OBSERVATIONS ON THE EFFECT OF EJECTION OF STOMACH OIL BY THE FULMAR *FULMARUS GLACIALIS* ON OTHER BIRDS

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CONTENTS

1. INTRODUCTION

It is a well-known fact that a smelly, oily substance occurs in the alimentary canal of the Fulmar *Fulmarus glacialis* and other species belonging to the Procellariiformes. In the course of time many widely diverging hypotheses have been framed concerning the function of this oil. The birds were supposed to use it to smooth down the waves in a heavy gale. It might be an extra addition to the fat from the oil glands and be used as such in preening. Others held it to play a role in the production of "physiological water" which the birds were said to need because they could not drink seawater. It was assumed to be a source of food for the young birds, as well as being used in courtship feeding. It was also suggested that it might be a necessary excretion of the surplus of fat taken in with the food, or of vitamins A and D. A review of the pertaining literature is given by Fisher (1952) and Matthews (1964).

Bird watchers always point out that in a dangerous situation the oil is ejected through the bill and thus used as a weapon. Such behaviour has also been observed in nestlings (Duffey 1951). According to Lees (1950) even hatchlings eject oil through the hole picked in the egg, if they are disturbed during hatching.

The present paper deals with some observations on birds in captivity on the effect of this ejection on other birds.

2. THE EXPERIMENTAL ANIMALS AND THEIR ACCOMMODATION

The experimental animals comprised:

One Fulmar Petrel *Fulmarus glacialis*, full-grown, age not known. The bird was kept in captivity for one year and then released. Two Guillemots *Uria aalge*, of which one (hereafter called Guillemot 1) had been kept in captivity already for two years at the time of the experiments. The other one (hereafter called Guillemot 2) was in captivity since one month.

Three Herring Gulls *Larus argentatus*, all in their second year, and in

captivity for some weeks.

One Common Gull *Larus canus*, an adult bird, caught and used the same day for the experiment.

All the birds were healthy and in good condition.

The birds were kept in the aviaries of the Netherlands Institute for Sea Research on the island of Texel. Each aviary consists of a cage of reinforced plastic gauze, measuring 7.2 by 7.2 by 2.6 m. The whole bottom of the cage consists of a concrete sea-water basin with a depth of 50—60 cm. The sea-water is recirculated. Due to a continuous overflow and filtration there is no slick formation on the surface and the water keeps clear.

In the middle of the experimental cage a small island (90 × 75 cm) of basalt blocks was made, while one of the corners was provided with a sitting board of 100 × 45 cm just over the water's surface.

In principle the birds were fed ad libitum. Food consisted of deep-frozen, whole sprat or smelt, thawed-up before use, offered on a small platform, some centimeters below the water's surface.

The aviary described is too small to permit good flying for a Fulmar. Only during windy weather the bird succeeded in keeping in the air for some time. For the rest it used to climb regularly on one of the basalt blocks from where it launched itself for a short flight before settling on the water.

Guillemots, however, cannot only fly in this aviary from the water to a basalt block and back again, but they can also fly high up along the gauze walls without touching them. They cannot, however, make a complete turn in this cage.

Herring Gulls and Common Gulls can turn round in the aviary and are able to spend a considerable time in the air.

3. THE EXPERIMENTS AND OBSERVATIONS

All experiments were carried out in the months January and February 1972, at a temperature of the air ranging from +7 to —4° C and of the sea-water from +5 to 0° C.

I. The Fulmar was introduced into the aviary where Guillemot 1 had been staying for some years already. The Guillemot reacted by flying low over the Fulmar for some time, followed by frequent diving, in which it always came to the surface very close behind the tail of the Fulmar, and once even underneath it, so that the Fulmar was pushed away and chased. After a short time, however, the Fulmar began to make threatening head movements in the direction of the Guillemot and the latter kept far away. After a few weeks the birds seemed to have got used to each other. The Fulmar was clearly the dominant bird. The Guillemot disappeared from the feeding platform, the basalt blocks and any part of the basin where the Fulmar went to, and kept a distance of at least 1 or 2 m from the Fulmar. This happened in such a matter-of-fact way that there was no clear

threatening or flee to be observed at any time.

II. After a month Guillemot 2 was introduced. Immediately the Fulmar became aggressive and pursued the newcomer. After some time the birds calmed down and the Fulmar squatted on the board.
Guillemot 2 also jumped on the board close to the Fulmar, which at once started to make excited noises and shaking movements, with wide-open beak into the direction of the Guillemot, drenching it with yellow oil. The Guillemot fled into the water and started bathing, however, its feathers stuck together and became wet. As it was in danger of drowning it was lifted from the water and transferred to a dry aviary. However, the bird remained wet all-through and succumbed some days later. The Fulmar too took to prolonged bathing after the ejection of the oil. We could not make certain whether it had soiled its own feathers too. After bathing, however, its feathers were in excellent condition.

