Original Articles and Case Reports

SOME OBSERVATION ON THE EPIZOOTIOLOGY OF NEWCASTLE DISEASE[1]

By L. W. MACPHERSON[2]

Call nan Cearc (The loss of the hens). This is the title of a Gaelic poem written by John Campbell of South Uist in 1898, and is probably the first record of an outbreak of Newcastle disease.

The poem describes an epizootic among poultry in the Western Isles of Scotland which resulted in the total loss of the domestic fowls in the area. The poet makes the point that ducks were quite unaffected by the disease. He also mentions assistance given to the islanders in the form of fresh stocks of poultry and settings of hatching eggs which were supplied by the Congested Districts Board. Confirmatory evidence of this was obtained in the 2nd and 3rd Reports of the Congested Districts Board to the Secretary of State of Scotland (1899 and 1900). These reports indicate that poultry and hatching eggs were allocated to individuals in the following areas: — Islands of Lewis, Harris, North Uist, South Uist, Barra, Skye, Coll, Tiree and the Shetlands and the mainland coastal areas of Gairloch and Lochbroom (Ross-shire) and Durness and Farr (Sutherland-shire). Unfortunately no reference is made in these reports to any disease having occurred in the poultry but comparison of the map showing the incidence of outbreaks in the 1949-51 epizootic (Fig. 1) with the map showing the areas supplied with hatching eggs and fowl by the Congested Districts Board (Fig. 2) shows an amazing coincidence.

A considerable weight of evidence is also available in the Hebrides amongst many of the people who remember the earlier epizootic and who can describe the symptoms of Newcastle disease very accurately. For instance Alexander Campbell, Glenvargill Farm, Isle of Skye, described the respiratory symptoms of his poultry stock as being "like those of an asthmatic man" and also des-

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2. Animal Pathology Division, Canada Department of Agriculture, Animal Diseases Research Institute, Hull, Quebec.

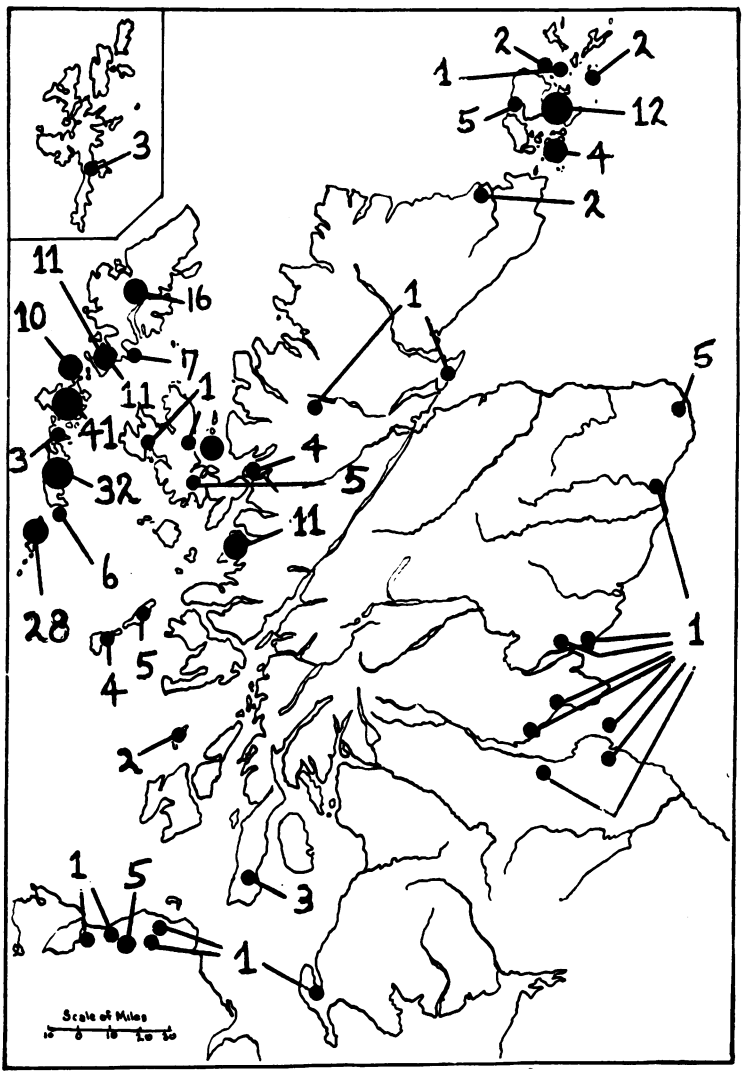


Fig. 1. Map showing incidence of confirmed outbreaks of Newcastle disease in Scotland during the 1949-51 epizootic.

