27. Kakapo, *Strigops habroptilus*.
This was an excellent bird for food. In the day it was difficu't to dislodge it from the roots ot large trees. Like the kiwi, it was caught on moonlit nights by sending a dog into the bush from the sandhills along the coast.

28. Shining cuckoo, *Chalcites lucidus*.
This species was common and stayed all the year at Martin Bay.

29. Long-tailed cuckoo, *Eudynamis taitensis*.
This bird was not found at Martin Bay throughout the year. It has a habit of screeching and throwing itself into a tree, after which it is difficult to find as it sits along the branch and not across it as do other birds.

30 Kingfisher, *Halcyon sanctus*.
The kingfisher was common around Lake McKerrow.

31 Native thrush, *Turnagra capensis*.
This was a gentle bird, quiet and tame. It was very common, and approached by a series of hops to take crumbs or other food offered to it. The thrush laid up to five eggs, but nests were not molested. Specimens were sent to Otago Museum, but they requested that no more be sent. In the 1880's Mrs. Hyndman was also familiar with the native thrush at Queenstown.

32 Native robin, *Miro australis*.
The native robin was another tame bird which was fed with crumbs. This species also was common at Queenstown. Sometimes it came inside the house. It was, in fact, so common that few specimens were sent to the Museum.

33 South Island tomtit, *Petroica macrocephala*.
This was a common bird in all bush, but was not tame in its habits.

34. Fantail, *Rhipidura flabellifera*.
The pied fantail was common, often entering dwellings; but the black fantail was unknown to my informant. These are difficult birds to skin.

35 Wax-eye or Silver-eye, *Zosterops lateralis*.
The wax-eye was common in the winter when the snow was on the mountains. It seemed to prefer the higher levels in the summer.

36. Bush canary, *Mohoua ochrocephala*.
The bush canary was a noisy bird seen in flocks in large kowhai, rata, and other flowering trees.

37. Tui, *Prosthemadera novae-seelandiae*.
The tui was everywhere common.

38. Bell bird, *Anthornis melanura*.
Bell birds were very common and renowned for their singing in the early morning and even late at night.

39. Saddle-back, *Creadion carunculatus*.
The saddle-back was regarded as an uncommon bird and difficult to see in the dense bush. A brown bird is exactly the same size and shape (immature young).

40. Native crow, *Callaeas cinerea*.
Hundreds of these birds lived in the high trees near the house. At times their song rivalled even that of the bell bird.

MENDELIAN INHERITANCE IN ROMNEY SHEEP*

By F. W. Dry and A. S. Fraser.

The study of hairiness, or medullation, was taken up at the Massey College in 1929 because this was regarded as a fault. As breeding work proceeded the genetics of gross hairiness proved to have fundamental significance. Then within the last few years unforeseen possible applications have claimed attention in the use of new-born skins as fur, and of hairy fleece wool for carpet manufacture, but the factors determining commercial outcome are not our present concern.

* Revised, September, 1948.

Hairy fibres are of two kinds: (1) kemps, which grow for a few weeks or months, stop growing, and shed; (2) fibres of persistent growth. In many new-born lambs large birthcoat kemps, called halo-hairs, project above the rest of the coat. Lambs were graded at birth for halo-hair abundance, and subsequently mated in breeding experiments on those recorded gradings. Halo-hair abundance proved to be strongly inherited, and, in those early experiments, manifestly in multifactorial fashion.

In 1931 a ram lamb with immense abundance of halo-hairs was given to the College by Mr. N. P. Nielsen, hence the name N-type. These lambs, besides their mass of halo-hairs, generally have hairy later fleeces. The Nielsen ram proved to be heterozygous for a dominant factor for N-type coat. Clear 1 : 1 ratios and 3 : 1 ratios were obtained, and rams showing themselves on breeding test to be homozygotes were secured in matings which could produce them.

Horns are much in evidence in the Nielsen and other N-type stocks. The early view that the dominant-N factor and a factor for horns are linked, with about 10% crossing-over, has been replaced by the conclusion that N-type coat and horns are different expressions of the same gene. Horns are on the average much larger in rams than in ewes, and they are sex-influenced, being dominant in the male and recessive in the female, with some exceptions in both sexes. Horns allow us to distinguish homozygous from heterozygous ewes with a large measure of success. At birth, we have concluded, homozygous rams consistently have lumps on the head in the positions of the horns, and sometimes these have pierced the skin when the lamb is born; the heterozygotes often have these lumps at birth, and these may indeed be through the skin, but often lumps are lacking so early. On the average, the horns of homozygous rams grow faster than those of heterozygotes. On the average, certain birthcoat fibres are more abundant in heterozygotes, and in the later fleece there is more kemp, manifestly grown in the follicles which have shed birthcoat kemps.

In 1947 we learnt to distinguish, at birth, between homozygous Dominant-N and heterozygous Dominant-N, with a very small margin of error indeed. The homozygotes have extremely high abundance of halo-hairs all over the wool-bearing area of the body. The heterozygotes often have a more or less marked reduction in halo-hair abundance at the anterior end of the body, and occasionally along the side, but when full abundance is maintained everywhere else there is almost always a reduction in a small arm-pit area, just behind the shoulder. Altogether, therefore, mistakes in diagnosis will assuredly be very few. The power to distinguish homozygote and heterozygote at sight is interesting on fundamental grounds, and is a great help in constructive breeding.