III. A week later Guillemot 1 was found on the board, shivering and wet through. It was dried in the laboratory by means of an electric hair-drier. It then appeared that the feathers on its back were stuck together by yellow petrel oil. The Guillemot was kept in a heated room and well fed. After some weeks the oil came off in small bits during preening and soon after that the bird had recovered in so far that its feathers were practically waterproof again. Therefore after 3 weeks it was put back into one of the open-air aviaries, after which the pre-nuptial moult began in the normal way.

IV. In the next week three Herring Gulls from another aviary were put with the Fulmar. The birds bathed and swam around for a short time, the Fulmar watched them from a basalt block. When two gulls came at a distance of about 2 m the Fulmar made threatening noises and shaking head movements directed at the gulls. When they came still closer the Fulmar became still more excited, jumped into the water and ejected a squirt of yellow stomach oil for seven times in succession, aimed at the two fleeing gulls. Then the Fulmar, which had not soiled its own feathers, bathed for a long time. All the three gulls had fled to the farthest corner and also bathed for a long time. The two gulls which had been hit became waterlogged, the third one remained quite waterproof. One of the gulls which had been hit died by drowning on the same day, the other one the following morning. The third gull kept away from the Fulmar as much as possible, but, due to human disturbance, it once tried to alight on the basalt block near the Fulmar. The latter immediately became excited and squirted oil on the breast of the flying gull at the same time getting some drops on its own feathers. Both birds bathed for a long time, the Fulmar returning to its block quite dry and clean after half an hour. The gull was floating with its breast deep in the water; it died the next day.

V. A week later the last experiment was made. The Fulmar was removed from the cage and shut up in a dark box, while a Common Gull was put into the aviary, which after bathing went to roost on the island. After two hours the Fulmar was brought back to the aviary. It began by having a prolonged bath. The Common Gull alighted on the water and approached swimming, then the Fulmar made threatening movements and noises towards the gull and chased it in the intervals of bathing. At first the Common Gull succeeded in keeping a distance of 2 m, but afterwards the chase became more serious and the Fulmar ended by squirting some oil on the gull's back. Then both birds started bathing at a considerable distance of each other, the greater part of the gull's back-feathers becoming waterlogged. Some time later the Fulmar succeeded in hitting the gull's breast; then the latter became quite drenched during bathing. The next morning the Common Gull was found dead.

4. CONCLUSION AND DISCUSSION

Six sea-birds in all, belonging to three different species, were hit by stomach oil from the Fulmar Petrel during experiments.

In all cases the feathers of these birds stuck together and lost their water-repellent capacity. Although the birds preened and bathed in clean sea-water for a long time they were not able to get their feathers dry. They became waterlogged and sank. Five of these animals died by exhaustion or drowning, the sixth was saved with difficulty, by nursing it some weeks in a dry and heated room.

Although low temperatures certainly quickened the process of dying it is clear that oil from the stomach of a Fulmar threatens the life of sea-birds in the same way as fuel oil. Birds which have got the full blast are sure to die when alighting at sea. For birds which have only got a few drops it will at least mean a lot of trouble before they are quite clean and dry again.

In the field it is difficult to study the effect on victims which have been fouled with petrel oil. Those observers which claim that the oil is a means of defence generally stress the smell which to humans is very unpleasant and which may act as a repellent (Thomson 1964).

The lethal effect of stomach oil from the Fulmar on the feathers of Puffins *Fratercula arctica* has been observed, however, by Pedersen (1954). On the Faroer he observed how Puffins which have been fouled went to sea to bath but could not get rid of the oil and finished by staying in the water, helpless and unable to take off.

It is not clear whether the oil is also a danger to other birds of the same species. According to Richter (1937) the Fulmars on the nesting grounds do threaten each other and go through the motions of ejecting oil, but the actual ejection of oil has never been observed in such cases. The remark made by Fisher (1952) that Fulmars, fighting with each other for food "sometimes become waterlogged" and that "if they do so they usually die of cold or hunger or both" might point to this phenomenon. Although he does not

mention stomach oil as a possible cause Kritzler (1948) describes how his captive Fulmars attacked each other and how they became ever wetter when bathing. Some birds actually drowned. Since all our sea-birds in captivity used to get a glossier and more water-repellent coat of feathers by bathing the statement by Kritzler that his captive birds became wet by frequent bathing does not seem the correct explanation. I think the feathers of his birds were fouled by something, probably stomach oil.