Circles indicate infected areas - the numbers in the circles represent the number of confirmed outbreaks in that area.

cribed the nervous symptoms of inco-ordinated and gyratory movement so characteristic of Newcastle disease in the field.

From 1898 Scotland has enjoyed a long period of freedom from Newcastle disease infection despite the periodic outbreaks which have occurred in England; the most probable explanation for this circumstance being that there is relatively little importation of poultry into Scotland from abroad.

However on the 6th September 1949 an epizootic which was to last for 2½ years manifested itself by two outbreaks which occurred simultaneously one at Strommess, Orkney, and the other at South Ronaldsay, Orkney, there being no obvious origin for either outbreak. By the 30th September 1949 a further

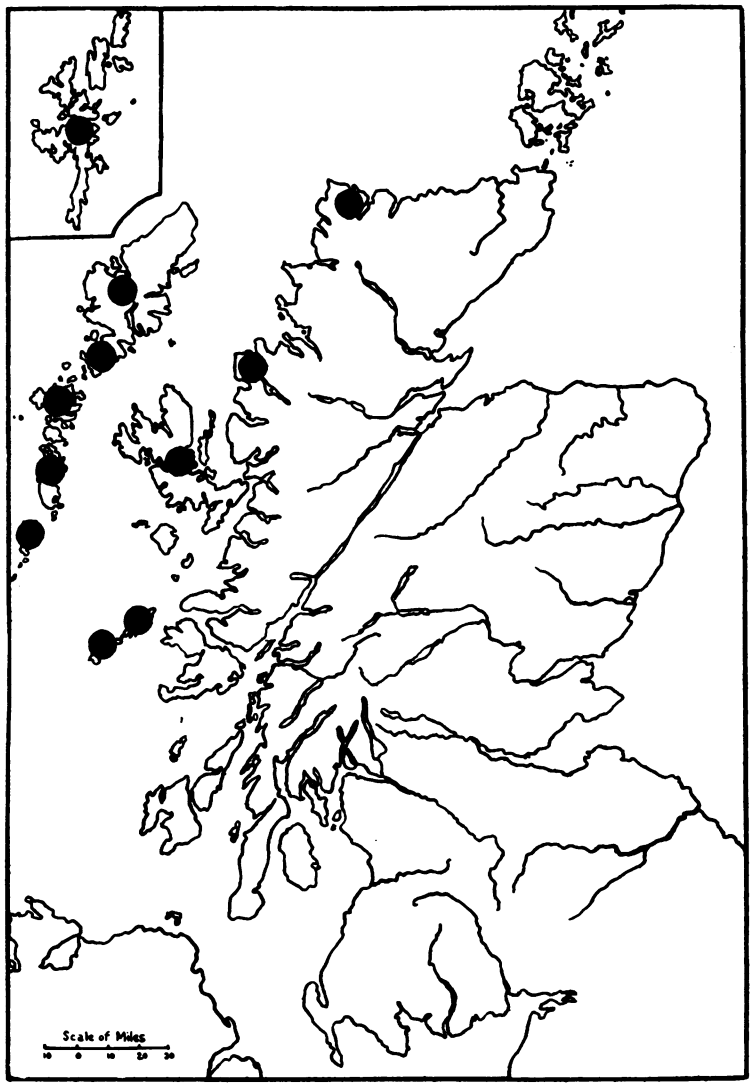


Fig. 2. Map of Scotland showing areas to which the Congested Districts Board supplied hatching eggs or domestic fowl 1899-1900.

Circles indicate areas to which eggs or fowls were supplied.

