

have been elevated several thousand feet, for it is more probable that (like other volcanoes) it owes its present altitude (14,200 ft.) merely to the long-continued accumulation of its lavas and tuffs. Evidence of downward sagging of the surrounding strata is indeed likely to be forthcoming, and a local analogous instance of such sagging is furnished a little farther south by the northerly tilting of the Miocene beds in the Karungu district towards the centre of the volcanic mass of Gwasi (6384 ft.), owing to the enormous weight of its successive lava-flows and tuffs, which are revealed so graphically in the lofty cliff-sections between the mouth of the Kavirondo Gulf and Karungu.

The fact that the caves of Mount Elgon occur at varying altitudes, and not at the same level, would seem also to militate against their having been excavated by wave-action of the Victoria Nyanza ; and I should feel inclined to ascribe the formation of these caves rather to springs arising from water percolating through the friable tuffs in which the caves occur, and issuing at the junction with an underlying impervious flow of lava. It is noteworthy that Mr. Hobley mentions the dripping of a spring from the roof of one of the Elgon caves, and he also states that in the case of the caves of the Nandi Escarpment small streams still occur in some of them. It seems to me, therefore, not unreasonable to suppose that both the Elgon and Nandi caves may owe their origin to the erosion of underground water at a period when the annual rainfall was heavier than at the present day and before the progressive desiccation had set in to which Mr. Hobley has called attention in the pages of this Journal (No. 9, p. 4).

GAME AND DISEASE

BY A. BLAYNEY PERCIVAL

When talking from personal observation of disease amongst game, one must of necessity be vague: for it is at the best but conjecture. One cannot, as with domestic stock, use a

thermometer; nor can one take a blood smear, unless one kills the animal to do so.

Under these circumstances there are certain rules of nature that must be taken into consideration, and the first and most important point, to which I wish to draw attention, is the way nature takes her own steps to prevent the spread of disease, yet at the same time using disease as one of her methods of providing that none but the 'fit' shall increase in numbers and stock the land. Nature is a cruel mistress and has no use for weaklings, nor has she safeguards for them.

In a true state of nature the meat-eating animals are all the time at work taking their toll from the herds of game, and killing the sick or weak animal which gives them the easiest chance. It is often put forward as an argument against game reserves, that, if game is protected, it will increase until it is so numerous that disease will break out. This is true if one is strictly preserving—as one preserves pheasants at home, and where all the meat-eaters are killed off; but in a reserve, where nature is allowed full sway, there is little danger, for a sick animal is not allowed to live many hours. A point which I wish to make very clear is this: 'So long as the balance of nature is kept, there is little or no disease.' Should an animal be a weakling, nature sees that it does not live long: it may die of some sickness, or in all probability it is killed by the 'meat-eaters,' but it will not propagate the species and so carry on a weak strain.

An odd sick animal is one of the rarest sights, except when a new disease arises, against which there is no immunity, or when the animals are poor, and therefore more liable to a disease like anthrax, which is largely disseminated by dust. I can say that in twenty odd years amongst the game in South Africa and British East Africa, I have not seen more than a few sick animals: either those that had been wounded or when an epidemic of some disease was at work. It must be understood that disease is seldom heard of, unless the animals die in such large numbers that the hyænas and other scavengers are unable to dispose of them quickly, or in a district which is closely under observation—as Nairobi was during the recent outbreak of anthrax. Here the ten or

twelve animals, which during the height of the outbreak died in one night, all vanished but a few broken bones within a few hours of daylight.

The instinct of a sick (or wounded) animal is to leave the herd and seek solitude ; it is therefore deprived of all assistance in the way of warning, and, in some cases, of protection. The case goes even farther, for it is the instinct of the herd to drive out the sick beast.

Such an animal—alone, sick, and dull—naturally falls an easier prey to the carnivora ; for not only are the real killers—such as lion and leopard—a danger, but the scavengers—such as hyænas, jackal, and the like—will readily pull down a sick animal.

For instance, in the case of wounded animals, one knows the large numbers that are hit and get away ; yet how seldom a wounded beast can be found the next day !

