

the masonry arch adjoining the one tower on the river side left out, making the river crossing symmetrical, both towers accentuating the limits of the steel construction.

Another view shows the highway bridge across the Rhine between the cities of Ruhrort and Homberg during erection. The construction began in 1905 and will be finished this year at an expense of about \$1,100,000. The width of the street is 53 feet between railings, and the distance between trusses 36 feet. The total length will be 2,000 feet, with a center span of 667 feet, which will make this the longest span in Germany, and, with only two exceptions, the longest in Europe; the larger spans being, in the Viar viaduct in France, 722 feet, and in the Firth of Forth bridge in Scotland, 1,710 feet. A span of 667 feet is too long for an ordinary truss bridge, the longest so far built being 546 feet. An arch or suspension bridge would have been possible, but these were considered undesirable on account of the danger of settlements of the foundations caused by coal mines near the bridge site. The only system left was the cantilever, which exerts vertical reactions only, and this was adopted. The outlines of the trusses are very pleasing, which is indeed rare in cantilever bridges. It is interesting to note that in spite of the great weight, the trusses are riveted throughout, no eye-bars or pin connections being used.

THE SHEEP-KILLING KEA.

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New Zealand has its full share of interesting animals, but with the exception of that strange out-of-date lizard-like animal, called by the Maoris the tuatara, the avifauna claims them all. The extinct moa, that giant of the bird world, is the only bird known that has not even a vestige of a wing; the little kiwi itself is almost wingless, and is the only bird known that has its nostrils opening to the exterior at the tip of its long beak; while among the migratory birds the godwit holds the record for long sea flights, for it flies from New Zealand to Siberia and back every year.

However, of late years the bird that has come to the front, owing to its strange habits, is the kea. This mountain parrot (*Nestor notabilis*) is somewhat larger than a pigeon, and its feathers are mostly dark green edged with black, while under its wings and on its tail its color is brick red. Its beak is very strong, and the upper mandible very much curved. The bird is confined to the South Island of New Zealand, where it lives among the peaks of the Southern Alps, which often rise from seven to over twelve thousand feet in height. However, it does not by any means always live near the summits of these snowclad peaks, but is most commonly found just about the forest limit.

About thirty-eight years ago, a number of sheep were found torn about in a way that was quite unknown to the sheep farmers, and so a very close watch was kept. The result was that several keas were seen sitting on some sheep and pecking at the wool, and at another time several keas were seen sitting around a wounded sheep. At once the keas were condemned without any further proof, and the slaughter of these interesting birds which was then commenced continues until this day. This was the first and best instance recorded of the keas killing sheep, and when the evidence is sifted there is no absolute proof at all in the record.

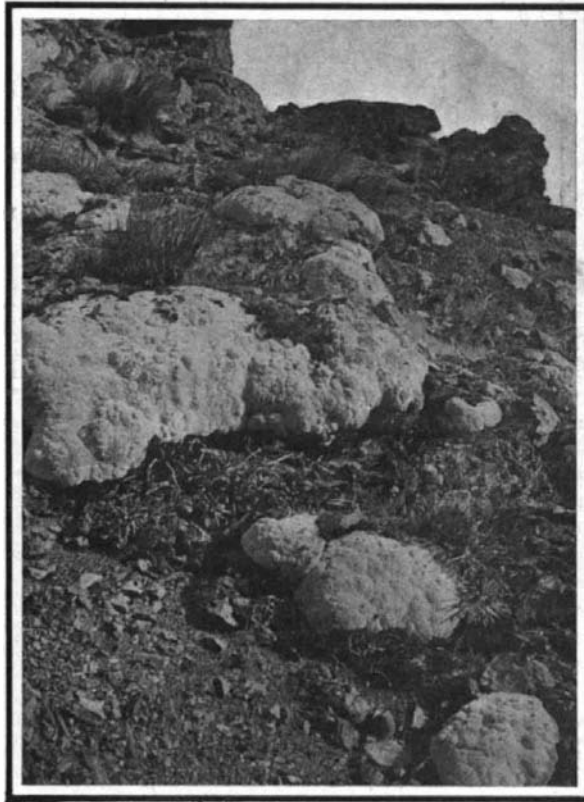
This supposed change of an insectivorous and berry-eating bird to a bird of prey has been the cause of a long controversy between station owners and sheep farmers and the scientific men of the colony, who took the part of the kea.

When the writer took up the question in 1905, after reading through all the available records, he could not find one writer who saw the bird kill a sheep, nor was the name and address of any actual eye-witness given. Not only was the fact of the kea's change of habit of scientific importance, but the loss of thousands of sheep made it essential that the question should be once and for all time satisfactorily settled. The writer then set to work, and collected written accounts from men who had actually seen the bird killing and attacking sheep, and the result of this investigation is published in the Transactions of the New Zealand Institute, 1906.

Great care was taken to make the evidence authentic, and in each case the witness had to send in a written statement that he would be willing to swear to his evidence before a justice of the peace.

The reason why so few people have ever seen the kea at work seems to be due to the fact that the killing is mostly done at evening or early morning, at places which men seldom reach until long after the bird has finished its deadly work. Among my correspondents, over thirty men have actually seen the kea killing the sheep. These witnesses do not consist only

of musterers and shepherds, but in many instances they are either managers of the sheep stations or the station owners themselves. Summing up the different accounts, which owing to limits of space cannot be published in full here, the birds' mode of procedure seems as follows: They may attack in ones or twos or in numbers, but usually one or two birds do the killing, and the others share in the spoil. The keas always seem to choose the pick of the flock. The bird



"Vegetable Sheep," Said to Account for the Sheep-Killing Habit of the Kea.

settles on the ground near its quarry, and after hopping around for some time, it leaps on its prey, usually on the rump. The movement of the sheep may cause it to fall off, but it persists until it has firmly perched itself on the sheep's back. Then the kea begins its operations by tearing out the wool with its powerful beak, and at last gets its beak into the flesh.