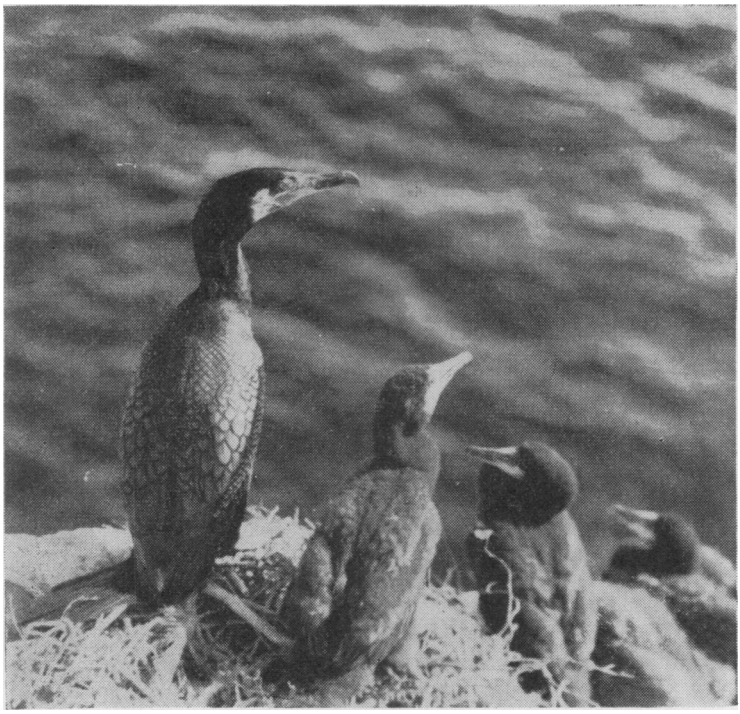
83 outbreaks had been confirmed along the Scottish coastline at such diverse points as the Bass Rock (East Lothian), Cromarty (Ross and Cromarty), Lochboisdale and Eriskay (Outer Hebrides), Rassay and Tiree (Inner Hebrides), Kyle of Lochalsh and Arisaig (Inverness-Shire) and in the Orkney Isles. No positive origin was established for any of these outbreaks but in view of their proximity to the sea the official attitude was that infection had occurred by the indiscriminate discharge of infected poultry offal from passing ships, or alternatively that at some infected premises, disease was being concealed and the infected poultry carcasses discharged into the sea. It was presumed that wind, tide, and possibly scavenging sea gulls assisted in the further dissemination of this infective material on to the foreshores and pastures to which poultry had access.

A series of epizootiological observations and field studies were made by the author while engaged as a veterinary officer in the Lewis and Harris area of the Outer Hebrides subsequent to 8th October 1949. These are presented below.

On 15th October 1949 the author conducted an investigation into a suspected outbreak of Newcastle disease at Leverburgh, Harris (Outer Hebrides). Some 40 head of poultry were involved and they evinced all the classical symptoms and post-mortem lesions of acute Newcastle disease infection. The nervous symptoms usually described in the literature in association with less acute outbreaks were particularly marked, opisthotonos, emprosthotonos, limb paresis, and torticollis were all observed. Some birds spun round and round in gyratory movements or flew vertically upward to a height of six to ten feet before crashing back to the ground. The classical "gasping for breath" symptom was also observed in practically all instances and there was marked diarrhoea throughout the flock. The post-mortem picture was typical with marked haemorrhages in the proventriculus, petechiae of the pleura, peritoneum and trachea, capillary haemorrhage in the subcutaneous tissue, and congestion or ulceration of the duodenum.

The owner of this flock was apparently a very keen shot and it transpired that in the past few weeks he had confined his activities to shooting cormorants. These birds were used for domestic consumption and the offal from them was disposed of by throwing it on to the manure heap to which the domestic poultry had ready access. In the ensuing 8 weeks a further 32 outbreaks occurred in the Lewis and Harris area at widely separated points along the coast. A similar pattern of outbreaks was also occurring over a considerable part of the Scottish coastline and particularly in the North-west islands. In practically every outbreak in the Lewis and Harris area it was established that a cormorant or cormorants had been killed some 7 - 14 days previously and that the domestic fowl had either been fed the offal or had access to it. Owners of poultry stock were extremely reticent regarding disclosures of bird-shooting as many of the guns were unlicensed and also on account of the possibility of prosecutions under the Wild Bird Protection Act.

