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Journal of the Royal Agricultural Society of England.
London,Royal Agricultural Society of England[1840-2002]
https://www.biodiversitylibrary.org/bibliography/86012

v.24 1863: https://www.biodiversitylibrary.org/item/182448

Article/Chapter Title: Utilisation of Town Sewage (JRASE 1863)
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Page(s): Page 65, Page 66, Page 67, Page 68, Page 69, Page 70, Page 71, Page 72, Page 73, Page 74, Page 75, Page 76, Page 77, Page 78, Page 79, Page 80, Page 81, Page 82, Page 83, Page 84, Page 85, Page 86, Page 87, Page 88, Page 89, Page 90

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drill is the most economical, efficient, and rational mode of incorporating turnip-manure with the land.

30. Purely mineral superphosphates fail to produce good turnip-crops on light sandy soils.

31. Superphosphate cannot be considered as the cause of the diseases to which roots are liable.

32. Roots grown on poor sandy soils exclusively with superphosphate nevertheless are liable to become diseased, or to fail altogether.

33. The deficiency of lime, organic matters, and especially potash in sandy soils, accounts for the difficulty of growing good roots on such land with purely phosphatic manures.

34. On light soils turnips should always be grown with, at least, some farmyard manure.

35. Bone-dust, partially dissolved by acid, is a better manure for turnips on light land than a purely mineral superphosphate.

36. On light land a mixture of equal parts of guano and superphosphate is better turnip-manure than either manure applied alone.

37. Liquid manure is very beneficially applied to root-crops on light land.

38. An excellent plan of applying bone-dust to the turnip-crop on light land is to ferment it with dung.

39. This is best done by putting alternate layers of dung and bone-dust in a heap three or four months before turnip-sowing begins, and to turn the heap about a month before it is distributed on the field.

Royal Agricultural College, Cirencester, January, 1863.

IV.—*On the Utilisation of Town Sewage.* By J. B. Lawes, F.R.S., F.C.S.

No one can read the evidence given before the Select Committee "On Sewage of Towns," appointed by the House of Commons last Session, without being struck with the great differences of opinion elicited during the examination of the witnesses. Whilst one and all agree that sewage is a most valuable manure, containing every constituent necessary to be applied to the land for our crops, they differ in a remarkable degree both as to the commercial value of a given amount of sewage, and as to the quantity requisite to be applied to a given area of land.

One witness who had been engaged for years in the application of sewage, and whose evidence is said in the "Analysis of Evidence" to be "entitled to great weight," gave it as his

opinion that 300 tons of sewage per acre would accomplish the same results as the 10,000 tons which he had in point of fact applied! Another witness, just returned from a visit of inspection of the sewage meadows at Edinburgh and Rugby, considered the inferiority of the produce at Rugby to be due to the much smaller quantity of sewage there applied, the amount ranging from 3000 to 9000 tons per acre; whilst, in the case of the Edinburgh meadows to which he referred, it was estimated by the same witness at 10,000 to 12,000 tons per acre, and to be as high as 30,000 to 40,000 tons on some of the meadows in that locality.

As to the money value of the excrementitious matters of each person contributing to sewage, it was assumed that the results recorded by one witness showed it to be about 20*s.*, and those of another about 1*s.* 9*d.* per head per annum. Again, estimates of the value of a ton of sewage varied from about a halfpenny to about 9*d.* And, finally, the evidence showed that in some cases the sewage of only about two persons, and in others that of 300 or more, had been applied to an acre of land.

The Royal Sewage Commission, appointed some years ago "to inquire into the best mode of distributing the sewage of towns, and applying it to beneficial and profitable uses," in the prosecution of their inquiry, visited almost every locality where town sewage was applied in any way to the purposes of agriculture, and the evidence they collected was almost as conflicting as that published by the Committee of the House of Commons above referred to. Feeling how important it was that the public should be put in possession of more exact and reliable data on a subject involving such vast sanitary and economical interests, the Commission, of which I am a member, decided upon instituting some careful experiments on the agricultural application of sewage. The experiments were made at Rugby, upon grass-land, on which, as above alluded to, the sewage was applied at the rate of from 3000 to 9000 tons per acre per annum, and the Report, giving the results obtained in the first season (1861), has already been presented to both Houses of Parliament.*

It is proposed to lay before the readers of the 'Journal of the Royal Agricultural Society' such portions of this report as bear more directly upon the interests of agriculture.

As, however, the Committee of the House of Commons, in their "Analysis of Evidence" above referred to, give it as their opinion "that sewage is applicable to all crops, and that if commercial results are sought for, it should be applied in small

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* "Second Report of the Commission appointed to inquire into the best mode of distributing the Sewage of Towns, and applying it to beneficial and profitable uses." (1862.)

dressings," it may appear to some that it would have been well had the Commission experimented upon corn and other crops as well as grass, and applied the sewage in smaller quantities per acre. It may be advisable, therefore, to mention some of the circumstances which influenced the Commission in limiting their experiments in the first instance to grass alone, and in deciding upon the quantities of sewage to be applied. It will be sufficient to cite the previous experience obtained at Watford, Rugby, and Edinburgh on these points.

The chairman of the Commission, the Earl of Essex, who rents the sewage of the town of Watford, had laid down pipes for its application over 210 acres of mixed arable and grass-land; but had been led by experience to limit the application to but a small proportion of that area, and almost exclusively to either permanent meadow, or Italian rye-grass. Indeed, in his evidence before the Committee of the House of Commons last year, his Lordship stated that practically he limited the application to about 10 acres of Italian rye-grass, and 35 acres of meadow-land; for the former of which he required about 5000 tons per acre per annum; and that for the latter the amount remaining at his disposal was inadequate.

At Rugby about 6700 of the population contribute to the sewage, and pipes were laid down for its application to about 470 acres of mixed arable and grass-land. The quantity of sewage pumped daily (which is by no means the total yield of the town) averages about 750 tons, and, reckoning 300 working days, this gives a supply of 225,000 tons per annum. If this amount were equally distributed over the 470 acres piped for its application, the supply would be something less than 500 tons sewage per acre per annum. But when the Commission first visited Rugby, in order to arrange with Mr. Walker, the proprietor of the land and of the sewage works, and with Mr. Campbell, the tenant of about 190 acres, for the use of a few acres of the land, and a supply of sewage, they found that the practical experience of some years had led to the limitation of the application almost exclusively to grass, and also, in a great measure, to the abandonment of the use of the hose and jet, and the substitution of open runs. The sewage, instead of being applied to 470 acres of mixed arable and grass land, was limited to but a fraction of that area; and Mr. Campbell, who had pipes laid down for about 190 acres, and was paying rent accordingly, had abandoned the use on all but about a dozen acres of permanent meadow or Italian rye-grass.

Neither Mr. Campbell, nor the present or previous tenant of the other portion of the land laid out for sewage irrigation at Rugby, was examined before the Committee of the House of

Commons last year; but in a pamphlet since published by the former gentleman, giving the results of his experience for eight years as a sewage farmer, he states "that he should expect a better paying return from 50 acres with 4500 tons per acre per annum, than from 100 acres with 2250 tons per acre."

