I have had two or three other cases of the same kind, and in all the results have been the same, namely, an increase in the amount of urine and an improvement in the general condition. This improvement followed, and appeared to be due to the action of the remedy.

The use of renal extracts is still in a purely experimental stage. Judging by the analogy of myxœdema, it would be in the cases of chronic renal cachexia only that we should look for striking results, and this requires early and correct diagnosis. In acute uræmia there is so little time to act that recourse must be had to other and more active measures.

Sir, I have now finished the task you set me. My choice of granular kidney as the subject was inspired by the hope that what had interested me would prove of interest also to others. I trust I may not have misjudged. I have not hesitated to express my own opinions, even at the risk of appearing egotistic, though I trust with sufficient modesty to escape the charge of dogmatism. On a subject so full of difficult and contentious questions, I cannot expect that my views will commend themselves to all. Yet defined opinions challenge criticism, and criticism tends to advance knowledge.

THE MILROY LECTURES

ON THE

EARTH IN RELATION TO THE PRESERVATION AND DESTRUCTION OF CONTAGIA.

Delivered at the Royal College of Physicians of London

By G. V. POORE, M.D., F.R.C.P. LOND.,

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LECTURE III.¹

AGRICULTURE.

MR. PRESIDENT AND GENTLEMEN,—Enteric fever, diarrhœa, plague, and some other diseases are favoured by filth, although we are ignorant of the precise way in which filth favours the occurrence of these diseases. Some might say that a filth disease is a soil disease, and that there is no line of demarcation between the two. This is true, but it is nevertheless very necessary for practical purposes to distinguish the one from the other. We are all agreed that it is dangerous to allow the purlieus of a house to become sodden with liquid filth, but it might be equally dangerous to the public health to encourage the idea that it is dangerous to dung the land for fear of inoculating it with infectious disease.

Infective organisms contained in dung have to run the gauntlet of many enemies—such as dogs, sparrows, rats, flies, maggots, beetles, earthworms, moles, sunlight, fresh air, innumerable saprophytes (both aerobic and anaerobic), and the chemical action of the roots of plants. Of course, there may be spores which emerge from these ordeals unharmed and still virulent, but it is evident that, being mortal as we are, they are likely to succumb before the digestive and disintegrating processes which they encounter. The bulk of the evidence goes to show that contagia must be largely destroyed in the soil, and that agriculture is really the corner stone of preventive medicine. It becomes of great importance, therefore, to devise means by which the fertilising material of our towns may be applied to the soil with safety and despatch.

I may be pardoned for reverting to the method of dealing with human excreta which I have practised now for twelve years in my experimental garden at Andover:

1. The excreta are moved every day so that there is no accumulation of filth near the dwelling.

2. They are put just below the surface of freshly-dug ground so that they are out of the reach of flies.

3. The ground is planted with plants of the cabbage order as quickly as may be, so that very soon there is no possibility of dust being blown off the surface of the ground, and the mass of living cabbage leaves freshens the air.

I cannot believe that dust from agricultural land is a danger in this country, whatever it may be in the tropics. In my

garden the ground treated in the manner stated, apart from the growth of cabbages, soon becomes coated with a green growth of alga. Mr. A. Gepp of the Natural History Museum, who visited my garden last summer, took some of this growth away and very kindly examined it, and he pronounced it to be an alga—"chiefly *vaucheria sessilis* (in good fruiting state) with a little *ulothrix*, a *gloeocystis*, and an *oscillatoria*." Such a growth effectually prevents the possibility of dust.

Dr. Samuel Hyde,² speaking on the Open-air Treatment of Consumption, says: "Sparseness of vegetation, like thinness of population, is a climatic factor favourable to the treatment of consumption. Where vegetable life abounds, there vegetable decomposition must also abound, and *vice versa*. Wherever there is life we have a corresponding amount of death accompanied necessarily by the products of decomposition." That is true, but it is also true that wherever there is death we have the potentiality of a corresponding amount of life. I believe that what I have called the circulation of organic matter is a beneficent fact from which there is no escape, and that whether we derive good or ill from the inevitable processes of death and decay depends very much upon ourselves. We must never forget that vegetation purifies the soil, freshens the air, rests the eye, and prevents dust, and these facts must be recognised as to a great extent counterbalancing the evils of dead leaves, and apart from the question of food supply, it is, I believe absolutely necessary to encourage agriculture in order that our race may be maintained in vigour. The strong contrast which exists between the agriculturist and the town worker in the matter of health is well known.

Agriculturists are amongst the healthiest in the community, and even the farm labourer, in the matter of health, is 33 per cent. better than the average.