Often when having wounded an animal, knowing that if it is followed up at once it will go for miles, I have sat down to give it time to stiffen or to die. Then while waiting, I have either seen with my glasses a jackal pick up the blood-spoor and follow it up, or else found the jackal near the animal when it was reached. Should, however, that animal get away and live till nightfall, then every hyæna, jackal, hunting-dog—to say nothing of lions—crossing the blood, will at once follow up ; and though jackal and hyæna will seldom chase or attack a hale animal, they will not hesitate to pull down a wounded one, or even a sick one. In a real game reserve the sick animals are killed before they have time to die, for there is little doubt that the scent left by a sick beast would be at once recognised by such animals as live on the dead and dying.

Vultures are possibly the quickest to spot the sick animal, and alight near to wait for its death, thus acting as guides to the four-footed scavengers, who all make for the spot where they see the vultures dropping. Taking this into consideration, it can be easily seen that the only occasions on which disease in game is recognised is when an epidemic breaks out.

The gathering of the scavengers—‘ those who come for the broken meat ’—is a most wonderful sight.

If an animal dies in the open, it is only a case of minutes

before the first vulture appears. A few minutes later the air is full of them, and then the four-footed scavengers begin to appear—the jackals first, usually in pairs. In an out-of-the-way district, or game reserve, where the sportsman is rare, they come openly trotting up, showing little fear; and if the vultures are not too numerous, they will at once attack the carcass. If the vultures are in large numbers, they will not venture near, but will sit and await their chance of a titbit, or wait until only the bones are left, and then they will take what remains. Possibly an old hyæna, very hungry, will be tempted to move in daylight, but his slinking approach is very different from that of the jackal: he seems to feel that he is a creature of the night, for he comes along, taking all the cover he can, till he sees the feast, when he will hurry up to it, and, driving off the vultures, set to work; even then he is very nervous, and constantly looks round for a possible enemy. Should he manage to get a large piece of meat, he will even retire to the nearest cover with it; one can see it is against his instincts to be abroad in the daytime.

The quick arrival of the vultures on the scene is explained by the way in which they quarter the skies so high that the human eye cannot see them; yet with their No. 12 Zeiss-power eyesight they can see all that goes on over a big area. The sick or wounded buck is seen by one vulture, and he drops towards it. From north, south, east, and west, other birds sail in towards the same point, and so the circle spreads until hundreds of birds are at the kill. The collection of hyænas at the feast must work out something on the same lines. Every hyæna has its own regular round, which is followed night after night, and, as he travels, his howl notifies his neighbours as to his movements. Should he find a kill his howls cease, and I have no doubt that this is quite enough to bid his friends to the feast.

This is of course if a kill is fresh. If a kill is a day or two old, which only happens when a beast has died in thick bush, and out of sight of the vultures, it will of its own accord notify everything down wind for a big distance; or the track of a sick or wounded beast will attract every meat-eater that crosses it.

The carcass of a rhino or elephant will mean good feeding for days, and this is the time to see hyænas. When an epidemic is at work, all the fisi for miles congregate for the broken meat. When the anthrax was bad outside Nairobi, in this year, there were many of them about, and I frequently saw twenty or more in a day's ride, and on one occasion saw in broad daylight twelve fisi by one kongoni carcass.

During the war in East Africa, a point in favour of the hyæna was the fact that he greatly helped to keep the camps healthy. In an ordinary country the fact that ten or twenty animals a day were dying, would have meant endless fatigues to bury or burn; but here it only meant putting the carcass out a hundred yards or so, and the hyænas saw to the burial. Kipling remarked, with reference to the South African Campaign, 'One horse will move a camp, if it has been dead long enough.' British East Africa has seldom had such experience, though, on the coast, it nearly happened, only it was not a horse but an overlooked Arab.

I am told that during the movements of our mounted columns the lions followed close to get the abandoned horses, and in many cases became very troublesome. As shooting was forbidden, the lions became bold, and often came up to the outskirts of the camp.