It seemed impossible to account for the abandonment, at Watford and at Rugby, of the use of sewage to crops generally, and in comparatively small amounts per acre, after so large an outlay had been incurred, entirely with a view to its application in these very ways, excepting on the supposition that the practice was not found to be profitable; and, to say nothing of evidence derived from other sources leading in the same direction in regard to the points in question, the Commission would hardly have been deemed justified in instituting experiments at Rugby in accordance with the plans originally adopted there on a more extensive scale than anywhere else, and abandoned, as unprofitable, after the experience of some years. It was, therefore, decided to confine the experiments, at any rate in the first instance, to grass land; to apply as a minimum as small a quantity of sewage as, having regard to the evidence at command, appeared likely to be effective; and, to apply as a maximum an amount below the quantities known to be employed at Edinburgh with so much success.

Extracts from the Report of the Royal Sewage Commission.

"At Rugby the whole of the available sewage of the town is rented by G. H. Walker, Esq.; and, after being collected in a large tank erected for the purpose, it is distributed, by means of a steam-engine, through iron pipes laid down for the supply to about 470 acres of mixed arable and grass land; hydrants being fixed at intervals along the lines for surface distribution, either by hose or open runs. These arrangements were obviously well adapted for the purposes of the inquiry the Commission had in view. Experience, at Rugby as well as elsewhere, seemed clearly to indicate that, to obtain the largest amount and value of produce at the least proportionate cost for distribution, dilute liquid sewage should be applied to the growth of succulent crops; and that it is best adapted for grass. It was decided, therefore, to confine the experiments, at any rate at present, to grass land. Accordingly, the Commission availed themselves of the kindness of G. H. Walker and J. A. Campbell, Esqs., to operate upon about 15 acres of grass land in the neighbourhood of Rugby supplied with sewage as above described.

"It also appears that produce of the kind in question is better adapted for the feeding of cows for the production of milk than

for any other purpose. It was decided, therefore, to devote the produce of one portion of the sewage-irrigated grass land to be cut green and given to milking cows. It, nevertheless, seemed desirable to test the fattening qualities of such produce, when cut green, and given to stock in the fresh state; and also to determine how far it is adapted for making into hay. Accordingly, it was proposed that the produce of a second portion of the experimental land should be given in the green state, to fattening oxen; and that that of a third should be made into hay, provided that the season and other circumstances would allow of it.

"Assuming that the ultimate object of the experiments is to provide such information as may be taken as the basis of arrangements for the application of the sewage of towns in the manner the most advantageous both to urban and rural interests, it is sought to determine, as far as possible:—

"1. The amount and composition of the produce, in relation to the volume of water supplied to the land by irrigation, to the amount of manurial constituents so applied, and to the population contributing the manurial constituents to the water.

"2. The most profitable method of applying the produce; that is whether it should be used in the green state or as hay; whether for the production of milk or of meat; and whether it should be consumed alone, or in conjunction with other food.

"The 15 acres of grass land consisted of two fields, the one of five, and the other of ten acres. For the purpose of the experiments they were laid out, by Mr. Bickford, in small surface drains, or 'runs,' according to the plan described in Vol. XIII. of the 'Journal of the Royal Agricultural Society of England;' and, at the upper end of each a tank holding $3\frac{1}{5}$ tons has been fixed, by means of which the amount of sewage applied to any given portion of land is accurately gauged. From these tanks, too, when full, samples of the sewage-water are taken, at stated intervals, for the determination of its chemical composition. The field of 10 acres has been divided, by an iron bullock-fence, into two equal parts. There were thus at command three portions of land of five acres each; these were respectively set out into four plots to be treated as follows:—

"Plot 1. To be unsewaged.

"Plot 2. To be irrigated with sewage at the rate of 3000 tons per acre per annum.

"Plot 3. To be sewaged at the rate of 6000 tons per acre per annum.

"Plot 4. To be sewaged at the rate of 9000 tons per acre per annum.

"The produce of one set of experiments has been given, in the green state, to fattening oxen; that of the second set (in the same condition) to milking cows; and that of the third (though, as afterwards explained, very little sewage was applied to it) has been made into hay.

"The results obtained in the first year's experiments, conducted as above described, are briefly summarised, under separate heads, in the present short Report. . . . . It will be obvious, however, that the results of a first season only must be taken as little more than initiative on many points; and that their numerical indications cannot be taken as the basis of safe deduction in regard to the economical questions at issue without much caution and reservation.

"I. *Quantities of Sewage applied, and of Green Produce obtained.*"

"TABLE I.—Showing the number of Tons of Sewage-water applied on each Plot, up to the end of October, in each of the two Fields.

FIRST SEASON, 1861.

	Sewage-water per Acre.					
	Five-acre Field.			Ten-acre Field (half).		
	Plot 2.	Plot 3.	Plot 4.	Plot 2.	Plot 3.	Plot 4.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
March	632·05	1045·12	1444·16	..	..	..
April	279·85	666·40	1176·98	563·04	1145·91	1376·91
May	75·82	96·49	97·66	18·32	64·14	118·82
June	78·78	223·32	577·23	..	..	392·26
July	531·67	430·18	654·05	512·01	392·18	905·73
August	130·60	580·17	787·28	225·90	316·30	595·11
September	143·14	703·32	614·72	33·98	517·72	381·81
October	201·69	678·23	800·66	33·98	367·68	455·84
Total	2073·60	4423·23	6152·74	1387·23	2803·93	4226·48
Rate per annum	3110·40	6634·84	9229·11	2378·11	4806·74	7245·39

"In the five-acre field, the produce of which was devoted to the feeding of oxen, the application of sewage did not commence until March 6, 1861, none having been applied in 1860. But the quantities applied on the respective plots up to the end of October were, upon the whole, pretty nearly at the rates intended; namely those of 3000, 6000, and 9000 tons per acre per annum.

"The ten-acre field had been dressed with undetermined amounts of sewage in 1860, and during February of the year of the

"TABLE II.—Showing the Amounts of Green Grass obtained during each separate Month, and in each successive Crop, in the two Fields.

FIRST SEASON, 1861.