THE MAINTENANCE OF THE FERTILITY OF THE SOIL.

There is much evidence to show that dung is absolutely necessary to maintain the fertility of the soil. In a paper by Sir John Lawes and Sir Henry Gilbert on the valuation of unexhausted manures,³ the difference between organic manures and mineral manures is well brought out. The lasting effects produced by farmyard manure (14 tons to the acre) are shown in the annexed table.

Experiments with Farmyard Manure on Permanent Grass Land.

	Unmanured every Year.	Manured 1856-63, Unmanured since.	Excess of Manured over Unmanured.
8 years, 1856-63 } 1st crops only {	cwt. 23½	cwt. 42½	cwt. 19½
12 years, 1864-75 } 1st crops only {	cwt. 19½	cwt. 32½	cwt. 13½
20 years, 1876-95 (1st and 2nd crops) ...	cwt. 25½	cwt. 29½	4

In only one year—1893, a year of drought—did the manured plot give less produce than the unmanured. The authors say: "It is true that the application of 14 tons of farmyard manure per acre per annum for eight years in succession is an unusually heavy dressing; but it is of interest to know that the

Showing the Yield of Wheat in Bushels per Acre.

Period.	Mixed Mineral Manure.			
	Alone.	And NH ₃ 86 lb. N.	And NH ₃ 129 lb. N.	And NH ₃ 172 lb. N for first 13 Years (1852-64) Unmanured for last 19 Years.
	Plot 5	Plot 7	Plot 8	Plot 16
13 years, 1852-64 ...	18½	37½	39	39½
19 years, 1865-83 ...	13½	29½	34½	14½

residue was very materially effective for some years, and that it was more or less so for thirty-two years after the application." The experiments on barley and wheat with artificial manures are equally instructive (see Table, p. 587).

In the above experiments, in which dung was not used, we find that the yield was less in the second period than in the first, and that when the large amounts of artificial manure were withdrawn in Plot 16 the yield dropped almost at once. The authors say: "There is, in fact, abundant evidence to show that there is but little effective manure residue after the growth of a grain crop by the application of ammonium salts; and there is little doubt that the produce of one bushel and a half of grain and its straw per acre per annum more over the nineteen years after the cessation of the application of ammonium salts than on Plot 5 with the mineral manure alone is, so far as it is to be attributed to residue, mainly due to the increased crop residue—stubble and roots accumulated during the thirteen years of the application; and much the same may be said of the after-effects when grain crops have been grown with nitrate of soda." Again: "When organic matter, animal or vegetable, is applied to the soil as manure, its complete decay and the complete liberation of its fertilising constituents extend over a considerable period of time. Poor land cannot be suddenly brought into condition by the consumption on the farm of purchased foods; nor can condition—that is, accumulated fertility, be at once withdrawn by suddenly stopping the use of food.

Food Supply.—Sir William Crookes, the President of the British Association, in his address (Bristol, 1898) drew attention to the fact that if populations continued to increase we might expect to be short of wheat. Our remedy was to increase the fertility of the wheat-growing area of the world, and taking, as was perhaps but natural, a purely chemical view of fertility, he put forward the proposition that the productiveness of the soil might be expected to bear a direct ratio to the amount of fixed nitrogen which is applied to it, and he found comfort in the fact that after the exhaustion of the nitre beds of Chili and the guano beds of Peru the chemist of the future would be able by the aid of electricity generated by Niagara and other natural forces to fix the atmospheric nitrogen for the benefit of the farmer. In the course of his address Sir William Crookes made allusion to the sewage question in the following words:

There is still another and invaluable source of fixed nitrogen. I mean the treasure locked up in the sewage and drainage of our towns. Individually the amount so lost is trifling, but multiply the loss by the number of inhabitants, and we have the startling fact that in the United Kingdom we are content to hurry down our drains and watercourses into the sea fixed nitrogen to the amount of no less than £16,000,000 per annum. This unspeakable waste continues, and no effective and universal method is yet contrived of converting sewage into corn. Of this barbaric waste of manurial constituents Liebig nearly half a century ago wrote in these prophetic words: "Nothing will more certainly consummate the ruin of England than a scarcity of fertilisers; it means a scarcity of food. It is impossible that such a sinful violation of the divine laws of Nature should for ever remain unpunished, and the time will probably come for England sooner than for any other country when, with all her wealth in gold, iron, and coal, she will be unable to buy one-thousandth part of the food which she has during hundreds of years thrown recklessly away." The more widely this wasteful system is extended, recklessly returning to the sea what we have taken from the land, the more surely and quickly will the finite stocks of nitrogen locked up in the soils of the world become exhausted. Let us remember that the plant creates nothing; there is nothing in bread which is not absorbed from the soil, and unless the abstracted nitrogen is returned to the soil its fertility must ultimately be exhausted.