Whilst talking about scavengers, it is interesting to note that Africa is wonderfully free from blow-flies and scavenger beetles. We recently had a visit from a Mr. Le Sœuf, from the Sydney Zoo, who was particularly interested in our scavengers, as in Australia they suffer from a veritable plague of blow-flies. Here, a carcass is disposed of in a few hours, or even minutes; for where vultures are thick, it does not take more than a few minutes to dispose of all the soft parts. On the other hand, Australia has practically no carnivora, and the carcass of a sheep lies till the blow-flies have laid their eggs, and so increase their breed.

When in 1905 the game died in great numbers on the Athi, the carcasses were fly-blown, with the extraordinary result that the upper side of the hide, exposed to the sun, became hard and dry, whilst everything inside was eaten away. One therefore found a dry skin, covering a complete skeleton,

covered with the cast pupa-cases of the blow-flies ; yet even then I do not remember that they seemed very thick. It was not necessary to carefully cover one's blankets during the day to keep them from getting fly-blown, as is the case in both Australia and New Zealand.

In the southern game reserve, where I do not think it is any exaggeration to say that thirty thousand head of game—chiefly hartebeest and wildebeeste—were killed as meat for troops during military operations, we might have had a serious upset of nature, and the lions and other meat-eaters, defeated by man in the eternal struggle to keep alive, might have produced a possible reign of man-eaters and cattle-killers amongst the more or less defenceless natives. To a very small extent this has happened ; but the zebra, which did not interest the man shooting meat for the camp, remained to feed the lion, while the deaths amongst the horses and cattle fed and drew the carrion feeders. Hundreds of hyænas followed the columns, and added to the horrors of a bush war : it was 'Heaven help' the wounded man who was not found by dark. As one who went through some of this fighting, I can say that, had I been left wounded, it would not have been long after dark before I fired my last shot, and at such close quarters that there would have been no possibility of a miss.

Since the military operations passed southward and left the game reserve, there have been more complaints from the Masai of cattle-killers amongst the lion than I have ever heard before. However, these gentry are being dealt with, and I hope that we will soon have things quite quiet again. It is always recognised that where game is plentiful the lions seldom attack man or his cattle. In districts where at times game is plentiful, coming from another district, returning lions are often bad. They follow and feed on the game, settling down until, later, they suddenly find that the game has gone. As they are unable to get food, they become man-eaters, or else rob the stock kraals.

Practically all our man-eating lions of any fame have been in such districts, but there are of course exceptions to this.

NGAR NARUA

The commonest disease known amongst the game, particularly on the Athi Plains and the southern game reserve, is ngar narua. For fifteen years I have known the disease, but it is only within the last year that it has definitely been proved to be anthrax. Having something to go on, I have made careful inquiries amongst the Masai—who are without question extremely clever on the subject of stock diseases—and from them I learn that two forms of ngar narua are recognised: mbarua, the bad form, which is the more general, and a milder form, likened to plague—in that it attacks the glands of the leg. This I take to be black quarter. In the case of mbarua, the Masai recognise that the disease is one which man may contract, and treat it accordingly. They say that contact with the meat, blood, or skin, causes sores, and, if treatment is not given to these, they often result in death. The treatment given by the Masai is to sweat the patient thoroughly, by wrapping him in the freshly stripped, warm hide of an animal—bullock or sheep, according to his size—depriving him of all milk or water, but giving him a decoction of some root. The milder form is not looked upon as dangerous to man, and the meat is considered eatable, except the affected parts. The disease (which is recognised as one which chiefly affects young stock) can in most cases be cured by copious bleeding, and cauterisation of the affected glands.

This year we had an outbreak of ngar narua amongst the kongoni, near Nairobi, which was proved by specimens and swabs to be anthrax.

In this case we have a clear history of an outbreak of the disease amongst the cattle at the camp of the King's African Rifles, at Mbagathi, which was followed a week or ten days later by deaths amongst the game in the neighbourhood.

Upon finding, from the specimens which I submitted to the bacteriologist, that this was anthrax, I at once put men on to carefully watch the spread of the disease. This was by no means difficult, as by watching the vultures a dead animal could be at once located. Much to my surprise the disease did not spread, but was confined to an area some six miles by

five, and here in two months about three hundred kongoni died. Other game was plentiful, but no other animal was reported as dying in the area. I kept men on the area for a month after the disease had apparently stopped, and also sent others with prepared swabs to work right through the reserve, but with negative result.