	GREEN GRASS OBTAINED PER ACRE.															
	FIVE-ACRE FIELD.								TEN-ACRE FIELD (half).							
	Without Sewage.	With Sewage.							Without Sewage.	With Sewage.						
	Plot 1.	Plot 2.			Plot 3.			Plot 4.	Plot 1.	Plot 2.			Plot 3.			Plot 4.
	During each separate Month.															
	tons cwts. qrs. lbs.	tons cwts. qrs. lbs.			tons cwts. qrs. lbs.				tons cwts. qrs. lbs.	tons cwts. qrs. lbs.			tons cwts. qrs. lbs.			
May	..	..			..			1 9 3 14	..	0 14 0 20			1 4 0 10			2 5 0 0
June ..	3 2 3 27	4 17 0 14			7 19 1 23			8 14 3 8	4 10 1 1	4 11 2 8			5 4 1 7			8 16 1 4
July	3 1 0 8	2 8 0 15			4 6 0 26			6 14 0 13	0 8 1 18	5 5 1 2			5 8 0 19			1 16 3 27
August ..	..	3 16 2 23			4 12 2 8			5 19 2 24	1 6 3 9	0 10 2 26			4 12 1 1			5 4 2 7
September	2 2 2 8	1 3 0 12			6 5 1 7			5 0 0 5	2 3 2 7	0 11 0 13			1 15 0 3			4 16 2 2
October ..	0 19 0 18	2 11 3 0			0 8 0 24			0 16 0 23	0 9 0 8	3 19 1 15			4 0 3 7			3 6 0 0
November	..	..			3 9 1 6			4 2 0 5	..	..			..			..
December	..	..			..			..	..	0 4 0 2			0 7 3 21			0 8 2 0
Total ..	9 5 3 5	14 16 3 8			27 1 0 10			32 16 3 8	8 18 0 15	15 16 3 2			22 15 2 12			26 13 3 12
	In each successive Crop.															
1st Crop	6 4 0 7	7 5 1 1			10 7 0 24			13 5 1 22	4 18 2 19	9 18 3 12			11 5 3 2			11 1 1 4
2nd Crop	3 1 2 26	4 3 1 25			7 8 1 0			9 15 0 11	3 19 1 24	2 11 0 0			5 18 2 17			7 1 2 6
3rd Crop	..	3 4 0 11			5 16 1 8			5 14 0 26	..	3 2 3 16			5 3 1 0			8 2 2 2
4th Crop	..	0 3 3 27			3 9 1 6			4 2 0 5	..	0 4 0 2			0 7 3 21			0 8 2 0
Total ..	9 5 3 5	14 16 3 8			27 1 0 10			32 16 3 8	8 18 0 15	15 16 3 2			22 15 2 12			26 13 3 12

the experiments (1861), by the previous tenant; it had been fed down very close by sheep and other stock, up to nearly the end of March; and the application of sewage, under the direction of the Commission, did not commence until April 1. Unfortunately the amount of sewage available in this field was very much less than was desired, so much so that the plots on the portion allotted to be cut green for milking cows did not receive the quantities intended, even though, after a few weeks, the application on the portion devoted to hay was entirely abandoned, in the hope of securing enough for the other.

"In both fields, owing to derangement and repair of the works, the supply of sewage was very inadequate during portions of the growing months of May and June.

"The upper portion of the Table (II.) shows the distribution of the produce of the respective plots throughout the season, according to the amounts of sewage applied; and the lower part shows the amounts of produce yielded in each successive crop under the same variation of circumstances. The results, as given in the upper portion, show not only how very much more total produce was obtained by the application of sewage, but also over what a much more extended period of the season an abundance of green food was obtainable when large quantities of sewage were applied; and it should be observed that, in both fields, plots 3 and 4, to which the largest amounts of sewage were applied, might with advantage have been cut earlier, and they would then have yielded much larger crops during May than are recorded for that month. On the other hand, in some cases not inconsiderable amounts of produce were obtained even as late as November. It is, however, probable that, in practice, it will not be advantageous to cut later than October; and it was only done in this case as a means of better estimating the quantity of the produce yielded. The lower portion of the Table shows that there is, in almost every case, an increase of produce at each successive cutting with each increase of sewage applied. It will be seen further on that the produce of the earlier cuttings contained a larger proportion of dry substance than that of the later ones; and also that the sewaged grass differed considerably both in the proportion and composition of its dry substance according to the quantities of sewage applied, and still more from the unsewaged grass.

"The proportion of produce obtained to sewage applied is better seen in Table III., where the amounts of sewage intended, and actually applied up to the end of October, the amounts of total produce, and the amounts of increase of produce for each 1000 tons of sewage applied, are given side by side.

"TABLE III.—Showing the Quantities of Sewage applied up to the end of October, and the total Amounts of Green Grass obtained per Acre, &c.

FIRST SEASON, 1861.

	SEWAGE.			PRODUCE.	
	Quantities required.		Quantities actually applied to end of October.	Total Green Grass per Acre.	Increase of Green Grass for each 1000 tons of Sewage applied to end of October.
	Per Annum.	To end of October.			
	tons.	tons.	tons.	tons cwts. qrs. lbs.	tons cwts. qrs. lbs.
Five-acre Field.—Produce given to Oxen.					
Plot 1 (2 cuttings) ..	None.	None.	None.	9 5 3 5	..
Plot 2 (4 cuttings) ..	3000	1981	1872*	14 16 3 8	2 19 1 7
Plot 3 (4 cuttings) ..	6000	3962	4423	27 1 0 10	4 0 1 9
Plot 4 (4 cuttings) ..	9000	5942	6153	32 16 3 8	3 16 2 6
Half of ten-acre Field.—Produce given to Cows.					
Plot 1 (2 cuttings) ..	None.	None.	None.	8 8 0 15	..
Plot 2 (4 cuttings) ..	3000	1769	1387	15 16 3 2	4 19 3 23
Plot 3 (4 cuttings) ..	6000	3538	2804	22 15 2 12	4 18 3 23
Plot 4 (4 cuttings) ..	9000	5308	4226	26 13 3 12	4 4 0 20

"The two fields were nearly a mile apart; the five-acre field was nearly level, and the ten-acre one considerably sloping. When, in addition to these facts, the different previous treatment of the two fields, as already referred to, the different amounts of sewage actually applied up to the dates ending the experimental season, and the fact that the dates of the cuttings on the respective plots differed according to the amounts of sewage, and the consequent progress of the grass, are taken into consideration, it appears probable that the amount of produce would, under equal circumstances, bear a very close relation to the quantity of sewage applied, pretty nearly up to the maximum limit contemplated.

"The produce without sewage was, in each field, equal to more than two and a-half tons of hay per acre. It was rather less in the ten-acre field than in the other; owing, doubtless, to the fact that the grass had there been fed down so close in March, before the commencement of the experiment.

"In the five-acre field the increase of green grass obtained for each 1000 tons of sewage applied, was scarcely 3 tons, where the application was at the rate of about 3000 tons per acre per annum;

* "In this case, the last cutting was on October 9, and the produce is, therefore, calculated against the sewage applied to the end of September only."

fully 4 tons where at the rate of about 6000 tons; and somewhat under 4 tons where at the rate of about 9000 tons. In the ten-acre, and more sloping field, where the sewage was better distributed over the lower and further portions of the plots, and which had been sewaged the year previously, and even early in 1861, before the commencement of the experiments, the increase of green grass for each 1000 tons of sewage experimentally applied was greater, amounting in each case to over 4, and in two out of the three, to nearly 5 tons. As an average of all the results obtained in the two fields, it may be stated, that the amount of increase of green grass yielded for 1000 tons of sewage applied was, in this first year of the experiments, equal to only about three-fourths of a ton of hay.

"II. *Results of the Experiments with Oxen.*

"Ten Hereford oxen were tied up in a shed; two to be fed on unsewaged grass, and the remaining eight to receive sewaged grass, as it was ready to cut, indiscriminately from the three plots in the five-acre field, to which sewage was to be applied respectively at the rate of 3000, 6000, and 9000 tons per acre per annum. The animals had the grass alone for a period of 16 weeks; namely, from May 27 to September 16. They had then, for a further period of four weeks, in addition to the grass, 4 lbs. of oilcake per head per day.