Sir John Lawes and Sir Henry Gilbert, in a communication addressed to the *Times* on December 2nd, 1898, point out that even supposing that atmospheric nitrogen could be fixed at a remunerative price, the addition of nitrates without the addition of the other mineral constituents necessary for wheat growing would be of no permanent use; but they express the opinion that the stores of nitrogen and other fertilising salts existing in our own soils and the soils of foreign countries can be made available by thorough tillage and proper rotation of crops. The land wants labour, and the production of wheat is likely to be proportionate to its market value. They point out that the average wheat production of the unmanured plot at Rothamsted (over 13 bushels) is greater than the average of the whole of the United States, a fact mainly due to proper tillage and thorough weeding.

It is tolerably evident that fertility is not merely a chemical question. The year 1898 was remarkable for a fine wheat crop in this country. The yield is said to have averaged 35 bushels instead of 28 or 29 bushels per acre. Sir John Lawes, in his annual letter to the *Times* (October 22nd, 1898) on The Wheat Crop of 1898, states that at Rothamsted the yield in the experimental plots was as under:

Wheat Crop in 1898.

	Bushels per Acre.	Cwts. of Straw.
Plot 3, unmanured	12	12½
Plot 9, nitrates... ..	23½	33½
Plot 7, ammonia salts	28½	44½
Plot 8, ammonia salts	29½	54½
Plot 2, farmyard manure	35	55½

In 1898 at Rothamsted the plot dressed with nitrate of soda yielded 23 bushels, as against 38 bushels on the farmyard plot, and in explanation Sir John Lawes says: "For only the second time during a period of more than 40 years the wheat plant was much injured where we have used the heaviest dressing of nitrate of soda for want of enough rain to form and distribute a sufficiently dilute solution of it; and a similar result occurred in the year of drought of 1893; whilst in this year (1898) the barley plant was much injured with only half the amount of nitrate applied." Sir John Lawes also gives the average yield of these five plots for periods extending over 46 years.

	Un-manured.	Farm-yard.	Ammonia Salts.	Ammonia Salts.	Nitrate of Soda.
36 years, 1852-87.....	13	33½	32½	36½	36½
10 years, 1868-97.....	12½	40½	34½	37½	33½
46 years, 1852-97.....	12½	35½	33½	36½	36½

From the above table it will be observed that not only has farmyard manure proved to be practically the equal of artificial for nearly half a century, but that during the last ten years the yield from it has been considerably more than that of any of the artificially-manured plots. It is interesting to observe, also, that had the wheat-growing area of this country in the year 1898 been sprinkled with nitrate of soda after the manner of Plot 9 at Rothamsted, the yield might have averaged only 23 bushels instead of 35 bushels. On 2,000,000 acres, which is approximately the wheat area of the United Kingdom for 1898, this means a deficit of 24,000,000 bushels, or 3,000,000 quarters. The chemical analysis of a soil often fails to give the clue to its fertility or sterility. Mr. Robert Elliot, in a paper on The Value of Plant Roots as Tillers of the Soil, quotes Sir John Lawes to the effect that "All our experiments tend to show that it is the physical condition of the soil, its capacity for absorbing and retaining water, its permeability to roots, and its capacity for absorbing and radiating heat, that is of more importance than its, strictly speaking, chemical composition." It is, in fact, abundantly evident that the biological side of fertility is quite as important as the chemical, and that organic manures are absolutely necessary to maintain the fertility of the soil, and that of all organic manure there is nothing to be compared with dung. If all that comes from the land be returned to it there can be no reason why the agriculturist should trouble himself with chemical theories. He has only by labour to maintain the soil in a good physical condition, and he may rest assured that its fertility will increase.

SANITATION IN HOLLAND.

In Holland the connection of sanitation with agriculture is far closer than with us and it is possible that we may derive some useful hints from our neighbours. In Holland the sanitary problems are of a formidable kind. The level of the country varies from a few feet above to a few feet below the mean level of the German Ocean, and it is needless here to recount how the Dutch people, marvellous for their shrewdness and untiring industry, have maintained a successful warfare against the forces of Nature. With the exception of two or three inconsiderable areas the whole of the kingdom of the Netherlands is a flat plain intersected at very frequent intervals by canals and rivers. These water-

courses are all sluggish, and in some of them the slow current is maintained artificially by pumping. It may be said that every Dutchman lives within a few yards of a watercourse of some kind, be it ditch or canal. These canals form a very cheap and admirable means of internal communication and in consequence the barge population is very large indeed. The population of Holland tends steadily to increase, such increase being most marked in the big towns.