The Masai in my employ insist that this was the same disease which every few years breaks out in one district or another amongst the game; but it is interesting to note that this outbreak was during the wet season, while 'ngar narua' is usually met with in the dry season, or, to quote the Masai, 'when the grass is white' (dry and bleached by the sun).

I think in 1905 there was the worst outbreak of ngar narua that I can remember, the game dying on the Athi Plains till they lay so thick that hyenas and vultures could not deal with them. The mortality was worst near Eldonyo Sabuk and Lucania Hills, where thousands died. These districts have now been settled for many years without any further outbreak of anthrax—a disease which, according to all authorities, infects for years the soil where an anthrax carcass has lain.

OL KI PIRI

During the present outbreak of pleuro, no report of the disease amongst the game has been received. I have had men down in the districts where this disease exists, and they report that eland and buffalo are feeding over the same ground as the affected cattle, without any apparent ill-effect. Pleuro, so far as my limited knowledge goes, is a disease the transmission of which needs immediate contact between a sick beast and a healthy one, and therefore is less likely to be passed from cattle to the game. Even if passed, it may not spread, owing to the absolute 'law' amongst wild animals that a sick beast at once leaves the herd, the solitary sick animal having but small chance of living for many hours. Nature takes her own steps to prevent the spread of disease.

The old Masai tell me, however, that when the first bad outbreak of pleuro took place—which was some six years before

the rinderpest struck the country—buffalo and eland died, but not in large numbers.

The Masai have a legend that ol ki piri (pleuro) was introduced by a bull which arose from the waters of Naivasha or Elmenteita, and proceeded to cover the female stock in a herd of cattle grazing near by. The Moru who was in charge of the herd speared the bull, but to his surprise no blood came, but a fluid like the discharge from an unhealthy wound. The animal, however, died from the wound, but the herd developed ol ki piri, and from them it spread all over the Masai country.

Other stories say it came from the west, and that the El Burgu first suffered from it.

RINDERPEST

This is the worst disease that has ever struck Africa. It swept from Abyssinia to South Africa in about six years, killing practically all the cattle and decimating the game. So far as I have been able to make out from the sources of information available, the following appears to be the history of this dreaded disease: Somewhere in the eighties, the cattle-plague, as it was then called, reached both Abyssinia and Egypt—the former from India, the latter from the Black Sea. For some years there does not seem to have been any noticeable spread of the disease, but in 1891 it appeared in British East Africa. I have been making most careful inquiries, and the general view amongst the Masai is that the first outbreaks in Masailand were amongst the Loi-tok-i-tok, on the slopes of Mt. Kilimanjaro. Here it had been brought by Masai raiders, who visited the coast about the end of 1890, and brought back a quantity of looted cattle. These cattle developed the dread pest, and in a short time the Loi-tok-i-tok had no cattle left. They, being without stock, came to the Malabalo, who lived on the Athi, and with them made a joint raid upon the Wakamba, to find that the Wakamba cattle were dying. However, they brought some looted stock back with them, only to start disease amongst their own cattle, which so far had been clean. An old Mkamba told me they contracted it from cattle brought from near Basso, or Lake Rudolph: this is a more probable story. At the

same time, I have heard stories to the effect that rinderpest came from the Wenyemwezi cattle which were looted from the country to the south-east of Lake Victoria. It is possible, therefore, that a second source of infection was from the west—probably from Egypt. There are some points difficult to follow in the way the disease spread. Coming from the north, it seems first to have got into the Wakamba cattle, to have spread from them through the neighbouring tribes, and to have again worked north-west to Laikipia and the country to the west. A few isolated spots—such as Mt. Marsabit and Mt. Nyiro in the northern frontier district, also some parts of the coast, seem to have escaped; but although these places were few and far between, still they helped to re-stock the country.