"The average results over the whole period during which the oxen had grass alone, are given in the following Table (IV.), and to these the few comments that it is necessary to make will be confined. The points shown are, the quantities of sewage designed to be applied, and the quantities actually applied on each plot up to the end of October; the average amounts respectively of unsewaged and of sewaged grass consumed per head daily; the number of weeks the produce of each acre would keep one ox; the pounds of increase in live-weight that the produce of each acre would yield; the value of the increase in live-weight from each acre, at 4*d.* per lb.; and the value of the increase in live-weight obtained from the increase of produce yielded for 1000 tons of sewage applied.

"The oxen weighed more per head than the experimental cows, but their daily consumption per head both of unsewaged and of sewaged grass was considerably less. It is quite obvious from the results given in the Table that grass of the description in question is not adapted for the fattening of oxen without the addition of other food. Indeed, one of the animals on the sewaged grass weighed 52 lbs. less at the conclusion than at the commencement of the experiment; and the maximum increase of

"TABLE IV.—Showing the Results of the Experiments with Oxen when fed on Green Grass alone.

SEASON, 1861.

	Unsewaged Grass.	Sewaged Grass.		
	Plot 1.	Plot 2.	Plot 3.	Plot 4.
Tons of sewage to be applied per acre per annum	..	3000	6000	9000
Tons of sewage required to end of October	..	1721*	3962	5942
Tons of sewage actually applied to end of October	..	1872*	4423	6153
Grass consumed per head daily lbs.	89·8	105·2		
Weeks the produce of each acre would keep one ox	33·1	45·1	82·3	99·9
Increase in live-weight that the produce of each acre would yield lbs.	87·9	134·4	245·0	297·4
Value of increase in live-weight from each acre at 4*d.* per lb.	£. *s.* *d.* 1 9 4	£. *s.* *d.* 2 4 10	£. *s.* *d.* 4 1 8	£. *s.* *d.* 4 19 2
Value of increase in live-weight from the increased produce of 1000 tons sewage	..	0 8 3	0 11 10	0 11 4

of any one was 103 lbs. in the 16 weeks, or at the rate of rather less than $6\frac{1}{2}$ lbs. per week. Taking the average of the two and of the eight oxen respectively, those upon unsewaged grass gave scarcely $2\frac{1}{2}$ lbs., and those upon sewaged grass scarcely $2\frac{3}{4}$ lbs., increase per 1000 lbs. live-weight per week; whereas, feeding on good fattening food, such oxen should give 9 to 10 lbs. increase per 1000 lbs. live-weight per week. In fact, these very animals did give increase at this, and even a higher rate, during the subsequent four weeks, when they had, in addition to the grass, 4 lbs. of oilcake per head per day. . . . . There can be no doubt, therefore, that with a proper allowance of oilcake, or some such food, a very different result would have been obtained throughout. It was, however, desirable that in the first experiments the grass should be tried alone.

"III. *Results of the Experiments with Cows.*

"Twelve cows were selected by Mr. Campbell from his large herd, and were placed in a house by themselves. Two of these were to be fed upon unsewaged grass, and the remaining ten upon sewaged grass, mown as it was ready indiscriminately from the three acres receiving respectively different quantities of

* "In this case to the end of September only; see note to Table III."

sewage. Like the oxen, the cows received grass alone for a period of 16 weeks, after which they had a similar addition of oilcake for a period of four weeks.

"Attention will here be confined to the average results over the period of 16 weeks, during which the cows were fed on grass alone. These are given in the following Table (V.), which shows the particulars of the sewage applied to each plot; the average quantity of unsewaged and of sewaged grass consumed by each cow daily; the average yield of milk per head daily; the number of weeks the produce of the respective acres would keep one cow; the number of gallons of milk the produce of each acre would yield; the gross value of the milk from each acre at 8*d.* per gallon; and the value (at the same rate) of the milk obtained from the increased produce of each 1000 tons of sewage applied.

"TABLE V.—Showing the Results of the Experiments with Cows when fed on Green Grass alone.

SEASON, 1861.

	Unsewaged Grass.	Sewaged Grass.		
	Plot 1.	Plot 2.	Plot 3.	Plot 4.
Tons of sewage to be applied per acre per annum	..	3000	6000	9000
Tons of sewage required to end of October	..	1769	3538	5308
Tons of sewage actually applied to end of October	..	1387	2804	4226
Grass consumed per head daily lbs.	150·2	124·0		
Average yield of milk per head daily .. .. lbs.	24·89	20·53		
Weeks the produce of each acre would keep one cow	19·0	40·9	58·8	68·9
Gallons of milk the produce of each acre would yield	321·4	570·7	820·4	961·3
Value of milk from the produce of each acre at 8*d.* per gallon	£. *s.* *d.* 10 14 3	£. *s.* *d.* 19 0 6	£. *s.* *d.* 27 6 11	£. *s.* *d.* 32 0 10
Value of milk from the increased produce of 1000 tons sewage	..	5 19 10	5 18 8	5 0 11

"As already stated, the produce of the three acres of sewaged grass was given to the cows indiscriminately, as it was ready; as, to have done otherwise, on the assumption that the milk-yielding quality of the grass obtained from the land receiving different quantities of sewage was weight for weight different, would greatly have complicated the experiments without the probability that the results could be taken as indicating, with

any certainty, the distinctions supposed. It will be understood, therefore, that the basis of the above estimates as to the amount and value of the milk yielded from each acre is the amount of grass obtained from each acre.

"The results show that the quantity of milk obtainable from the produce of each acre of land depended very much upon the quantity of sewage applied. Deducting the value of the milk produced from the grass of the unsewaged from that from each of the sewaged acres, reckoning it at 8*d.* per gallon, it appears that where about 1400 tons of sewage were applied during the seven months, the produce calculated for each 1000 tons of sewage actually applied gave an increased amount of milk to the value of 5*l.* 19*s.* 10*d.*; where twice that amount of sewage was applied, 5*l.* 18*s.* 8*d.*; and where three times the quantity, 5*l.* 0*s.* 11*d.*

"It will be observed that the cows on unsewaged grass both consumed more and yielded more milk per head per day than those on sewaged grass; but the proportion of milk to a given amount of fresh grass consumed is almost identical in the two cases. As will be seen further on, however, the unsewaged grass contained a considerably higher proportion of dry or solid substance than the sewaged. The question arises whether, or in what degree, the comparatively limited consumption of sewaged grass (with the coincident lower actual yield of milk per head), was due to its very great succulence, the proportion of water to dry substance in the food practically setting the limit to the consumption. However this may be, the result was that a given amount of dry substance of the sewaged grass yielded very much more milk than the same amount of that of the unsewaged.

"IV. *Composition of the Sewage-Water.*

"Samples of the sewage-water, as it was delivered into each field, were taken as follows:—Whilst the sewage was distributing, samples of about a quart were taken at intervals of two or three hours, from the full gauge tank in the field, which held $3\frac{1}{5}$ tons of the fluid. These samples were collected in a carboy for a period of a week, when, after well agitating, a sample of the mixture was sent to Professor Way for analysis. During the first two or three months of the experiments such samples were taken nearly every week, but afterwards only every fourth week. There were thus, for the months of April to October inclusive, 12 samples of sewage-water from each field submitted to analysis."