In no country in Europe, probably, has the state of public health improved more remarkably than in Holland.

The causes of this improvement in the death-rate are probably (1) the improvement in the physical and moral condition of the lower strata of society; (2) sanitation in its widest sense; (3) the rapid increase of population especially in the towns, causing a dilution of the high death-rates in the old crowded portions by the lower death-rates of new settlers in the outskirts; and (4) the decrease in the birth-rates. In Holland, as in England, the importance of pure water, especially for town populations, is abundantly recognised, and public supplies have within recent years been carefully protected from pollution and filtered before being distributed. The risk from drinking canal water must have been very great indeed. The mode of dealing with faecal matters is necessarily different from ours. In Holland waterclosets are the exception and not the rule, and while the slop water of the houses is allowed to flow into the canals the fæces are collected and used for agricultural purposes.

In Holland generally the death-rate from enteric fever compares favourably with our own. Knowing as we do the great risk of drinking sluggish water liable to faecal contamination (which has been exemplified in the Tees valley) the low enteric death-rate in Holland is not a little remarkable. Enteric being a fever of slow and insidious onset, it is impossible in sporadic cases to say where or how the patient may have been infected, and in cities with an ever-shifting population this difficulty is accentuated. That being the case, it will not be without interest if I give a few particulars concerning the provinces of Groningen and Friesland which I visited in the vacation of 1898. These two provinces are almost entirely devoted to dairy farming, the breeding of horses and cattle, and agriculture. The shifting and travelling population is a small one, and it is here if anywhere that we may learn the effect of local habits and customs on the public health.

In the town of Groningen, with 63,863 inhabitants, the improvement in the death-rate in the past twenty years has been as remarkable as that observed in the other Dutch cities or in any town or city in that country. In this town, as also in Leeuwarden, the capital of Friesland, and in the great majority of Dutch towns, the faecal matter is collected in pails, and it is probable that in the whole extent of the two northern provinces of Groningen and Friesland there is not a watercloset to be found. The whole of the faecal matter is scrupulously collected and returned to the soil. Dutch cleanliness is proverbial, and certainly I have never been in a town so exquisitely clean as in the town of Groningen. The accumulation of ordure in the streets and backyards is simply not tolerated, and the inhabitants co-operate with the scavengers in clearing away all refuse as quickly as possible. The collection of the faecal matter is very simple. The closet pails are much smaller than those which are commonly used in this country, and they are emptied twice or thrice a week or daily if the householder is ready to pay a small fee. The collecting cart is really a tank upon wheels with a sort of hood projecting behind like the hood of a carriage facing the wrong way. The pails are brought out, and the man and pail are hidden by the hood as the contents are simply tipped into the tank. The pails, even when full, being such as one man can lift easily, the collection is probably ten times as rapid as is the case in those English towns which make use of huge two-man pails, which, when empty, weigh 50 lb. and more. Again, it is obvious that the Groningen authorities do not make the mistake of hauling about an immense weight of pails which add enormously to the expense. The depot where the material is collected is on the outskirts of the town, where a wharf has been constructed with a view to its removal by barge for the purposes of the farmer. Here, again, the arrangements are very simple. The stuff is simply stacked beneath rough sheds covered with corrugated iron. The men employed have found out exactly how to do it, and by arranging a layer of street sweepings with peat ashes (the fuel used in this district is almost exclusively peat) alternately with a layer of pail contents, the whole mass drains and consolidates into a very rich black manure which the farmer highly appreciates. The floor of the depot is concreted and provided with channels, so that the urine drains away into a large tank, whence it is pumped into barges for the use of the agriculturist. Considering the work which went on in it, this depot was wonderfully neat; the stacks were as evenly made as the best hay stacks, and the paths between them were quite free from befolements. The smell from the putrid draining was, to say the least, powerful; but the solid stuff soon ceases to be very offensive. There were large numbers of flies in this depot, but I frequently remarked that the flies in the town of Groningen were not nearly so troublesome as is the case in cities less carefully scavenged.