On 20th October 1952 enquiry of the local lobster fishermen regarding deaths among sea birds yielded evidence that a few dead cormorants had been observed by them floating in the sea off the small islands South-west of Harris. While this information was regarded as significant it has to be borne in mind that there is the possibility that these birds were wounded inshore by hunters and had subsequently died and been carried away by the tide. Examination of the shores of the area for any signs of bird carcasses was very disappointing, occasional skeletons or bunches of feathers from dead birds were observed but wild carrion birds and the omniverous seagulls ensured that no carcasses remained identifiable for any length of time. Any extensive



European Cormorant, adult and young at nest. Lake Island, Saguenay Co., P.Q., July 20, 1933. (Photograph by Harrison F. Lewis).

mortality amongst the cormorant population can be completely discounted as there was no diminution in their numbers.

Thus the evidence incriminating the cormorant as the source of Newcastle disease infection in these outbreaks appeared overwhelming. In November and December 1949 some 60 cormorants were shot by the author off the Lewis and Harris coasts. Blood samples were taken from these birds and routine field post-mortems conducted. The post-mortem examinations failed to show any macroscopic lesions whatsoever. Blood samples and a long bone, dissected from each cormorant, were dispatched to the Ministry of Agriculture's Veterinary laboratory at Weybridge for virological examination the results of which have been published, Blaxland (1951). An incidence of approximately 40% positive or doubtful H.I. titres to N.D.V. was obtained from the cormorant sera and six virus isolations were made from the long-bones.

During this series of outbreaks an interesting observation was made regarding local spread. A disturbing feature in some of the outbreaks in remote areas had been the discovery of long-standing cases of disease. In these instances there appeared to be no deliberate concealment, failure to report disease being more a frame of mind than wilful neglect. In some cases it was procrastination, in others a desire not to cause trouble in bringing someone a long distance to investigate deaths in a few hens. These cases, however, presented a good

opportunity to observe the local spread where slaughter had been delayed. The lack of local spread in such cases was remarkable, despite what appeared to be almost direct contact between healthy and diseased fowls, and innumerable human contacts. Even in cases where a number of clean flocks were mixing with infected flocks on open range for a period of weeks and were eventually slaughtered as dangerous contacts no symptoms of disease were shown. On the other hand where flocks were housed in the same building the spread of infection appeared to be extremely rapid.

To cover the background of the 1949-51 epizootic of Newcastle disease, it is necessary to indicate the distribution and habits of the cormorant species and the areas where cormorant shooting is practised.

Despite the Biblical admonition condemning the consumption of cormorant flesh, Lev. 11. 13 and 17, "And these are they which ye shall have in abomination among the fowls....." "And the little owl, and the cormorant, and the great owl", these birds are shot quite extensively in the Hebrides, Orkneys and to some extent in the adjacent mainland coastal areas. Two varieties of cormorant exist viz. the Greater Cormorant (Phalocrocorax carbo) and the Lesser Cormorant or Shag (Phalocrocorax aristotelis). Other sea birds which are shot for food in these areas include the Red-throated Diver (Colymbus immer) and the Great Northern Diver (Colymbus stellatus). These are of course much rarer species and were not regarded as being of significance in this investigation. In the nothern part of the Island of Lewis, the young of the Gannet (Sula bassana) are shot for human consumption in considerable numbers. Wilson (1) succeeded in isolating Newcastle disease virus from a gannet in association with an outbreak of disease among domestic poultry on the Bass Rock, East Lothian. It was interesting that no outbreaks of Newcastle disease occurred in the gannet-eating area of Lewis. Some interesting information was obtained regarding an 'export' trade in cormorants from North-western Scotland. It appeared that it was quite common practice in the Mallaig-Morar area of Inverness-shire to shoot large numbers of cormorants and dispatch them to the London hotels where they were presumably fed to the unsuspecting guests as wild duck.