In heterozygous Dominant-N sheep the gene now and again comes to poor expression, and probably occasionally fails to penetrate in any recognisable way. Horned rams having comparatively few halo-hairs that were the sons of Dominant-N rams have bred as heterozygotes, siring N-type offspring. There is some evidence that the various different expressions of the N gene are affected by modifying factors, but an alternative interpretation is that the N gene is itself a powerful modifying factor, augmenting the action of a number of different genes. If, however, there were little or nothing to multiply, the result would then be meagre, or even zero. For example, if something essential for horn growth were lacking we can understand how the N gene would be unable to make horns grow.

N genes influence a number of characters in all N-type stocks namely: halo-hair abundance; hairiness of persistent fibres with accompanying lack of crimp; a variety of fibre type details not here presented; size of birthcoat tufts; presence of brown patches especially on the back of the neck and to a less extent elsewhere, notably at the root of the tail; horns; and length of the spinal processes on the thoracic vertebrae. Thus there is marked pleiotropy, whether the N gene is primarily responsible, or whether its action is that of an amplifier.

Three other stocks of N-type sheep have been run at the Massey College. The N-gene of a second Dominant-N stock was probably brought on to the property in a hairy ewe purchased in 1929. Breeding tests, following a cross between the stocks, have shown the Nielsen-N gene and the Massey-N gene to be the same. Another small stock was thought to be multifactorial, as the foundation sheep were all more or less short of the N-grade of halo-hair abundance. We are satisfied that a number of these animals were heterozygous for the dominant-N gene, of Nielsen-N origin in some, of Massey-N origin in others. Certainly this stock does now possess the Dominant-N gene, and it would seem that selection for modifiers for its typical expression was quickly effective. It is intended henceforth to interbreed all the Dominant-N sheep.

A fourth stock is Recessive-N. The first Recessive-N ram was the double grandson of a hairy ram bought in 1929 who, it seems safe to conclude, was either a homozygous Recessive-N sheep, or a carrier of the gene. With a rare exception, Recessive-N rams are horned, but the ewes have never grown horns. Non-N rams heterozygous for this gene often have small horns.

The most fundamental question in genetic analysis engaging attention in recent years is the relation between Dominant-N and Recessive-N. Rams well authenticated as Recessive-N, on being mated with ewes from outside sources, known to have been free from halo-hairs on the back, have sired several N-type lambs, and upon these rare N-type animals we have speculated freely.

The Dominant-N and Recessive-N genes have proved not to be allolomorphic. Recessive-N and Dominant-N were crossed. The Recessive-Dominant-N sheep so produced have been mated with Recessive-N, and have given a good 3 : 1 ratio. The interbreeding of Recessive-Dominant-N animals has produced several Non-N lambs, the number of N-type and Non-N not departing significantly from the 13 : 3 ratio.

In 1948 it has been possible for the first time to breed from an N-type ram sired by a Recessive-N ram from an unrelated Non-N ewe, without halo-hairs on the back, from an ordinary Romney flock. This ram, mated himself with no-halo ewes from outside sources, has sired several N-type lambs. In the light of all the evidence the most likely explanation is that this ram is heterozygous both for the Recessive-N gene received from his sire, and for a dominigene, received from his dam, which brought to expression the single dose of the Recessive-N gene.

This experimental breeding with sheep, which has proved to have been along Mendelian lines from the outset, has taken a long time. At the beginning, six years elapsed before it was realized that a Dominant-N oligogene existed, and it is now six years since, following the recognition of the Recessive-N oligogene, a series of experiments was planned on the relation between these two genes. In twenty seasons some three thousand five hundred lambs have been bred.

This research has introduced the investigators to an array of phenomena and problems of Mendelism. These include the conditioning of the same characterization by independent genes; pleiotropy; sex-influenced inheritance; heterozygous expression, including failure of penetrance as well as poor expression; genetic analysis by direct examination; modifying factors including a dominigene; the mode of working of the gene; and dosage effects. A teacher of Genetics occupied with N-type sheep is liable to draw illustrations from them with undue frequency.

STUDIES ON THE ENTOZOA OF MAN IN NEW ZEALAND*

PART III.

A NOTE ON THE INCIDENCE OF *ENTEROBIUS VERMICULIS* (Linn.).

By L. R. Richardson and A. Elizabeth Clark, Victoria University College.

The larger entozoa of man held a prominent place in medicine prior to the demonstration of the pathological nature of some bacteria. The development of bacteriology directed attention away from the entozoa, and their study was largely neglected for many years. The past twenty years has seen a revival of researches on the entozoa. This work is showing that the long neglect of these animals has in no way impaired their success. Dr. Norman Stoll has recently brought together available data on the incidence of helminth infestation. In his address, "This Wormy World" (*J. Parasit.*, 33 [1], 1–18), he estimates the world incidence for several species as follows: 39 million infested with *Taenia saginata*; 457 million infested with hookworm; 355 million infested with *Ascaris*; and, tentatively, 209 million infested with *Enterobius*, the common pinworm of man.

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