[The results of the 12 analyses of sewage-water from the five-

acre field are given in Table I., p. 89, and those of the samples from the ten-acre field in Table II., p. 90, in the Appendix.]

"A summary of these, with an additional column, showing the constituents in 1000 tons of sewage, is given in Table VI. below; and the results as there recorded will be sufficient for consideration on the present occasion. There are there given the mean composition per gallon of the 12 samples from the five-acre field, of the 12 from the ten-acre field, and of the 24 samples; also the amount of each of the several constituents in 1000 tons of the sewage-water according to the mean of the 24 analyses.

"TABLE VI.—Showing the mean Composition per gallon, and per 1000 tons, of the Sewage-water.

SEVEN MONTHS—April to October inclusive, 1861.

Constituents.		Mean Grains per Gallon. 12 Samples from the 5-acre Field.	12 Samples from the 10-acre Field.	The 24 Samples.	Lbs. per 1000 Tons.
Organic matter	In solution	10·26	10·30	10·28	329
	In suspension	16·75	11·57	14·16	453
	Total ..	27·01	21·87	24·44	782
Inorganic matter	In solution	36·82	35·85	36·34	1163
	In suspension	16·18	12·55	14·36	459
	Total ..	53·00	48·40	50·70	1622
Total solid matter		80·01	70·27	75·14	2404
Ammonia	In solution	4·99	4·98	4·98	159
	In suspension	1·65	1·18	1·41	45
	Total ..	6·64	6·16	6·39	204
Potass*		1·12	0·95	1·04	33
Phosphoric acid*		0·87	0·99	0·93	30

"Reference to the Appendix Tables will show that the composition of the sewage differed very much indeed, and pretty equally so in the two fields, at different periods of the season; depending upon the amount of water reaching the sewers, and the consequent state of dilution of the sewage. The Table given

* "The potass and phosphoric acid were determined in two samples only in each case."

above shows, however, as was to be expected, that the average composition of the sewage collected in the two fields was almost identical. The only difference of any importance is in the amount of suspended matter; there being less organic matter, inorganic matter, and ammonia, in suspension, in the sewage collected in the 10-acre field than in that from the other.

"Without going into any detail on the point on the present occasion, attention may be called to the fact that the column showing the amount of the several constituents in 1000 tons of the sewage, considered in relation to the amounts of increased produce obtained by that quantity of sewage, as shown in Table III., indicates that the constituents of dilute liquid sewage can by no means be valued at the same rates as those in portable, artificial manures, such as guano. In illustration it may be stated that the quantity of ammonia estimated to be contained, on the average, in 1000 tons of the sewage, is equal to the nitrogen of the mixed excrements of about 21 or 22 persons of a mixed population of both sexes and all ages for a year, and to that in about 11 cwts. of Peruvian guano; and the total solid matter in 1000 tons of the sewage is seen to be somewhat more than a ton. The average amount of increase of produce obtained by the application of this large quantity of manurial matter was, however, only equal to about three-fourths of a ton of hay; nevertheless, as has been shown, the increase of grass bore a pretty obvious relation to the amount of sewage employed, until the latter approached (during the actual period of the experiment) the rate of about 9000 tons per acre per annum.

"It is further worthy of remark that the mean composition of the Rugby sewage, as given above, differs comparatively little from that which published analyses indicate for the sewage of London; and the correspondence is the closer when, having regard to the relative amounts of sewage to which the different analyses are applicable, the calculated average instead of the mere arithmetical mean composition of the sewage is taken in the two cases. Thus, the average proportion of total solid matter in the Rugby sewage for seven months, up to the end of October, 1861, was about $77\frac{1}{2}$ grains per gallon, whilst the average amount in London sewage appears to be about 91 grains. The correspondence in the amount of ammonia, which, more than any other constituent, indicates the relation of population to the amount of water, is, however, much more striking. Over the seven months the average amount of ammonia in the Rugby sewage is estimated to be 6·65 grains per gallon; and, founded on the rate of flow of sewage and the analyses given by Dr. Letheby of both the day and night sewage from 10 different sewers, the average amount of ammonia in the sewage of London

is calculated to be 6·66 grains per gallon. Taking 10 lbs. of ammonia to represent the mixed excrements of one individual of a mixed population of both sexes and all ages for a year, 1000 tons of the sewage of either London or Rugby would, according to the above estimates, contain the excrements of about 21 or 22 individuals.

"V. *Composition of the Unsewaged and Sewaged Grass.*

"It was obviously of great importance to determine the proportion of dry or solid substance contained in the produce cut, weighed, and given to the animals, in a green and very succulent condition; to determine the difference in composition due to the application of sewage; and also that of the successive crops taken at different periods of the season. To this end samples of $2\frac{1}{2}$ lbs. of the unsewaged, or 5 lbs. of the sewaged grass, were taken from every load as soon as it was weighed at the homestead, the samples from each plot respectively being mixed together day by day as taken, until the cutting of the plot was completed. Each such mixed sample was exposed on sheets of canvas in the open air until sufficiently dry. It was then stored in sacks, and finally cut into coarse chaff, well mixed, weighed, and a weighed portion of the mixture taken for the purposes of analysis."*

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* "50 ounces of the coarsely-cut chaff were taken in each case, and each of these samples was carefully divided into 4 equal parts; two of which were fully dried at 212° F. to determine the absolute dry substance, and then burnt to determine the mineral matter, and a third was finely ground, and a portion of it sent to Professor Way for analysis.

"It should here be remarked that there are many practical difficulties in the way of getting accurate results in regard to the amount of dry substance in large bulks of green produce such as those in question. Cut in the morning, as the crops always were, the grass generally held a good deal of superficial as well as other moisture, and, with equal conditions of weather, the heavier the crop the greater the amount of water so retained. Again, if the weather were dry and hot, the grass would lose moisture considerably between the time of cutting and that of weighing and sampling at the farm buildings; or, if rainy, the grass would be more or less saturated with water. To add to these difficulties, which are almost inseparable from such an inquiry, the taking of the samples, and their partial drying and preservation, were necessarily left in the hands of those unpractised in such work.

"It will be obvious from the above considerations, that the exact figures given which relate to or involve the question of the proportion of dry substance in the produce must be accepted with some reservation; though it is believed that at any rate the direction and more general indications of the results on the point may fully be relied upon. The results given of the analyses of the dry substance itself will, of course, be much less affected by the irregularities referred to; and the differences in its composition according to the difference in the conditions of growth are points well worthy of a careful consideration in a hitherto untrodden field of inquiry.

"It should be added that, taking advantage of the experience of the past year, all possible precautions are being taken to eliminate avoidable irregularities in the conduct of this part of the work during the present season (1862); and to secure greater uniformity and certainty in the partial drying and preservation of the specimens, a small drying-house, heated by a stove, has been erected."

"TABLE VII.—Showing the Amounts of Dry Substance in the Unsewaged and Sewaged Grass.

FIRST SEASON, 1861.