The cormorant is ubiquitous in all the northern seas and inland waters of any size throughout Europe, and similar forms are found in Australia, Asia, Africa and America. Birds breeding in the more northern parts tend to migrate south in the winter and there is in the British Isles a noticeable southward movement in the autumn. In the British Isles the breeding area of the Greater Cormorant is in most cases coincident with that of the Shag but in N.W. Scotland the latter bird predominates; elsewhere, as a rule, the Greater Cormorant is the more abundant species. Both species are gregarious in their nesting habits building in colonies of up to 1000 nests, packed closely on cliff ledges, especially in wave-washed caves. April is the normal month for

eggs and the young fledglings usually clear the nests by August or September. Even in the winter these birds like to huddle together on the nesting ledges and make off in the mornings in small groups to the fishing zones. Cormorants can also be seen in groups in the large inland water areas at every month of the year.

Essentially the cormorant is a fish eater but Coward (2) has suggested that they may have carnivorous tendencies. This is a very important observation as it gives a possible clue to the initiation of Newcastle disease infection in the cormorant colonies. In this connection it should also be noted that the cormorant's normal diet consists of small saithe, lythe, codling, eels etc, who, in their turn, will feed voraciously on flesh if given the opportunity. This presents the possibility of small fish ingesting infected poultry and in turn being eaten by a cormorant who in turn could develop active Newcastle disease. The possibility of subsequent widespread dissemination of Newcastle disease in a gregarious species of this type is self-evident. It is also well-established that in parts of the Far East notably Japan and Korea the cormorant has for centuries been used as an ancillary fisherman. His capacious gullet is capable of very considerable distension and the author has shot a cormorant and subsequently recovered 21 fish from its gullet by holding the bird upside down. The Japanese fishermen maintain stocks of captive cormorants to assist them and it would seem highly probable that they would have contact with domestic poultry. The possibility of disease developing in the cormorant species in such circumstances is obvious.

EXPERIMENTAL RESULTS

Experiment I To ascertain the incidence of Newcastle disease infection in cormorants on the Scottish coastline in 1952.

In 1952, 32 cormorants were shot by the author in the Scottish western coastal region. Blood samples were taken from each bird and a portion of spleen and liver. Each serum sample was subjected to the H.I. test for Newcastle disease antibody according to the method of the U.S. Department of Agriculture (3). All 32 sera were negative to the test for Newcastle disease antibody. The spleen and liver samples were pooled in small groups of 4 - 6 samples, triturated in a Ten Broeck tissue grinder, treated with penicillin and streptomycin, and inoculated into 10 day old eggs by the allantoic route. There were no deaths among the embryos after 4 days incubation and spot haemagglutination tests of harvested allantoic fluid indicated that no virus was present.

Experiment II. To determine the effect of (a) feeding N.D.V. to a cormorant. (b) inoculating N.D.V. intramuscularly into a cormorant, (c) administering N.D.V. intra-nasally to a cormorant.

Six fledgling cormorants (Phalocrocorax carbo) were caught and fed in

captivity. On arrival at the laboratory serum samples were obtained from each bird and subjected to the H.I. test for Newcastle disease antibody. The test was negative in all cases. The experience gained in feeding these birds in captivity indicated that they were purely fish-eaters and they could not be induced to feed voluntarily on flesh even when subjected to long periods of starvation.

(a) Effect of Feeding: On 21st April, 1954, 2 cormorants were forcibly fed on liver, spleen and intestines from a hen which had succumbed to infection with N.D.V. (Herts strain). Neither bird showed any indication of illness till 7 days later, when one of the birds sickened and died. Post-mortem examination yielded no lesions indicative of Newcastle disease infection but N.D.V. was isolated from both spleen and liver of the dead bird. A serum sample obtained from the bird in extremis gave a negative H.I. titre for Newcastle disease. The surviving bird was also bled on 28th April 1954 and a high H.I. titre was shown. This high antibody titre was maintained till 26th May when it showed signs of waning and on 2nd June a sample of serum from this cormorant was negative to the H.I. test. Faecal samples were taken from both birds after feeding and after submitting this material to penicillin-streptomycin treatment is was inoculated into 10 day old eggs by the allantoic route. Newcastle disease virus was isolated from samples of faeces collected on the 5th and 6th days after feeding.

(b) Effect of intra-muscular inoculation: On 23rd April 1954 a further 2 cormorants were inoculated intra-muscularly with 1 cc. N.D.V. (Herts strain) in the form of infected allantoic fluid. These birds showed no symptoms of disease while under experiment but developed a high H.I. titre to N.D.V. 5 days after inoculation. This high antibody titre was maintained by both birds till 9th June when it began to wane and on the 20th June serum samples taken from the birds were negative to the H.I. test. Faecal samples were taken from both these birds at varying periods and after suitable treatment inoculated into eggs. No virus isolations were effected.