In the town of Leeuwarden the pails are taken to and fro to the depot, but the pails are much smaller and lighter than those in use in England,

so that 54 of them (three tiers of 18 each) can be carried on a one-horse lorry. In the 10 years (1885-94) there were in each of the provinces of Groningen and Friesland 490 deaths from enteric fever and typhus fever, 980 deaths in all or an average of 98 per annum in a population of some 600,000, giving a rate for typhus fever and enteric fever of 0.16 per 1,000. During the same period there were 97 deaths from the same cause in the town of Groningen and 27 in the town of Leeuwarden, or 12.4, giving an average of 12.4. These figures are not large, but they show that as regards these diseases the condition of Groningen was slightly worse than the town of Leeuwarden. As in England so in Holland, the death-rate from enteric fever has been falling steadily, and the returns for the last available year (1897) are very instructive. From these returns I find that in the province of Groningen, with 296,521 inhabitants, there were 23 deaths from enteric fever in 18 parishes, giving a death-rate of 0.08, and in the province of Friesland, with 339,425 inhabitants, there were 19 deaths from enteric in 12 different parishes, giving a death-rate of 0.056 per 1,000. It is a remarkable and most interesting fact that in 1897 there was no death from enteric fever in either of the capital towns of Groningen or Leeuwarden, containing over 95,000 inhabitants (Groningen 63,863 and Leeuwarden 31,598).

The figures given above must be taken to show that in these two provinces there is no serious endemicity of enteric fever. When we consider that dairy farming is the staple industry of these provinces, that milk, which is most sensitive to typhoid fever infection, is everywhere abundant, and that human excreta containing a certain proportion of typhoid fever excreta are used, and have been used for ages, to manure this fertile district, which almost lies in the water, the comparative freedom from enteric fever seems very full of instruction.

These facts seem to me to afford a very large measure of proof that there is no inherent danger in the methods of sanitation pursued in Groningen and Friesland, and, in fact, in Holland generally.

In the United Kingdom of Great Britain and Ireland there are, including waste lands, 77,672,000 acres supporting a population of 40,000,000, and in Holland there are (excluding lakes and rivers) 7,786,000 acres supporting 4,894,000, so that Holland supports a bigger population per acre than the United Kingdom.

In the United Kingdom the area under cultivation (crops and grass) amounted to 47,868,553 acres in 1897, and this figure appears to be slightly decreasing. In Holland in 1895 the total area under crops and grass was 5,149,817 acres, showing an increase of 95,000 acres in the preceding three years. In the United Kingdom there is 1.2 acre of cultivated land per head of the population, and in Holland there is 1.05 acre. Let it not be supposed that the Dutchman owes his position of agricultural supremacy to the "natural" fertility of the soil of his country. Doubtless he has found a large amount of well-watered pasture land ready to hand, but it is undeniable that some of the very best of his land has been won from the sea, the desert moorland, and the bog, by indomitable pluck and perseverance. Above all, the Dutchman is fully impressed with the necessity of returning to the soil everything that comes out of it. Nobody knows better how to facilitate that circulation of organic matter which is a law of Nature, and he sees that his profit depends upon the completeness and rapidity of that circulation, and that in farming, as in other businesses, a rapid turnover of capital is to be aimed at. In Holland everything which has manurial value is returned to the land, and we find that the population is increasing as fast as ours, and that the land under cultivation is increasing, although the area of land is less per head in Holland than in the United Kingdom. The level of public health is as high in Holland as in the United Kingdom, and an enormous amount of farm, garden, and dairy produce is exported to this country, where the land under cultivation is tending to decrease, where manurial wealth is being recklessly burnt or turned into the sea, and where one-half of the population is absolutely ignorant of the uses and value of dung, and the other half is, if not ignorant, too squeamish to use it.

CARRINGTON MOSS.

This seems to be the place in which to allude to the spirited action of the city of Manchester, which has reclaimed Carrington Moss, and is about to reclaim Chat Moss by fertilising the ground with the organic refuse of the city. The ground is a virgin peat, which is admitted to be deadly to one at least of the supposed earth organisms. The experiment is a splendid one, and will certainly be the precursor of similar action elsewhere. The material sent to Carrington in 1897 consisted of 37,082 tons of nightsoil, 587 tons of sweepings,

and garbage, and 11,673 tons of cinders. The Carrington Moss estate, therefore, regarded merely as a dumping ground for garbage and refuse, must be a source of satisfaction to the Cleansing Committee of the city of Manchester.

