knowledge, that such vast accumulations of what were originally highly fertilising substances should be discharged into the estuary of the Thames, and not only be absolutely wasted, but converted into a perpetual nuisance, brought up at each tide within the limits of the metropolis from which they started.

"It is true that within the last fifty years we have imported enormous quantities of guano, phosphates, and nitrates, but of these there must eventually become a scarcity, if not an end. In the meantime, may not chemists do something to reduce the waste of fertilising agents that is now taking place among us? Agricultural colleges have been founded—agricultural chemistry is a recognised branch of science; but with increase of knowledge has come increase of foreign competition, fostered by improved means of transport and communication, and it is at the present time a doubtful point whether many soils, even if rent-free, can be cultivated in this country for cereals, except at a loss.

"While touching on agricultural chemistry, I cannot pass over in silence the experiments which have now been carried on continuously for a period of fifty years at Rothamsted, by Sir John B. Lawes, assisted during the whole half-century by Dr. Gilbert. The extremely liberal provision which, during his life-time, Sir John Lawes has made for the purpose of continuing and extending his experiments, would alone entitle him to a full measure of public gratitude. When, however, we consider the nature and extent of the experiments already conducted, we must feel that no expression of public estimation can be too high when, as will shortly be the case, the Rothamsted jubilee is celebrated. As to the results already obtained, and as to the nature of the experiments still being carried on, it would be out of place here to enlarge. Remarkable, however, as are the effects of different manures on the botanical character and growth of herbage, and on the strength and yield of cereals, the different results arising from the mere variation of the temperature, sunshine, and rainfall, in successive years, are more remarkable still.

"I feel, however, that I have detained you long enough with these crude considerations of topics more or less chemical in their character, and that it is time for me to conclude.

"We are here assembled on the borders of the two counties of Lancashire and Cheshire, in both of which are great centres of chemical manufactures, and the principal productions of which are in a great degree dependent on the knowledge and due application of chemical laws. We meet at the seat of one of the most active sections of the Society of Chemical Industry, which has received us with open arms, and has provided us with an 'Open Sesame,' which will admit us to inspect many of the most interesting of the works and factories of the district. We gladly avail ourselves of the opportunities thus liberally opened to us, and if by chance any of us can afford assistance, advice, or encouragement to our brethren in Liverpool, I am sure that all present will gladly render it, and not forget that we are all members of one body, and all mutually interested in the advance of chemical knowledge, and especially of Chemical Industry."

THE PLAGUE OF FIELD VOLES.

RATHER more than a year ago a Committee was appointed by the Board of Agriculture to inquire into and report upon the circumstances attending the existing plague of voles in some of the southern counties of Scotland; and to ascertain, either experimentally or otherwise, whether any, and if so what, preventive and remedial measures could be adopted, and under what conditions those measures were likely to be of value.

The committee consisted of Sir Herbert Eustace Maxwell, Bart., M.P. (chairman), the Right Hon. the Earl of Minto, K.T., the Rev. John Gillespie, Prof. D'Arcy W. Thompson, and Mr. Walter Elliot.

Mr. J. E. Harting, Librarian of the Linnean Society, acted as the Secretary to the Committee.

From the recently-published report we obtain the following information. "The animal, which by excessive multiplication has caused so much mischief on hill-farms in the southern uplands of Scotland, is the short-tailed field-vole (*Arvicola agrestis*). At all seasons it is a well-known inhabitant of our pastures and may be found at all heights from sea-level to near the summits of our highest mountains. It usually produces three or four litters a year, each consisting of from four to eight young, but in some seasons they are even more prolific, the breeding season is prolonged, young voles being observed from February to November, and the litters containing as many as ten young.

"The present outbreak may be traced back to the year 1888, when the voles were observed to be increasing on the farm of Glenkerry and others in Selkirkshire. In the summer of 1889 the low-lying pastures near Closeburn, in Dumfriesshire, were observed to be infested by enormous numbers of voles, which remained there during 1890, and disappeared in 1891, probably moving up to the hill pastures, where in June 1892 they were swarming.

"The districts principally affected are the hill pastures in the north-west of Roxburghshire, the south of the counties of Selkirk, Peebles, and Lanark, and the northern part of Dumfries from Eskdalemuir by Moffat to Thornhill. The voles have also appeared in great numbers in the parishes of Dalry and Carsphairn, in the stewartry of Kirkcudbright.

"Mr. R. F. Dudgeon has estimated that in Roxburghshire 30,000 to 40,000 acres had been affected, of which he considered 12,000 to 15,000 acres had been rendered useless; in Dumfriesshire 40,000 to 50,000 acres, and in the stewartry of Kirkcudbright 10,000 to 12,000 acres were described by him as infested by voles."

"The map accompanying the report of the Committee shows that an area not less than 600 miles in length and from 12 to 20 miles in breadth has been overrun.

We reprint the following conclusions and recommendations contained in the report.