	Mean per cent. Dry Substance in Fresh Grass.			
	First Crop.	Second Crop.	Third Crop.	Fourth Crop.
Five-acre Field.				
Plot 1 (Unsewaged)	25·1*	27·9	24·4	..	..
Plot 2 (Sewaged) ..	..	30·5	19·8	13·4	..
Plot 3 (Sewaged) ..	30·4*	26·9	14·2	13·7	15·4
Plot 4 (Sewaged) ..	15·8*	27·7	13·7	12·9	9·6
Ten-acre Field.				
Plot 1 (Unsewaged)	22·0	26·9	..	..
Plot 2 (Sewaged) ..	23·3	17·1	12·6	16·9
Plot 3 (Sewaged) ..	21·4	15·1	7·3	15·1
Plot 4 (Sewaged) ..	18·4	16·1	14·4	17·8

"The figures given in the above table show that the proportion of the dry substance in the grass varied very much indeed according to circumstances. The first crop contained generally a higher proportion than the second, particularly in the case of the sewaged grass; and the second, a higher proportion than the third or fourth. It also appears that the unsewaged grass averaged a higher proportion of dry substance than the sewaged. These results are quite in accordance with what would be expected from the known variations in the conditions of growth. The exact proportions of dry substance found, and recorded in the Table, depended, however, very much indeed upon the stage of growth at which the produce of the respective plots or crops was cut, and upon the condition of the weather at the time of cutting. Thus, the first crop of sewaged grass, particularly in the 5-acre field, was, for the most part, too ripe when cut, and hence the very large relative proportion of dry substance which on the average it contained. Again, in both fields, a considerable portion of the second crop of the unsewaged grass was much riper when cut than that of the sewaged. On the other hand, some of the crops, especially portions of the third and fourth, were cut and sampled in a very wet condition, and to this, in a certain sense,

* "These samples were taken before June 20, and were, by mistake, weighed with scales not sufficiently accurate for the purpose; the results are, therefore, given separately."

accidental, though unavoidable circumstance, must be attributed the very low proportion of dry substance found in some cases.

"The general result was, that the animals which had the unsewaged grass received considerably more dry or solid substance in a given weight of the fresh produce than those which had the sewaged grass. Hence, though the oxen on unsewaged grass consumed much less of the fresh food in relation to their weight than those on the sewaged, they nevertheless took into their stomachs quite as large a proportion of real dry or solid matter as the others. The cows on the unsewaged grass consumed, however, even more of their fresh food, with its higher proportion of dry substance, than did those on the sewaged; and they, at the same time, gave a larger quantity of milk, almost exactly in proportion to the increase in the amount of fresh food consumed. But, as a given weight of the fresh sewaged grass contained considerably less dry or solid substance than an equal amount of the unsewaged, it resulted that considerably more milk was obtained from a given quantity of the dry or solid substance of the sewaged than of the unsewaged grass.

"The question arises, was there any difference in the composition of the dry or solid matter of the two kinds of grass such as may be supposed to account for the greater productiveness, at any rate in milk, of that from the sewaged land? The following Summary Table relates to this point.

"TABLE VIII.—Showing the mean Composition (per cent.) of the Dry Substance of the Grass produced without and with Sewage, and in each successive Crop.

FIRST SEASON, 1861.

	Without and with Sewage.				Each successive Crop.			
	Unsewaged.	Sewaged.			1st Crop.	2nd Crop.	3rd Crop.	4th Crop.
	Plot 1.	Plot 2.	Plot 3.	Plot 4.				
Number of Analyses giving the means .	5	7	9	9	11	9	7	5
Nitrogenous substance (N × 6·3) . . .	13·08	18·67	18·92	19·78	10·33	18·07	23·76	28·25
Fatty matter (ether extract)	3·21	3·54	3·53	3·44	3·01	3·60	3·65	3·84
Woody fibre	28·80	29·34	30·15	29·13	30·80	28·45	28·50	28·60
Other non-nitrogenous substances . . .	45·66	37·09	35·94	35·92	47·79	38·28	30·84	24·57
Mineral matter (ash) . .	9·25	11·36	11·46	11·73	8·07	11·60	13·25	14·74
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00

"The figures in this table do indeed show a considerable difference in the composition of the dry substance of the unsewaged

and the sewaged grass; and those in the Tables of detail . . . . . show that the great bulk of the produce varied more than the mere mean results here given would indicate.

"The chief point of remark is, that the solid matter of the much more luxuriant and succulent sewaged grass contained a considerably higher proportion of nitrogenous substance than that of the unsewaged. It also contained somewhat more, both of the impure waxy or fatty matter extracted by ether, and of mineral matter, which may be taken to indicate a less advanced or ripe condition at the time of cutting. But, owing to the generally less ripe and more succulent condition of the sewaged than the unsewaged grass, it is highly probable that a larger proportion of its nitrogenous substance was in an immatured condition; and, so far as it was so; it would be less available for the formation of the nitrogenous compounds of flesh or milk. It would at any rate be unsafe, without further evidence on the point, to attribute the higher milk-yielding quality of the dry substance of the sewaged grass unconditionally to its higher proportion of nitrogenous substance; and, it may be remarked that, according to such a rule, a given weight of the dry substance of the third and fourth crops should be very much more productive than an equal quantity of that of the first; for the Table shows that there was twice or thrice as high a proportion of nitrogenous substance in the solid matter of the crops grown late in the season as in that of those grown in the earlier and more genial periods of vegetation. Nor is the evidence at present at command such as to justify the conclusion that the superior milk-yielding quality of the dry substance of the sewaged grass is essentially connected either with its larger proportion of impure fatty, or of mineral matter. That the greater succulence of sewaged grass conduces at least to quantity of milk, experience seems to show; and that the constituents of its solid matter are in a readily convertible condition, the results of this first season's experiments on the question seem clearly to indicate.

"It remains to be seen how far the results of a second year's series of experiments, conducted with the greater attention to some points of detail which past experience suggests, will serve to confirm, modify, or further explain the conclusions to which the results given in this section seem to point.

"VI. *Composition of the Milk yielded from the Unsewaged and from the Sewaged Grass.*

"Once a week, during the greater part of the experimental period, the morning and evening milk of the two cows fed on unsewaged grass was mixed together, and a gallon sample of the

mixture taken. Samples of the milk from the ten cows fed on sewaged grass were taken in the same way. These samples were immediately put into bottles filled up to the corks and sealed down, and sent off the same evening by railway to Professor Way for analysis."

[There were in all 13 samples of the milk from the cows fed on unsewaged grass, and 15 of that from those fed on sewaged grass, taken as above described, and the results of the analyses of the 28 samples are given in the Appendix to the Report of the Commission. *]

"In the following Summary Table (IX.) are given,—the mean composition of nine samples of milk taken from the cows fed on unsewaged grass alone, and of ten taken from those fed on sewaged grass alone; the mean of four samples from each lot of cows during the concluding four weeks, when they had oilcake as well as grass; and also the composition of the milk of the ten cows taken on one occasion during the experiment, when, owing to a deficiency of the experimental grass at the time, they had, for a short time, a mixture of sewaged Italian rye-grass and clover, and a little oilcake besides.

"Table IX.—Mean Composition of the Milk, per Cent.

Season 1861.