On August 11th, 1897, I visited Carrington Moss and had the advantage of being shown over it by Mr. McConnell, the bailiff. Carrington Moss was bought by the Manchester Corporation in 1886. It is ten miles from the city, in close proximity to the famous Chat Moss, from which it is separated by the Manchester Ship Canal, which serves for the transit of material from Manchester. The estate, for which the corporation gave £38,000, has an extent of 1,100 acres, of which 600 were wild Moss commanding a rental of a shilling an acre for sporting rights. The corporation has spent £56,000 on light railways, roads, drainage, rolling stock, buildings, etc., making the cost £94,000. (The outlay on the estate is given as £82,046 in the City Treasurer's Abstracts, 1897.) In the nine years 1889-97 491,686 tons of refuse material have been placed upon Carrington Moss, or very nearly 50 tons per acre per annum. The moss has been drained by a series of deep trenches, with nearly vertical sides, cut at regular intervals. The refuse, as it arrives from Manchester, is transmitted by means of a light railway to various parts of the estate, where for the most part it is placed in heaps and allowed to "ripen" before being placed upon the ground. These heaps soon cease to be in the least offensive. Nightsoil is frequently applied directly to the fields. At the time of my visit two barges, estimated to contain 80 tons of refuse, were unloading at the little wharf which has been especially constructed. The hay harvest was just over and the corn harvest was soon to commence. The crops one and all were in splendid condition. Oats, potatoes, carrots, wheat, and all the other usual farm crops appeared to be first-rate, quality excellent, quantity enormous. The roads were hard and firm, having been brought to this condition by the application of clinker and other forms of hard material from the city. The farm is not quite a dead level, but the inequalities of the surface are very slight, so that from every point the spectator is able to survey an area of very considerable extent. Without previous knowledge there was nothing in the appearance of the farm (except the deep trenches) to indicate the character of the subsoil. All indications of bog had completely vanished. On reaching Mr. McConnell's house we walked out upon a pretty lawn surrounded by a flower border brilliant with carnations and the ordinary garden plants. The lawn was firm and perfectly dry and I was not prepared for the demonstration which I was to have of the character of the subsoil. Taking an iron rod having a length of 1½ ft. and a diameter of about ½ inch, Mr. McConnell with one hand drove it through the turf of his lawn completely up to the handle. I then did the same thing. As the rod passed through the first foot or so there was some resistance and a sense of grittiness was imparted to the hand, but, this first obstruction passed, the descent of the rod was progressively easier until it was finally stopped by the handle resting on the lawn. On withdrawing the rod the lower half was found to be wet, while the upper part was dry. To the upper half clung a little grit and peaty earth, the lower half was clean but wet. It was then only that one recognised that this fertile paradise was literally floating.

Mr. McConnell informs me that Carrington Moss is everywhere about 12 ft. in depth and that the variations in depth are very slight; whereas Chat Moss, although distant only a few miles, has a depth which varies from 4 ft. to over 30 ft. On Chat Moss, where the digging of drainage trenches was in progress, I examined the peat which had been removed. These trenches are dug to a depth of about 4 ft. to begin with. The peat near the surface had the ordinary fibrous character, whereas that from the bottom looked like brown jelly. The moss resembles a huge sponge. Mr. McConnell states that the surface of Carrington Moss is gradually sinking. The sponge is being squeezed and drained, and rendered more compact. The half million tons of garbage which have been placed upon the surface must exercise considerable pressure, and must serve to squeeze moisture into the deep trenches. Then, again, the upward drainage of the abundant crops is obviously very large indeed. The amount of moisture retained by and evaporated from an acre of oats or mangel must be very great.

Mr. McConnell assured me that the farm as a place of residence is by no means damp, and that the rain that falls upon his lawn quickly drains away to the reservoir beneath, and leaves the surface dry. He and his family and the employees on the farm have always enjoyed excellent health. There has been one case of enteric fever in nine years, the cause of which is doubtful.

Of the 1,100 acres of land occupied, 372 acres are farmed by the committee, 639 acres are let to tenants, and the rest is occupied by roads, wharves, plantations, etc. The rental of the portion which is let amounts to £1,516 19s., or about £2 7s. 6d. per acre, while the rent of the amount retained by the corporation is put in the accounts as £933 (that is, £2 10s. per acre for the 372 acres farmed, or just £2 if the roads, etc., be included).

In the year ended March 31st, 1897, the value of the farm produce amounted to £3 632, or about £9 15s. per acre, while the net profit on the farm appears to have been £1,041, or £2 16s. per acre. The amount paid in wages was £1,520, and the rent, as stated, was £933. If we may assume, as we have every right to assume, that the land rented was as productive as the land retained by the corporation, then the value of the produce of the 1,011 acres under cultivation would, at £9 15s. per acre, amount to £9,864, and we then arrive at the conclusion that each of the 49,342 tons sent to Carrington Moss in 1897 produced almost exactly 4s. worth of food. But now that the Moss is entirely reclaimed it will not take more than 30 tons of stuff to the acre, or, say, 30,000 tons per annum. Thus by a well-considered expenditure, Manchester has provided

itself with (*quâ* refuse) a destructor capable of dealing with about 100 tons per diem for ever, and in its formation this machine has absorbed nearly half a million tons of refuse of which the city had of necessity to be rid at all costs. When the loans necessary for the purchase and development of this estate have been paid off it is certain that Carrington will cost the Manchester ratepayer nothing, and will probably yield a return in crops of about 6s. 8d. for every ton of refuse used. Land which produced nothing, and which let for 1s. per acre, has been made to yield £10 worth of produce, and an eventual rental of £2 10s. per acre. This is a result of which Manchester may well be proud.

