</th><th colspan="2">Friday.</th><th colspan="2">Saturday.</th></tr>
<tr><th>First Year.</th><th colspan="2">Second Year.</th><th>First Year.</th><th>Second Year.</th><th>First Year.</th><th>Second Year.</th><th>First Year.</th><th colspan="2">Second Year.</th><th>First Year.</th><th>Second Year.</th><th>First Year.</th><th>Second Year.</th></tr>
<tr><td>A.M.
8.30 to 9.30 ..</td><td rowspan="6">Groups as per "group" time-table; farm, workshops, dairy, &c., 8 to 12 a.m. and 1 to 5 p.m.; in-door subjects, 9 to 12 a.m. and 1.30 to 4.30 p.m.</td><td colspan="2">Chemistry .. ..</td><td>Chemistry ..</td><td rowspan="6">Groups as per "group" time-table; farm, workshops, dairy, &c., 8 to 12 a.m. and 1 to 5 p.m.</td><td rowspan="6">Groups as per "group" time-table; hours as on Monday.</td><td>Chemistry ..</td><td rowspan="3">Horses group, 8 to 12 a.m.; other out-door groups, 8 to 11 a.m.; and veterinary, 11 to 12 a.m. In-door groups: Drawing, 8.30 to 10 a.m.; and veterinary, 10 to 12 a.m.</td><td colspan="2">8.30 to 10 a.m.
Physics .. ..</td><td>Chemistry ..</td><td rowspan="6">Groups as per "group" time-table.</td><td>..</td><td rowspan="3">Horses, farm, and groups; workshops.</td></tr>
<tr><td>9.30 to 11 ..</td><td colspan="2">Chemical laboratory ..</td><td>Chemical laboratory</td><td>Chemical laboratory</td><td colspan="2">10 to 11 a.m.
Entomology .. ..</td><td>Chemical laboratory</td><td>..</td></tr>
<tr><td>11 to 12 ..</td><td colspan="2">Agriculture .. ..</td><td>Agriculture ..</td><td>Physiological chemistry</td><td colspan="2">Agriculture .. ..</td><td>Agriculture ..</td><td>..</td></tr>
<tr><td>P.M.
1.30 to 2.30 ..</td><td rowspan="2">Groups A and B.
1.30 to 3 p.m.
Biological laboratory</td><td rowspan="2">Groups C and D.
Land surveying</td><td>Botany ..</td><td rowspan="2">1.30 to 3 p.m.
Botany.
..</td><td rowspan="3">Groups as per "group" time-table.</td><td>Groups A and B.
Veterinary</td><td>Groups C and D.
Book-keeping</td><td>Entomology</td><td rowspan="3">Horses, farm, and dairy groups.</td><td>..</td></tr>
<tr><td>2.30 to 3.30 ..</td><td>Physiological chemistry</td><td colspan="2">Veterinary (lecture) ..</td><td>Mensuration</td><td>..</td></tr>
<tr><td>3.30 to 4.30 ..</td><td>3 to 4.30 p.m.
Land surveying</td><td>Biological laboratory</td><td>Mechanics ..</td><td>..
3 to 4.30 p.m.
Mathematics.
..</td><td colspan="2">Mechanics .. ..</td><td>Physiography</td><td>..</td></tr>
</table>

On Sunday: First year, students to milk; second year, to clean harness. Weekly examinations: Friday, 7 to 9 p.m., as per list.

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