"The Committee have reluctantly been led to the conclusion that they are unable to recommend any specific method of dealing with or putting an end to the present outbreak.

"It appears to be an instance of the power which small animals are well known to possess, of prodigiously rapid multiplication under favourable climatic conditions and with a plentiful supply of natural food.

"Experience shows that a combination of such favourable conditions will always tend to bring about a recurrence of the plague. That being so, it ought to be the endeavour of every farmer and shepherd to be on the alert, and report without delay to the land agent, and to the secretary of the local farmers' club, or agricultural society, the first signs of the multiplication of vermin, so that palliative measures may at once be adopted, not on isolated farms, but everywhere throughout the district.

"The most effective measures appear to be periodical and timely burning of grass and heather, followed by active pursuit of the vermin by men using wooden spades and dogs. If this were promptly done in the early stages of the outbreak, it is quite possible that it might be averted altogether or greatly mitigated in severity.

"It is hardly necessary to point out that the proprietor of the land should be informed as soon as anyone else, because his keepers and others might be usefully employed in assisting to prevent what amounts, if unchecked, to a common calamity upon all classes connected with land.

"Where plantations of limited extent are attacked, pit-falls wider at the bottom than at the top and about 18 inches deep should be dug. The voles fall into them and cannot escape, and the ground is soon cleared of them in this way.

"The Committee cannot speak with approval of the use of poisoned grain, except where the area affected is very limited.

"Nor have they been able to come to any conclusion favourable to the adoption of Prof. Loeffler's method of destroying voles by means of bread saturated in a preparation of the *bacillus typhi murium*, or mouse typhus. The personal investigations made by the chairman and secretary in Thessaly (where in May 1892 Prof. Loeffler was employed at the expense of the Greek Government to combat the plague of field-voles then prevailing in that country) convinced them that the favourable reports circulated as to the complete success of the experiments have not been justified by the results. In certain parts of Thessaly the voles were reported by landowners and others to be as numerous in January 1893 as ever they were.

"The Committee readily admit that, when used in a fresh state, the bacilliferous fluid is an effective though somewhat dilatory poison for mice and voles, and has this advantage over mineral poisons that, as has been proved, it is innocuous to human and other forms of life.

"It has also been reported by Prof. Loeffler that the Scottish voles sent to him alive by instructions from the Committee have been found as susceptible of the mouse typhus bacillus as their

Greek congeners. But there are three objections which render this method almost worthless except for employment in houses, gardens, enclosed fields, or other limited areas :—

"(1) It is very expensive; the virus supplied to the Greek Government was paid for at the rate of 4s. a tube, containing enough when dissolved to treat about two imperial acres, a cost which in many instances would exceed the rent of the Scottish hill pasture. To this must be added the price of bread used in distributing the virus, which would appreciably raise the cost of the process. Thus to deal effectually with a hill farm of say 6000 acres, would entail an expenditure of from £700 to £1000, making the remedy more costly than the evil.

"(2) Mouse typhus is not contagious; it can only be communicated to those animals that will swallow some of the virus. The allegation that healthy voles will become infected by devouring the bodies of the dead has not been satisfactorily proved. That Greek voles when in captivity have been observed to feed upon the corpses of their fellows hardly warrants the assumption that Scottish voles in a state of liberty will do the same; and unless the disease were communicable from one animal to the other, it is not easy to see how the remedy could prove effective on extensive hill pastures.

"(3) The fluid loses its value in about eight days after preparation. Consequently much disappointment might ensue if, after a supply had been obtained, a fall of snow or wet weather were to interfere with its distribution over the land.

"The remedy which has been found most effectual in Thessaly is an injection of the fumes of bi-sulphide of carbon into the burrows. This, however, is a more expensive process than the other, besides being injurious to the health of those engaged in its application. It is, moreover, inapplicable to the Scottish vole (*Arvicola agrestis*), which does not burrow to a depth like the vole of Thessaly (*Arvicola Güntheri*), but lives in shallow runs amongst the roots of herbage.

"With the under-noted exceptions the natural enemies of the voles may be divided into two classes, viz., those which destroy the voles, and are harmless to sheep, crops, and game; and those which, though preying on voles, are so hurtful in other ways as to have no claim to preservation :—

(i.) Vole-killers, harmless, or nearly so, to sheep, crops, and game.	(ii.) Vole-killers, hurtful in other ways.
Owls of all sorts,	Foxes,
Buzzards,	Ravens,
Kestrels,	Carrion and Hooded Crows,
and the smaller Seagulls.	Great Blackbacked Gulls,
	and Adders.

"Strict injunctions ought to be given by landowners that the birds mentioned in the first class should not be destroyed. Their presence in full numbers, though inadequate to avert an outbreak, would undoubtedly tend to mitigate it, and, as has been proved in the case of the short-eared owl, they have the faculty of multiplying a normally in presence of an unusual supply of food. They are at all events most useful allies to man in combating attacks of ground vermin.