CONCLUSIONS.

I have brought forward a considerable number of facts to prove that the dangers of applying dung to the soil are as nothing in comparison with the advantages—advantages which have been acknowledged from the dawn of historic time till now. It remains to say a few words on the financial side of the question. The great experiment at Manchester seems to prove conclusively that even in a huge city and with the heavy outlay which seems to be inseparable from all modern municipal undertakings, a well-considered scheme of application of offal and ordure in a dry state to the soil is the most economic way of getting rid of it. I have shown how in Holland great cities may be kept spotlessly clean, and in spite of obvious difficulties the public health be maintained by a well-devised system of scavenging. The cleanliness of Groningen is a thing which is scarcely realisable by one whose ideas of street sanitation are acquired in the West End of London, and the economy with which the scavenging is accomplished seems astounding to that poor pigeon, the London ratepayer. I have further shown that Holland, with a smaller area of cultivated land in proportion to population than England, is able to export to this country enormous quantities of farm and dairy produce; and that, while the English farmer can scarcely exist, the Dutch agriculturist grows rich.

It will not be uninteresting, perhaps, if I give some of the financial results of my small experiment at Andover, which is now in its fourteenth year of trial. In this experiment the ordure and house refuse of about 100 persons have been removed and applied daily for gardening purposes. The amount under the space is now exactly one acre, one rood, and seven poles, and I should like to say that the quantity of faecal matter at the disposal of my gardener by no means satisfies him. I am also convinced that the garden might take with advantage at least double the quantity, if not more. There is no evidence after a long experience that the soil is overdone. On the contrary, its "condition" has steadily improved. The produce of my garden has been sold on the principle of profit-sharing, so that the gardener is interested in extracting the greatest amount of produce from the soil. During the past year careful accounts have been kept, and I find that the produce fetched £72 9s. 6d., which works out to £56 per acre. Of this sum £41 12s. 7d. were received for fruit and £30 6s. 11d. for vegetables. The method of agriculture which I pursue is well known, but this has caused no prejudice against the garden produce, which finds a very ready market.

Except in the vacation, I certainly do not visit Andover more than once a month. My experience leads me to say that it is to me almost inconceivable that the daily scavenging of our towns should not yield enough profit to pay the wages. It is especially to be noticed that the yield of this garden has undergone steady increase, and I have every hope that such increase will continue. But it would be a great mistake to suppose that an acre of ground cultivated and manured as is my garden is going to yield £50 worth of produce per annum at once. The test of true gardening is increase. With the lapse of years and without appreciable cost the increase of fruit trees is automatic, and the yield of seeds is equally automatic and prodigious. My garden has gradually become fully furnished to a large extent with its own offspring, and in that fact lies part of the secret of its increasing yield. What we see in the London parks in the summer is not "gardening," but a beautiful display, after the manner of the bouquetiste, of the results of gardening elsewhere. In the same way the filling of flower beds with a crowd of named

and fashionable plants bought for the season is not gardening, but a mere evidence of wealth. The real gardener in these cases is the nurseryman.

The gradual increase in the yield of a plot of land, at least for a very long series of years, is limited only by the amount of skill and tillage which it receives and the amount of dung which is available for it. We are gradually becoming alive to the fact that fertility is a biological question rather than a chemical question. To imagine that chemicals can ever replace dung is a pure delusion from which we shall some day be aroused. The success or failure of agriculture is very largely a question of dung, and it must be admitted that the dung prospects in this country are very bad indeed. Imported animal food yields very little dung for the land, because it is mostly washed (ultimately) into the sea, while the use of steam engines, motor cars, and bicycles must mean a diminution of horse dung. The sanitary pioneers of half a century ago thought that the huge expenses of modern sanitation would be compensated by the yield from sewage farms. That has proved to be erroneous. Sewage has proved to be merely the happy hunting ground of sanitary tradesmen who have fattened on the ratepayer. The century closes with the spectacle of a Royal Commission still discussing the best way of destroying the potentialities of life and prosperity.