	Cows fed on Grass alone.		Cows fed on Grass and Oilcake.		Cows fed on Sewaged Rye-grass and Clover, and Oilcake; 1 Sample.
	Unsewaged; Mean of 9 Samples.	Sewaged; Mean of 10 Samples.	Unsewaged; Mean of 4 Samples.	Sewaged; Mean of 4 Samples.	
Casein	3·246	3·241	3·352	3·423	3·125
Butter	3·604	3·430	3·657	3·707	3·473
Sugar of milk, &c. ..	4·405	4·218	4·561	4·689	4·700
Mineral matter ..	0·753	0·776	0·740	0·771	0·752
Total solid matter	12·008	11·665	12·310	12·590	12·050
Water	87·992	88·335	87·690	87·410	87·950
	100·000	100·000	100·000	100·000	100·000

"There is apparently but little difference between the average composition of the milk yielded from the unsewaged and the sewaged grass, whether they be respectively consumed alone, or

* In the Appendix to the Report of the Commission will also be found the results of the analyses of the individual samples of grass, and the details of the sewage applied, the produce of grass obtained, and of the food consumed, and milk and increase yielded by the animals.

in conjunction with oilcake. That from the sewaged and more succulent grass is slightly more aqueous, and contains slightly less of the organic constituents—casein, butter, and sugar of milk—and slightly more of mineral matter, during the early part of the season, when the cows had grass alone; but these relations are reversed during the four weeks when oilcake was given in addition. The addition of the oilcake, both in the case of the unsewaged and of the sewaged grass, but particularly in that of the latter, notably increased the proportion of the three organic constituents, and of the total solid matter of the milk, but somewhat diminished that of the mineral matter. Again, comparing the figures in the second and the fifth columns, those in the latter giving the composition of the milk when, for a few days only during the progress of the experiment, the diet of the cows was changed from sewaged grass alone to sewaged Italian rye-grass and clover, with oilcake in addition, the influence of the oilcake is seen to be of the same kind as already alluded to —increasing generally the proportion of the organic constituents, and of the total solid matter of the milk, and diminishing somewhat that of the mineral matter.

"CONCLUSIONS.

"Subject to the reservations which have been indicated, the results of the first season's experiments may be briefly enumerated as follows:—

"1. By the application of large quantities of dilute town sewage to permanent meadow land during the spring and summer months, there was obtained an average increase of about 4 tons of green grass (which, owing to the lower proportion of dry substance in the sewaged grass, was equal to only about three-fourths of a ton of hay) for each 1000 tons of sewage applied, until the amount of the latter approached the rate of about 9000 tons per acre per annum. The largest produce obtained was about 33 tons of green grass per acre. The period of the year over which an abundance of green food was available was, with the largest amount of sewage, between five and six months.

"2. Oxen tied up under cover, and fed on cut green grass alone, whether sewaged or unsewaged, gave a far lower rate of increase than the average attained by animals fed on ordinary good fattening food; but when for a few weeks oilcake was given in addition to the grass, they yielded a good average rate of increase.

"3. Cows tied up under cover, and fed on cut green grass alone, after previously receiving oilcake, fell off considerably in their yield of milk, and about equally whether the grass were sewaged or unsewaged. The cows on unsewaged grass consumed

more food and gave more milk, in relation to their weight, than those on sewaged grass; but the amount of milk yielded for a given amount of fresh food consumed was almost identical in the two cases; though, in proportion to the dry or solid matter which the food contained, the sewaged grass yielded considerably more milk than the unsewaged. Milk to the gross value of 32*l.* per acre was obtained where the largest quantity of sewage was applied. The gross value of the milk from the increased produce of each 1000 tons of sewage was between 5*l.* and 6*l.*

"4. The composition of the Rugby sewage-water varied very much during the course of the season, being much more concentrated during the drier months. On the average, over about seven months, 1000 tons of sewage contained about 21½ cwts., or little more than one ton of solid matter; about 212 lbs. of ammonia, or about as much as is contained in 11 cwts. of Peruvian guano; and probably represented the excrements of 21 or 22 individuals of a mixed population of both sexes and all ages for a year. This average composition agrees very closely with that which published analyses indicate for the sewage of London.

"5. On the average the sewaged grass contained, as cut, a considerably lower proportion of dry or solid substance than the unsewaged; but the dry substance of the sewaged grass generally contained a higher proportion of nitrogenous compounds.

"6. Analysis shows very little difference in the quality of the milk yielded respectively from sewaged and unsewaged grass. The difference in composition, such as it is, is slightly in favour of the milk from the unsewaged grass when grass was given alone, and slightly in favour of the sewaged grass when oilcake was given in addition."

Nothing has tended more to prevent a proper understanding between town and country—the producers of sewage and the consumers of manure—as to the commercial value of sewage, and the best manner of utilising it, than the very exaggerated statements which are from time to time put forth on the subject. Only a few weeks ago an *anonymous* pamphlet, pretending to be in the interest of the urban rate-payers, was published, which quotes an estimate, professedly founded on scientific authority, that the sewage of London, reckoning the prospective population at 3,000,000, will be worth something over 10,000,000*l.* sterling per annum! It required an expenditure of, I believe, 60,000*l.*, to satisfy those who some years ago insisted upon the very high agricultural value of solid manure obtained from sewage by lime, that the value assigned to it by myself, and others, was correct. At

present there are no advocates for the manufacture of a solid manure from dilute town sewage. The controversy now lies between those who would distribute it in small quantities over enormous areas, and apply it to all crops, and those who would employ it in large quantities over comparatively small areas, and confine its application almost exclusively to succulent crops.

As already referred to, the "Select Committee on the Sewage of Towns" in their "Analysis of Evidence" give it as their opinion "that sewage is applicable to all crops, and that if commercial results are sought for, it should be applied in small dressings." I have very carefully considered the evidence given before that Committee, and I must confess that neither can I endorse the opinion just quoted, nor do I think there are many acquainted with agriculture who will think it borne out by the evidence when they have themselves perused it.

I have not the slightest doubt that any attempt to apply the sewage of London in its present average state of dilution, or that of any other town similarly diluted, to crops generally, and in quantities of a few hundred tons per acre, will result either in great pecuniary loss to those who invest their capital in supplying the sewage, or in signal failure, and perhaps pecuniary loss also, to those who, like Mr. Campbell, Mr. Congreve, and Mr. Mullins, the Rugby tenants, may purchase it for distribution in the manner proposed.

On the average, one ton of the sewage of London or Rugby contains only from 2 to 3 lbs. of solid matter, of which only about half, or less, will consist of the valuable constituents of human excrements; and with the progress of sanitary arrangements as at present generally carried out, the dilution appears to be daily increasing. It will be quite obvious, at any rate to most agriculturists, that the fact of having to bring upon the land such an enormous quantity of water in order to supply such a small amount of manurial matter, must materially affect the applicability of such manure to land under tillage, the cost at which a given amount of constituents can be brought on to the land, and their productive value when there. In fact, it is clearly quite fallacious to assume the general applicability to all crops, of manure so diluted, from any considerations as to the applicability of the same constituents in the undiluted form.