"The Committee further deprecate in the strongest manner possible the use of the pole-trap for the capture of hawks. Besides the inhumanity of this device, it is indiscriminate, and harmless owls, kestrels, and buzzards are just as likely to be taken by it as are the more mischievous species.

"Three animals, diligent vole destroyers, have been omitted from both these lists, because they are undoubtedly hurtful to game. The first of these is the common rook (known to the shepherds as the corn crow), of which, however, the services to agriculture are now generally recognised.

"The other two animals referred to are the stoat and weasel. Of all the smaller beasts of prey these are perhaps the most hateful to gamekeepers, and it is hardly reasonable to expect that stoats should be allowed to multiply in game coverts, or in the vicinity of pheasant coops. But the Committee have no hesitation in recommending that weasels, which are persistent mouse-hunters and do little damage to game, should not be molested, at least on moorlands and hill pastures, where they can do little harm and much good."

THE ZOOLOGICAL SOCIETY.

THE report of the Council of the Zoological Society of London for the year 1892 was read at the annual general meeting on April 28, and printed copies of it were distributed shortly afterwards. The following extracts are of general interest.

"The considerations which prompted the Council of the Society, as announced in their report last year, to award two of its medals to the representatives of families through whose exertions the Great Skua has been retained as a veritable member of the British fauna, have induced the Council to act this year in like manner in regard to a still scarcer species—the osprey (*Pandion haliætus*). It has been represented to the Council that for some years past but three pairs of this bird, which on many accounts is of great interest, have regularly bred in Scotland, and that their protection has been an object of much solicitude to those on whose property the nests are built. The Council are able to state that the effect of their former award has not only been beneficial to the birds concerned, but has been highly appreciated by the public at large, and they trust that the same good result will follow the bestowal of the Society's silver medal upon Donald Cameron, of Lochiel, and John Peter Grant, of Rothiemurchus, in recognition of the efforts made to protect the osprey in their respective districts."

These medals were presented to the above-named gentlemen at the general meeting of the Society on June 22.

Reference was made to the resolutions adopted by the Council in regard to steps proposed to be taken by the Government of New Zealand for the preservation of the native birds of that country. The resolutions were as follows :—

"That the Council of this Society have learnt with great satisfaction the steps that were proposed to be taken by the Earl of Onslow, when Governor of New Zealand, and by the Houses of General Assembly, for the preservation of the native birds of New Zealand, by reserving certain small islands suitable for the purpose, and by affording the birds special protection on these islands.

"That the Council much regret to hear that difficulties have been encountered in carrying out this plan as regards one of these islands (Little Barrier Island), and trust that the Governor of New Zealand may be induced to take the necessary steps to overcome these difficulties, and to carry out this excellent scheme in its entirety.

"The Council venture to suggest that, besides the native birds to be protected in these reserves, shelter should also be afforded to the remarkable Saurian, the Tuatera lizard (*Sphenodon punctatus*), which is at present restricted to some small islands on the north coast of New Zealand in the Bay of Plenty.

"The number of visitors to the Society's gardens in 1892 was 605,718. The corresponding number in 1891 was 598,730, showing an increase of 6988 entrances.

"The deaths during the past year have been 862 in number, being 40 in excess of the number of deaths during 1891. Of these the more important were—a lioness, a male cheetah, two common zebras, an aard wolf, a male beatrix antelope, and the last surviving giraffe.

"Two gentlemen have utilised the students' rooms for carrying on investigations. Mr. F. G. Parsons has been studying the comparative myology of the rodents; and Mr. P. Chalmers Mitchell has commenced an investigation upon the spleen of the vertebrata.

"The number of animals belonging to the first three classes of vertebrates living in the Society's menagerie at the close of 1892 was 2413. The corresponding number on December 31, 1891, was 2232.

"The total number of registered additions to the menagerie in 1892 was 1335, of which 698 were acquired by presentation, 315 by purchase, 141 were bred in the gardens, 142 were received on deposit, and 39 obtained in exchange.

"Among the deaths of animals in 1892 occurs that of the last remaining individual of the stock of giraffes, a male, purchased January 27, 1879. The Society is now, for the first time since the arrival of the four original giraffes on May 24, 1836, without any representative of this mammal in its series. Nor does there seem to be at present much chance of our being able to supply the deficiency. Owing to the closure of the Soudan by the Mahdists the supplies of this and other large African mammals, which were formerly obtained *via* Cassala and Suakim, have ceased, and, so far as can be ascertained, there are now no living giraffes in the European market. There have been thirty individuals of the giraffe in the Society's gardens since 1836, of which seventeen were born there, and thirteen acquired by purchase. Of these thirty, one was presented to the Royal Zoological Society of Ireland in 1844, five have been sold at prices varying from £450 to £150, and the remainder have died in the gardens.