In these lectures I have brought forward many facts to show that there is no proof of any danger arising from the use of dung for agricultural purposes, while it is undeniable that the practice of agriculture is pre-eminent healthy and invigorating. I have been unable to find any evidence that contagia spread in the soil. To live in filth and to inhale the products of putrefaction given off from privies or pails of *læces* or sodden ground result in disease, but there is no evidence whatever that disease thus generated is able to spread through the soil and infect a neighbouring house or street. Looked at in another way we must admit that filth disease, like many other forms of disease, is proportionate to overcrowding.

While we exult (not always reasonably) in our diminished death-rate, let us not forget the diminished birth-rate, the multiplication of asylums of various kinds, and the steady increase in the amount of help from public funds which is necessary to maintain the health and decency of the masses. The year just ended has been unsurpassed in the volume of trade and the bounty of the harvest, but the infant mortality in our towns for the Michaelmas quarter was the highest on record.

At present he who advocates any attempt to entice a fair proportion of the people "back to the land" is regarded as a Utopian dreamer. I feel convinced that the only chance of getting a living from agriculture lies in the due enrichment of the soil. There is no chance of this so long as the only form of sanitation which receives any official encouragement is one which involves a systematic starvation of the soil. One sometimes comes across statements which would lead one to suppose that cultivated land is a public danger, statements which are mere assertions. Our sanitarians, careless of food supply, are liable to be dominated by ideas and to fix their attention unduly upon one side of the question and upon one disease. The more enthusiastic of them, if they can secure a trifling diminution in the mortality from one disease, seem quite ready to "make a solitude and call it peace."

REFERENCES.

¹ Lectures I and II were published in the BRITISH MEDICAL JOURNAL of February 25th and March 4th respectively. ² BRITISH MEDICAL JOURNAL, October 8th, 1898. ³ *Journal of Royal Agricultural Society*, vol. viii, 1897, p. 674. ⁴ *Ibid.*, vol. viii, 1897, p. 469.

THE PASTEUR INSTITUTE IN HYDERABAD. — A Hyderabad correspondent states that the statement already made regarding the scheme being settled is premature and somewhat inaccurate. He, however, allows that a scheme for such an institute has been formulated, and is now before His Highness the Nizam for consideration and orders, and that it contemplates not only the foundation of a Pasteur Institute, but also of a bacteriological laboratory. For the last six or seven months work has been going on in a temporary laboratory in connection especially with the plague, and many important results have been obtained.

THE ARRIS AND GALE LECTURES ON THE ANATOMY AND SURGERY OF THE PERITONEAL FOSSÆ.

Delivered at the Royal College of Surgeons of England,

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LECTURE II.—THE PERICÆCAL FOLDS AND FOSSÆ. —PERICÆCAL HERNIA.

[ABSTRACT.]

THE pericæcal folds and fossæ are primary and secondary. The primary folds are vascular in origin; the secondary folds are dependent upon the adhesion, sometimes wanting, between the cæcum and ascending colon and the posterior abdominal wall. The primary folds are found whatever the position of the cæcum may be, the secondary are only present when the cæcum and ascending colon are normally placed.

The primary folds are:

1. An anterior, raised up by a branch of the ileo-colic artery as it runs over the anterior aspect of the ileo-colic junction.
2. A posterior, raised up by the artery to the appendix.
3. An intermediate, which is partly muscular and partly vascular in origin.
4. An accessory anterior fold due to a lateral branch of the ileo-colic artery.

THE ILEO-COLIC ARTERY AND ITS BRANCHES.

The ileo-colic artery (Fig. 12) as it approaches the angle of

Fig. 12.—The ileo-colic artery and its branches.

junction of the ileum with the ascending colon gives off, as a rule, five branches. The precise mode of origin of these branches may vary within considerable limits. The most frequent arrangement is for the vessel to divide into two main trunks which subsequently split up, the anterior into two, and the posterior into three branches.

The anterior branches are: (a) A branch running to the left along the upper border of the ileum, and (b) a branch which continues, in the line of the ileo-colic, over the ileo-colic junction. In a few cases the largest offshoot of this latter branch is a vessel which runs to the right on to the colon, forming in its course a well-defined curve with the concavity upwards and to the right. The posterior branches are: (a) A branch running upwards to anastomose with the right colic; (b) a branch which runs to the posterior aspect of the junction of the ileum with the colon distributing twigs to the right and left; and (c) the appendicular artery which runs in the meso-appendix to the tip of the vermiform process. The chief branch of this last vessel arises close to the lower margin of the ileum, and runs