It is interesting to note that, in 1898, Arthur Neumann, writing of the country near Lake Rudolph, speaks of rinderpest as a thing of the past; while Swayne, writing of Somaliland, about the same time, speaks of the numbers of buffalo and other game, and never mentions the disease. By this it appears as if it did not reach the east of Somaliland till after 1898.

Travelling south, from Lake Victoria and Kilimanjaro, it spread rapidly along the eastern side of Tanganyika; but Nyassaland does not at this time seem to have suffered. It apparently passed between Lakes Tanganyika and Nyassa into the Angoni country, and from there south, across the Zambezi, appearing north of Bulawayo in October 1895. By March 1896 the Rhodesian Government had given up all hopes of doing anything, and in October or November 1896 it was in the Eastern Transvaal, where I personally met it, and saw the greater kudu wiped out. The same year it reached Cape Colony: the pace at which it spread being extraordinary, going, in one year, from the Zambezi to the Cape—a distance of 1000 miles. In Rhodesia, it had great assistance from the transport roads—all the transport at that time being by waggon and oxen. This, however, was quickly stopped, but without result; and in March 1896, all hope of checking it having been given up, the restrictions were removed in order to allow as much food as possible to be brought up before all the cattle died. When, in 1896, the Matabele Rebellion took place, the fact that waggon transport had to all intents and purposes finished, badly hampered the troops.

It has been estimated that in Rhodesia alone 100,000 cattle died ; and that to the south, Khama and his people lost 800,000 head. What the total for Africa must have been is inconceivable ; yet the wonderful recovery shows what a country it is for stock-rearing. That great hunter and observer, the late F. C. Selous, states that in Rhodesia there was an extraordinary absence of vultures, and he attributes it to their having died of a surfeit of rinderpest meat in the early stages of the disease. This, however, does not appear to have been the case in this country.

RINDERPEST IN BRITISH EAST AFRICA.

My chief informants on the subject are the Masai and other stock-owning people, who are naturally more observant than the agricultural tribes.

When rinderpest first reached the country, only the cattle suffered ; but it was not long before the disease was apparent amongst the then huge herds of buffalo. Eland also showed it early ; and subsequently all the game, except the gazelle, zebra, elephant, rhino, and hippo, became infected. Here an interesting point is to be noted, for the wildebeeste was said to be the last animal to become infected, none dying until after all the cattle were dead.

Giraffe, always subject to disease, died in large numbers.

Those species which suffered worst were buffalo, eland, greater kudu, roan, lesser kudu, and bush-buck ; of these, all but the greater kudu have made practically complete recovery.

The buffalo, perhaps, showed their losses more than anything else, for the whole of the animals inhabiting the open country vanished : either they were dead, or had taken to the bush, where they spread the infection to the bush-buffalo. These forest- and bush-loving buffalo were seldom in such large herds as the animals of the open, and some of these herds appeared to escape, for, when I first began to investigate the game of this country in 1901, I found small isolated herds here and there.

During a recent small outbreak of rinderpest amongst the buffalo, I have, on visiting the scene of the outbreak, been

alarmed to find that there were no living buffalo, where only a month or so previously there were numbers. However, I was reassured by the Wandorobo, who informed me that should an outbreak occur, it is the invariable custom of the buffalo to move at once. They dive deeper and deeper into the forest, away from the other buffalo, who in an ordinary way haunt the edges and open glades of the forest.

This habit may have helped the forest-buffalo to escape the fate of his brothers in the open.

When I first visited the Athi Plains, sixteen years ago, the remnants of the buffalo and wildebeeste heads could still be seen, only the boss of the horns and part of the skull remaining. They lay mostly along the river banks; for, as usual, a sick beast goes near the water to die.

At this time there were not more than forty buffalo on Eldonyo Sabuk, and rather less in the Kamiti swamp; now, in spite of shooting them, there must be nearer 400 in the former and 200 in the latter haunt, although many have been shot there.