(c) Effect of intra-nasal inoculation. On 10th October, 1952, 2 cormorants were inoculated intra-nasally with 1 cc. N.D.V. (Herts strain) in the form of infected allantoic fluid. There were no obvious symptoms but one bird sickened and died on 12th November 1952. Post-mortem examination of this bird showed evidence of Aspergillosis but no lesions indicative of Newcastle disease. Newcastle disease virus was isolated in eggs following inoculation of spleen and liver material from this bird. Virus was also isolated from faecal samples collected from both cormorants on 11th November, i.e. one month after infection and high H.I. titres to N.D.V. were demonstrated in the sera of both birds on that date.

DISCUSSION

Any individual engaged in the field control of animal virus infections

cannot fail to be impressed with the dearth of positive evidence with regard to the origin of many outbreaks of disease. The origin in many of the initial outbreaks of Newcastle disease is shrouded in mystery and even the spread of disease during such outbreaks may not conform to existing ideas.

The existing conception of Newcastle disease presents the domestic fowl as the primary host with other domesticated poultry in the role of subsidiary hosts and comparatively little attention has been focussed on the possibility of wild fauna being involved in the epizootiology. Methods of spread postulated suggest that infected stock or carcass contacts are the most important factors in the spread of this disease.

Where contact between healthy and infected stock cannot be demonstrated as a likely origin recourse is frequently had to 'swill' as a possible source of infection. Examination of the literature indicates that 'swill' can be the origin of Newcastle disease infection, a typical example being the 1947 epizootic in England which was clearly traced to the feeding of poulterers' and butchers' 'swill' to poultry following the importation of infected poultry carcasses from Hungary. In many cases however it is most probable that swill is incriminated as a possible source of virus on very little evidence. In feeding any domestic animal it is usually easy to demonstrate contact with swill in some form but the question of its virus content may be doubtful. Fomites are regarded as another fruitful source of virus infection — contaminated receptacles, vehicles, feeding-stuffs, even man are blamed as mechanical carriers.

With the strains of Newcastle disease responsible for the various epizootics in Europe and Asia a short incubation period and high mortality have been the rule. This presumed a short infective period as far as the domestic fowl is concerned and one would imagine that such a disease would be self-limiting if confined to this species. It is unusual for a pathogenic organism to produce such a highly virulent disease in the main or primary host and this raises the possibility that some other species, in which infection is milder, and in which there is a lower mortality, is the primary host. Examples of this are numerous, e.g. Typhus fever has a low mortality in its primary hosts, the rat, and the rat flea but once adapted to man and the human louse it develops a very high mortality for these secondary hosts. This is taken to indicate a more recent and less well-adapted parasitism of *Rickettsia prowazeki* for the human and the louse.

The 1949-51 epizootic of Newcastle disease in Scotland brought into relief most strikingly the discrepancy between the classical theories of spread of this disease and the epizootiological evidence which is presented in this work. Here new centres of disease developed several hundred miles away from any known active disease in poultry and as the epizootic spread connection with the sea became obvious. Sea birds appeared to be the obvious intermediary

TABLE 1

Newcastle Disease infection of Cormorants and its relationship to the occurrence of parallel infection of domestic poultry in Scotland (1949-53).

Date	Number of Confirmed Outbreaks	Examination of Cormorants
1949	208	60 cormorants examined. Virus isolated in 10% Antibodies demonstrated in 40%*
1950	18	Nil
1951	10	Nil
1952	Nil	32 cormorants shot July-August 1952. No virus isolated. No antibodies demonstrable.
1953	Nil	8 cormorants bloods examined. No antibodies demonstrable.

*Virological Examinations by Blaxland (4)

and it was the author's opinion that the conception of mechanical transmission was quite untenable.