The sheep, which for some time has been moving uneasily about, gives a jump as the beak pierces the flesh, and then begins to run wildly about in vain efforts to rid itself of its tormenter. When, however, the sheep finds it cannot dislodge its enemy, it seems to become terrified with pain and fright, and rushes blindly about, usually at a high speed, the kea meanwhile holding on and balancing itself with outstretched wings. When the beast stumbles, the kea rises on its wings, and settles down again onto the sheep when it has regained its feet. This awful race is continued, until, bruised by its numerous falls, utterly exhausted by its death struggles, the poor animal stumbles to rise no more, and becomes an easy prey to the kea.

It has always been supposed that the kea attacked



THE NEW ZEALAND KEA, WHICH HAS ACQUIRED THE HABIT OF KILLING SHEEP.

the sheep for the sake of the kidneys, and the first man to dispute this, as far as I know, was Mr. F. F. C. Huddleston. Dr. Alfred Russel Wallace, in his book entitled "Darwinism," after describing the method of the kea's attack, says: "Since then it is stated that the bird actually burrows into the living sheep, eating

its way down to the kidney, which forms its special delicacy."

From the evidence of men who have seen many sheep killed and wounded by keas, this statement appears to be erroneous; and of the many correspondents that have communicated with me, only one states that the bird eats the kidneys, and later on, the same writer says: "I have shot many keas by the dead sheep, and they have vomited up fat." It appears, if, even in this instance, the birds eat the fat rather than the kidneys.

One reason why people suppose the kea to be fond of kidneys is that the keas nearly always attack the sheep on the loin, just near these organs. But this may be due to the fact that the rump of the sheep is its widest part, and provides a firm foothold for the kea. Several witnesses say that it is almost impossible for the kea to keep on the sheep's back unless he perches on this part. Furthermore, when flying after a sheep, the rump is the nearest and handiest part to settle on; and as the birds often have to alight on the sheep when it is running, it is no wonder that the rump is the part chosen. It naturally follows that when perched on the animal's hind quarters, the bird will commence to pick the sheep's back at the handiest part, namely, the loin, which is very easy to tear open, owing to the absence of ribs. Even the first recorded accounts of sheep killing mentioned that the birds attacked the loin. I can hardly believe, as some people do, that by some kind of instinct the kea knew where the kidney fat was to be found in the live sheep. This latter idea is somewhat upset by the fact that cases have been seen where the flesh around the backbone has been eaten, and the kidney and the kidney fat left almost untouched.

We now come to the interesting question as to how the kea acquired the habit of killing sheep and eating the carcasses. This can never be completely answered, but there are several theories which are well worth considering, as they throw a certain amount of light on the reasons for the bird's change of diet.

I. The *Vegetable Sheep* theory is certainly the most popular, though it has very little to recommend it. The supporters of this theory suppose that the kea had been in the habit of tearing open the "vegetable sheep," *Haastia pulvinaris* and *Raoulia eximia*, in search of grubs which are supposed to live in these peculiar plants. They are found especially in the northern half of the Middle Island at an altitude of from 4,600 to 6,000 feet, and in external appearance they somewhat resemble a sheep, growing as they do in the form of cushions often as large as sofas, and the whole surface having a woolly appearance. It was supposed that when the sheep first wandered into the kea's domains, the birds mistook them for the wool-like plants, and with the idea of digging out the grubs, they began to tear open the skin of the sheep. In this way the keas are supposed to have acquired the method of killing the sheep and eating the flesh.

This all sounds very feasible, but on further investigation, it is found that the true facts do not support the theory.

1. Where the keas were first known to kill sheep, the vegetable sheep do not exist.
2. There are no grubs in vegetable sheep that are large enough to attract the keas.
3. In places where both the keas and the vegetable sheep are found, the latter is never seen in a torn-up condition.

It seems to me that unless further evidence is forthcoming to support this theory, it must be left out of consideration.

II. The *Curiosity Theory* suggests that the kea, being a very inquisitive bird and fond of investigating anything at all strange that comes in its way, when it first saw the sheep wandering into its domain, at once began to investigate this strange object, and so learned to tear the sheep open.

III. The *Hunger Theory* suggests that lack of food caused the birds to feed on the fat and meat thrown away at the sheep stations. In this way it obtained a taste for meat, and soon became daring enough to attack the living example.

IV. The *Maggot Theory* suggests that the birds first began to eat the maggots found on the dead sheep, and soon learned to eat the meat and then to attack live sheep.

This theory seems to have much in favor of it, especially when we remember that the kea is naturally insectivorous. Again, the very fact that the birds seem fond of dead carcasses rather supports this theory. It is of course impossible to say which theory is nearest the truth, but I think that there is no doubt that the main factors that caused the harmless keas to change their diet and become birds of prey of no mean order are expressed in the last three theories.

In conclusion, I think that I am justified in saying that, as far as human evidence can be relied on, I have conclusively proved that the kea has not only taken to meat eating, but that it does actually attack and kill sheep for the sake of the meat and fat.