Both these probable cases of fatal consequences of oil ejection on birds of the same species arise from an accidentally too large concentration of birds: a. birds in captivity in too small a cage (Kritzler 1948), b. hungry birds fighting over a large prey (Fisher 1952).

Armstrong (1951) pointed out that oil ejection may have been developed in the southern hemisphere as a defence against winged predators. This behaviour might have enabled the albatrosses *Diomedea* spec. and Fulmars to develop from nocturnal animals nesting in holes to diurnal animals with open nests.

The conspicuously white downy young of the Fulmar squirts oil immediately when attacked and so defends itself against predating birds. Duffey (1951) observed that these chickens also attack innocent species flying too close to the nests, such as Kittiwakes *Rissa tridactyla* and Fulmars, or walk by too close, such as Puffins, by sprinkling them with drops of oil. When returning to the nest the Fulmars can at first only come near their own chicken by means of a certain appeasement behaviour (Duffey 1951).

On the nesting site the old birds are said to confine themselves threatening mock-ejections when birds of the same species are concerned. If finally they do proceed to actual ejections, they start by aiming badly.

Still it is remarkable that the Fulmar should have such a dangerous weapon at its disposal. The final destruction of an opponent after only a slight confrontation seems rather excessive.

The reaction of our experimental animals to the presence of the adult Fulmar was quite insufficient, especially as to his warnings and head movements before he started ejecting oil. They were able neither to avoid the oil nor to remove the sticky stuff from their feathers. Obviously they are not sufficiently adapted to an oil-ejecting bird. That species from the northern hemisphere are generally not adapted to this danger may be due to the fact that the Fulmar has probably only entered this area from the Antarctic as late as the Pleistocene (Voous 1949). Only during the last century the species has spread over a larger area in the Atlantic and obtained a relatively high density (Fisher 1952).

Authors disagree on the possible origin of the oil. Sometimes bits of food are ejected together with it (Duffey 1951, Fisher 1952) which may mean that it is at least partly composed of the remains of a meal. Kritzler (1948) found that the oil of his birds was very similar to the pork-fat he fed them. In our Institute Dr. W. F. ten Berge kindly analysed some stomach oil the bird had

ejected. He could find no difference with the oil from the food-fishes, however, it was greatly different from oil from its oil gland. On the other hand Rosenheim and Webster (1927) found that the oil was very similar to the spermaceti of the Sperm Whale *Physeter catodon* and to the products of the oil glands and that it is rich in vitamins A and D. Matthews (1949) is of the opinion that it may very well be a genuine secretion, produced by gland-cells in the proventriculus. Probably it is supplied by a number of sources.

5. SUMMARY

Some experiments are described in which a Fulmar Petrel *Fulmarus glacialis* fouled a number of healthy birds, viz. 3 Herring Gulls *Larus argentatus*, 2 Guillemots *Uria aalge* and 1 Common Gull *Larus canus* with stomach oil. In all cases the feathers which had been hit by the oil became wet during bathing. The waterlogged birds sank deep into the water, were unable to fly and finally died of exposure or drowning. Only one of the birds, a Guillemot, survived the experiment by being nursed for a long time in a dry environment.

It is clear that, whenever during a conflict the oil from the stomach of a Fulmar is ejected on the feathers of another bird, this is similar to the fatal contact with fuel oil. It is therefore remarkable that those birds do not show any sufficient reaction to a threatening Fulmar and are not able to remove the sticky stuff from their feathers.

I thank Miss S. M. van der Baan for translating the manuscript.

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7. SAMENVATTING

Enkele experimenten worden beschreven, waarbij een Noordse Stormvogel *Fulmarus glacialis* een aantal gezonde vogels, met name 3 Zilvermeeuwen *Larus argentatus*, 2 Zeekoeten *Uria aalge* en 1 Stormmeeuw *Larus canus* met maagolie bespuwde. In alle gevallen werd het verenkleed van deze vogels op de met olie bevuilde plaatsen tijdens het baden nat. De doorweekte vogels zonken diep in het water weg, konden niet meer vliegen en kwamen uiteindelijk door uitputting of verdrinking om het leven. Slechts één van de dieren, een Zeekoet, overleefde het experiment, doordat hij langdurig in een droge omgeving werd verzorgd.

Het is duidelijk, dat indien tijdens een conflict de olie uit de maag van een Noordse Stormvogel op het verenkleed van een andere vogel wordt gespogen, dit voor deze eenzelfde dodelijke bedreiging vormt als stookolie. Het is dan ook opmerkelijk dat deze vogels onvoldoende op een dreigende Noordse Stormvogel reageren en niet in staat zijn de kleverige substantie van het verenkleed te verwijderen.

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