The classical concepts of spread by direct contact or by contact with swill were readily discounted in these outbreaks. The areas affected are to a considerable extent self-supporting insofar as poultry or poultry products are concerned. As is the case on most farms it is very probable that the poultry had contact with kitchen waste and while in some areas this might be incriminated as a possible source of infection, in the islands where the disease raged with maximum intensity no imports of poultry or poultry carcasses are made, and therefore the possibility of infection from such a source can be eliminated.

The evidence available points exclusively to the cormorants as the source and possibly as the reservoir of infection in the Scottish coastal outbreaks:—

1. Enquiry had established that there had been deaths in the cormorant species.

2. The geographic disposition of outbreaks indicated a sea borne infection and the density of the outbreaks corresponded with the author's personal knowledge of the incidence of cormorant shooting.

3. In almost every outbreak dealt with by the author a history of recent cormorant-shooting was obtained and the history of the outbreaks indicated that the time between exposure of the cormorant offal to the poultry and

development of Newcastle disease corresponded to the incubation period for this disease.

4. Infection of the cormorant species was definitely established during the epizootic (See table No. 1). Among 60 cormorants shot in the area 40% had Newcastle disease antibody in their sera and 10% had virus in their long bones.

5. Examination of 32 cormorants subsequent to the epizootic showed no evidence of infection with Newcastle disease virus either in antibody tests or attempted virus isolations.

6. It is the author's submission that an outbreak of Newcastle disease occurred in 1898 with the same geographical distribution and with the same origin.

7. Experimental infection of captive cormorants showed them to be susceptible to Newcastle disease infection by the intra-muscular, intra-nasal and oral routes of administration and that such birds may excrete Newcastle disease virus in their faeces for a period up to 4 weeks.

8. The short duration of immunity in the cormorants under experiment as measured by antibody content of their sera indicates the possibility of repeated infection of this species analogous to repeated influenza infection in man.

An obvious question which remains unsolved is that of the origin of infection for the cormorant. Suggestions regarding this problem have already been submitted but it must be emphasised that the low mortality and comparative mildness of the disease in the cormorant species may indicate a long-established biological adaptation of Newcastle disease virus to these birds and that the domestic fowl may in fact be only the secondary host.

While the Scottish epizootic was clearly linked to cormorant infection the possibility of other wild fauna being similarly infected cannot be overlooked. Indeed the practice of cormorant-shooting in the Scottish Islands constitutes an interesting biological indicator of the degree of cormorant infection. The evidence presented suggests that the cormorant population has only been infected twice in 50 years. It is possible that an extensive survey of other wild fauna for Newcastle disease would be most fruitful and might disclose the true reservoir in some other host. In this connection the isolation of Newcastle disease virus from a Gannet, Wilson (1) and from an Osprey, Zuydam (5) is of considerable significance.

The application of the knowledge obtained in the Scottish epizootic is most interesting when related to the known world epizootiology of this disease. Examination of the world literature on geographic distribution of Newcastle disease indicates a particularly high incidence of this disease in coastal areas and islands throughout the world. Unfortunately in many cases the

locus of initial outbreaks are not recorded or the disease has been well established in a country before it has been recognised. In the author's opinion the locus of initial outbreaks in the following epizootics is significantly linked to the sea: Dutch East Indian Archipelago, Kraneveld (6), the Philippine Islands, Rodier (7), Australia, Albiston and Gorrie (8), East Africa, Hudson (9), South Africa, Kaschula, Canham, Diesel and Coles (10), Madagascar, Buck (11). In all these epizootics the initial outbreaks occurred near the sea shore. Hudson (9) commented on the occurrence of Newcastle disease in the Mombasa area reporting the disease to be enzootic in the coastal zone with extensive virulent outbreaks every few years. Gorrie (12) in a personal communication stated that in Victoria, Australia the initial outbreak occurred "within a stone's throw of the sea". Kaschula, Canham, Diesel and Coles (10) described an outbreak near Durban, South Africa and emphasised the ease with which local spread was curtailed.

It must also be accepted that in many cases Newcastle disease has been introduced to some countries by infected fowl or carcasses. Typical of this was the introduction of Newcastle disease into the Central European countries by means of importation of infected fowl from Italy. The origin of the English epizootic of 1947 has also been clearly shown to have resulted from the importation of infected poultry carcasses from Central Europe, Andrews (13). This infection has been maintained and England is not yet free from Newcastle disease. It is possible however, that in the 1949-51 period some of the English coastal outbreaks were related to infection in cormorants but that the co-incident inland outbreaks masked the relationship to the sea and this resulted in all the outbreaks being shown with a common origin.