The agriculturist would, indeed, only be justified in contracting for a supply of town sewage at a price far below the estimates of those who propose to deliver it to him; and, taking into consideration not only the great, but the varying, and perhaps increasing dilution of sewage, the question of the composition as well as the amount of the sewage supplied, must form

the basis of any contract between town and country in the matter. The amount of nitrogen in sewage, in the forms of ammonia and nitric acid, affords the best indication of the amount of human excrements it represents, and hence it is the best guide as to the probable amount of the other valuable constituents. The relative value of the sewage might, therefore, be estimated according to the average number of grains of ammonia per gallon.

The question now at issue, it must be remembered, is not whether the constituents of human excrements, if presented to us in a concentrated, dry, and portable form, might not then be applicable to all crops, to those under tillage designed to ripen their seeds, as well as others, but whether those same constituents distributed through enormous bulks of water, as under the present, and rapidly extending system, can be so applied?

No one will doubt that if the sanitary requirements of the nation could be attained by any system which would preserve the excrements of the population free from admixture with water, and present them for use, at once undiminished in value by decomposition, and in a portable and innoxious condition, the land of the country devoted to the growth of human food might, by their application to it, be greatly increased in its productiveness.

The question of the sanitary arrangements of our towns was taken up by engineers before agricultural chemistry was much studied, and they have committed us to plans which, though they effectually remove the noxious matters from our dwellings, must greatly limit the area, and mode of their agricultural utilisation; and which, at the same time, have tended greatly to the pollution of our streams. To say nothing of the enormous cost that would be involved in entirely subverting the present methods of removing the excrements of the inhabitants of our large cities from their dwellings, it must be admitted, that no feasible scheme has yet been proposed by which this could be accomplished without the use of water. Such is certainly a great desideratum; but perhaps a consummation more to be wished than expected.

It is, perhaps, more probable, that by a reduction in the water supply, or by a more effectual separation of the sewage from the rain-fall, town populations may succeed in producing for the use of the farmer a less diluted sewage. But, in the mean time, we must deal with the sewage as we find it; and the price which the farmer could afford to pay for it would certainly offer no inducement to capitalists to invest their money in distributing it in small quantities over extensive areas. The only persons benefited by such a scheme, would be the contractors, and others, engaged in carrying out the undertaking.

Appendix. Table I.

"Results of the Analyses of 12 Samples of Sewage-water collected in the Five-acre Field. Season 1861.

	Grains per Gallon.															
	April.				May.	June.				July.			August.	Sept.	October.	General Mean; 12 Samples.
	1-6	15-20	22-27	Mean.	Apr 29 to May 4.	11-15	17-22	24-29	Mean.	(9)	(15)	Mean.	5-10	(9)	(15)	
Sample numbers . . .	1	2	3		4	5	6	7		8	9		10	11	12	
	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.
Organic matter — In solution .	9·10	8·64	8·10	8·61	9·90	8·70	11·30	11·10	10·37	12·20	10·20	11·20	9·70	12·20	12·05	10·26
Organic matter — In suspension	3·90	1·76	17·70	7·79	12·30	18·70	13·30	11·90	14·63	10·90	16·20	13·55	10·50	64·40	19·70	16·75
Organic matter — Total .	13·00	10·40	25·80	16·40	22·20	27·40	24·60	23·00	25·00	23·10	26·40	24·75	20·20	76·30	31·75	27·01
Inorganic matter — In solution .	30·40	24·96	31·70	29·02	33·30	34·80	38·10	35·70	36·20	35·40	36·10	35·75	44·30	49·30	47·80	36·82
Inorganic matter — In suspension	2·70	2·24	8·90	4·61	6·40	14·30	8·10	12·60	11·67	11·00	17·10	14·05	5·60	90·90	14·30	16·18
Inorganic matter — Total .	33·10	27·20	40·60	33·63	39·70	49·10	46·20	48·30	47·87	46·40	53·20	49·80	49·90	140·20	62·10	53·00
Total solid matter . .	46·10	37·60	66·40	50·03	61·90	76·50	70·80	71·30	72·87	69·50	79·60	74·55	70·10	216·50	93·85	80·01
Ammonia — In solution .	2·59	2·88	3·08	2·85	2·69	4·43	5·14	4·59	4·72	4·32	4·78	4·55	5·40	10·57	9·42	4·99
Ammonia — In suspension	0·40	0·49	1·27	0·72	2·39	1·59	0·80	1·37	1·25	0·93	1·24	1·09	1·80	5·07	2·40	1·65
Ammonia — Total . .	2·99	3·37	4·35	3·57	5·08	6·02	5·94	5·96	5·97	5·25	6·02	5·64	7·20	15·64	11·82	6·64
Potass	0·86	..	..	..	1·37	..	..	..	..	..	..	..	..	..	..	..
Phosphoric acid . . .	0·64	..	..	..	1·09	..	..	..	..	..	..	..	..	..	..	..

Appendix. Table II.

"Results of the Analyses of 12 Samples of Sewage-water collected in the Ten-acre Field. Season 1861.

	Grains per Gallon.															
	April.				May.	June.				July.			August.	Sept.	October.	General Mean; 12 Samples.
	1–6	15-20	22-27	Mean.	April 29 to May 4.	11–15	17–22	14-29	Mean.	(9)	(14)	Mean.	5–10	(9)	(15)	
Sample numbers . . .	1	2	3		4	5	6	7		8	9		10	11	12	
	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.
Organic matter — In solution .	9·40	9·10	8·40	8·97	11·10	8·90	10·30	12·10	10·43	13·30	10·30	11·80	7·50	12·40	10·80	10·30
Organic matter — In suspension	11·20	2·20	8·90	7·43	19·10	9·50	7·10	11·30	9·30	7·90	8·40	8·15	10·20	20·80	22·20	11·57
Organic matter — Total .	20·60	11·30	17·30	16·40	30·20	18·40	17·40	23·40	19·73	21·20	18·70	19·95	17·70	33·20	33·00	21·87
Inorganic matter — In solution .	29·90	30·80	31·20	30·63	31·90	34·00	34·20	35·30	34·50	33·80	34·30	34·05	38·80	51·50	44·50	35·85
Inorganic matter — In suspension	12·10	1·30	7·00	6·80	15·70	5·80	7·70	13·00	8·83	10·40	7·90	9·15	9·50	23·50	36·70	12·55
Inorganic matter — Total .	42·00	32·10	38·20	37·43	47·60	39·80	41·90	48·30	43·33	44·20	42·20	43·20	48·30	75·00	81·20	48·40
Total solid matter . .	62·60	43·40	55·50	53·83	77·80	58·20	59·30	71·70	63·06	65·40	60·90	63·15	66·00	108·20	114·20	70·27
Ammonia — In solution .	2·63	3·40	3·28	3·10	3·26	4·45	4·75	4·71	4·64	4·45	4·65	4·55	4·48	10·49	9·18	4·98
Ammonia — In suspension	2·06	0·37	0·51	0·98	2·38	1·27	0·82	1·05	1·05	0·81	0·50	0·66	1·40	1·63	1·36	1·18
Ammonia — Total .	4·69	3·77	3·79	4·08	5·64	5·72	5·57	5·76	5·69	5·26	5·15	5·21	5·88	12·12	10·54	6·16
Potass	0·61	..	..	..	1·29	..	..	..	..	..	..	..	..	..	..	..
Phosphoric acid . . .	0·70	..	..	..	1·28	..	..	..	..	..	..	..	..	..	..	..