For many years there seemed to be little or no increase in the eland and buffalo; but suddenly the change came, and the increase was rapid. It always happens in nature that, should any species get really low in numbers—as in South Africa and in America—then the strictest preservation will only, at the best, enable the animal to increase slowly until it reaches a certain stage. After that, better results may be expected. I only wish I could give as good a report on the greater kudu as on eland and buffalo; but the kudu seems still in the preliminary stage of recovery. They have increased somewhat, but very slowly, so that one almost despairs. They undoubtedly have more enemies than buffalo or eland, the hunting-dog being one of the worst. The kudu, however, is in comparison with a horse a wonderful performer amongst the rocky foot-hills, which he usually inhabits, but is really easily pulled down by such a remarkable tracker as the hunting-dog.

The recovery of the eland from the rinderpest is wonderful. Sixteen—and even ten—years ago, eland were extraordinarily scarce. To-day there are hundreds on the Athi; and from the Rift Valley and the Uasin Gishu Plateau so many complaints

have been received of damage done by eland, that the special protection given to them in these areas has been taken away.

Since, however, they have increased just as much or more in the outside districts, I have no fear of any ill effects: in fact, I consider that eland and buffalo have now reached a stage where, under fair sporting shooting, there should be no danger of their being much reduced in numbers.

Another animal which suffered, and was slow in its recovery, was the bongo. This animal is always looked upon as rare, but is really common, and is found in quite large herds in its own particular haunts—the high dense forests.

To-day the bongo is no easier to shoot than he was; but he is fifty times more common than he was fifteen to twenty years ago.

The other game never suffered to an extent sufficient to throw them back more than a year or two.

Wild pigs of all sorts suffer from rinderpest. In South Africa, I saw my first bush-pig, dead—not one, but many; and in British East Africa the outbreaks amongst warthog have been numerous. In fact, it is almost certain that if rinderpest breaks out, the warthog will get it—even when there are no records of the disease amongst other game—and I look upon them as a distinct cause in spreading the disease.

Without doubt the game, and also the local cattle, have developed to some extent an immunity against the disease; yet the warthog does not appear to have done so.

If game were still as susceptible to rinderpest as they were at one time, the disease would not be in isolated areas as it is to-day, but would, after the first outbreak, in a few days, be all over the country. This would also apply where double inoculation was being practised; yet I have not been able to hear of the spread of the disease from any such centre.

On the point of the distribution of rinderpest, I personally think that to-day the tick-bird, as well as the vulture, is an obvious danger; yet it must be admitted that Mr. F. C. Selous's statement that the vultures vanished during the outbreak in Rhodesia, and the fact that the disease travelled as fast in South Africa, where vultures had been practically exterminated, shows that they are not the chief carriers.

Jackal.—Hardly game in the full meaning of the word, but still a game little beast and, so, worthy of a note.

The first outbreak of any disease that I noticed amongst the jackal was in 1906, when distemper broke out, and swept the whole country east of the Kikuyu Escarpment. The jackal died by the hundred and soon became a rare animal; while even the 'pie-dogs' of Nairobi suffered, and most of them died. The old warriors of all ages went as quickly as the pups. This was, I think, the first outbreak of distemper in British East Africa. I could get no proof that the hunting-dogs or hyenas died, but for some few years they certainly appeared to be much scarcer.

A year or two later the disease spread into the Rift Valley, where again the jackal died and the Wandorobo lost all their little hunting-dogs. Since then several outbreaks of disease have occurred—the latest being in Laikipia, where the jackal seemed to die off. In this case no signs of distemper were seen amongst dogs, nor did any of the jackal show signs of rabies—a disease which apparently affects them. For, every few years, one hears of the jackal either attacking man in a strange way, or inviting their own death by wandering into farms unconcernedly in broad daylight. Though I know of several cases of natives and dogs having been bitten, I have never heard of any further development.

NOTES ON SNAKES IN EAST AFRICA

By A. LOVERIDGE

Pleasant memories of chasing grass-snakes along English hedgerows, of smooth snakes on the Dorset heaths, or adders midst bracken and gorse of Welsh mountains are not effaced by three years' gadding about in East Africa with its greater variety and more dangerous serpent-life.

Indeed, one is prone to think that the former provided better sport. At any rate one could pounce more wholeheartedly upon a grass-snake; probably, however, it is only