The observation of local spread in outbreaks in Lewis and Harris suggested that the incidence of mechanical transmission of infection is minimal. No evidence of lateral spread in this series of outbreaks was obtained despite numerous human contacts between infected and healthy poultry stocks. In almost every outbreak in this area infection originated by ingestion and spread was confined to birds housed together.

SUMMARY

1. Evidence is presented to support the contention that an extensive epizootic of Newcastle disease in fowls occurred in North West Scotland during 1897-98. The location of the outbreaks being in the islands and coastal areas. This is the only occurrence of Newcastle disease known in Scotland prior to the 1949 epizootic.

2. The outbreaks of Newcastle disease in Scotland in 1949-51 were studied by the author while engaged in field control of this disease. The outbreaks were almost entirely confined to island and coastal areas, especially the Outer Hebrides.

3. Evidence was obtained during this epizootic suggesting that the cormorant was the source of infection of the various outbreaks in fowls.

(a) In 26 outbreaks of Newcastle disease investigated by the author a history was obtained in 23 cases that a cormorant had been shot and its entrails exposed to the poultry 8 to 12 days prior to the outbreak this being the usual incubation period of the disease. In the remaining 3 outbreaks cormorant colonies were known to live in close proximity to the feeding areas of the domestic poultry concerned and may have contaminated these areas with their droppings.

(b) Active infection was established in the cormorant species during the epizootic. Of 60 cormorants examined during this period antibody to Newcastle disease virus was found in 40% and the virus was isolated from 10%. In 1952, one year after the epizootic 32 cormorants were examined and no antibody was demonstrable in their blood nor was virus isolated from their viscera.

(c) There was no evidence of importation of contaminated stock, nor feeding of potentially contaminated swill to the affected poultry. Lateral spread of disease from flock to flock was not observed in any outbreak.

4. In experiments with captive cormorants it was found possible to produce infection in these birds by administering Newcastle disease virus intranasally, intra-muscularly or orally. In all cases high antibody titres were obtained and the faeces found to contain virus up to 4 weeks.

RESUME

Selon l'auteur, une maladie des oiseaux de basse-cour qui sévit en Ecosse en 1897-98 n'était autre que la maladie de Newcastle. Tout comme aujourd'hui, la maladie sévissait alors dans la région côtière et dans les îles avoisinantes. Des enquêtes dans 26 explosions différentes ont mis en évidence le rôle épidémiologique dans la maladie de Newcastle. Ainsi, dans 23 cas, les volailles atteintes étaient venues en contact, 8 à 12 jours avant l'apparition de la maladie, avec des viscères de cormorans abattus. Dans les 3 autres cas, on a appris que des colonies de cormorans se trouvaient dans le voisinage immédiat. Les enquêtes n'ont révélé aucune importation d'oiseaux malades on d'aliments contaminés. Le cormoran est sensible à l'infection expérimentale par le virus de la maladie de Newcastle.

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THE TREATMENT OF CONTAGIOUS FOOTROT IN SHEEP BY THE TOPICAL APPLICATION OF CHLOROMYCETIN*

Ten per cent. chloromycetin in propylene glycol or in methylated spirits was found to be the most efficient agent of those tested for the treatment of contagious footrot of sheep.

In laboratory tests, 77 per cent of 17 affected feet were cured by one treatment and the remainder by two treatments. Two of the retreated cases did not require re-paring.

In field trials 87 per cent of 107 affected feet were apparently cured by one treatment. These tests were made on three different properties. Rams comprised 27 of the 61 sheep and 25 of these remained in an infected environment after treatment. No evidence of the presence of the disease could be found in these 25 rams 30 days after a second treatment of the feet which had failed to respond to the first treatment.

Only 50 per cent of 22 affected feet were cured after one treatment with 5 per cent chloromycetin in methylated spirits and 41 per cent of 22 affected feet were cured after one treatment with 2 per cent chloromycetin in methylated spirits. (Author's Summary)

*The Australian Veterinary Journal, July 1954, pp. 209-212.